Mega Transport Projects and Sustainable Development: Lessons from a multi case study evaluation of international practice.

ABSTRACT: Mega infrastructure investments currently feature as significant aspects in many of the development agendas worldwide. Such projects are often deemed 'unsuccessful' because they have been unable to meet their original expectations in terms of outturn cost, on-time delivery and construction quality. This paper aims to contribute to the debate concerning broader definitions of project success by presenting the findings from an evaluation of 27 mega transport projects drawn from nine countries with respect to their achievements towards multiple dimensions and challenges of sustainable development (SD). The study found the projects exhibited a generally low adherence to SD principles and the lack of shared vision of what SD means threatens to undermine the potential for mega infrastructure to contribute positively to its delivery. The absence of clarity and consensus poses a number of critical challenges for mega infrastructure planning, including questions about whether they can effectively meet the needs of intra and inter-generational equity (and socio-economic equity), as well as global concerns about such matters as emissions, fuel scarcity and climate change.

KEYWORDS: Sustainable Development, Mega Transport and Infrastructure Projects, Project Appraisal and Evaluation

1. Introduction

Mega infrastructure projects have in recent decades rapidly grown in number, size, complexity and cost. These projects, typically associated with capital expenditures of well over US$1 billion, are frequently perceived as critical to the 'success' of major urban, metropolitan, regional and/or national development because of their potential to affect significant socio-economic and territorial change (OMEGA Centre, 2011; 2012). According to many infrastructure specialists, these projects should not be considered merely as larger and more expensive versions of traditional infrastructure investments. Rather, they should be regarded as a totally 'different breed' of project (Capka, 2004) because of their diverse outcomes and impacts that frequently go well beyond the physical assets that are being delivered (OMEGA Centre, 2011; 2012).

Notwithstanding that mega infrastructure investments currently feature as significant aspects in many of the development agendas worldwide, such projects are often deemed

'unsuccessful' because they have been unable to meet their original expectations in terms of outcomes, typically outturn cost, on-time delivery and construction quality. Arguments based upon these narrow metrics have tended to dominate the international narrative about infrastructure development, particularly megaprojects and mega transport projects (MTPs) (see Morris and Hough, 1987; Flyvbjerg *et al*., 2003; Samset, 2012). A major cause for such perceived underperformance has been attributed to the inadequacies (and inappropriate applications) of decision making within the planning phases of the project. The *ex-ante* project appraisal methodologies in particular, negatively contribute to excessively narrow frames of project conception, appraisal and delivery (Dimitriou, 2009; Schutte, 2010; OMEGA Centre, 2010; Barfod, 2012; Macharis and Nijkamp, 2013). This is often at the expense of broader issues regarding megaproject 'success' as it relates to project outputs and impacts, such as their socio-economic effects or their adherence to principles of sustainable development.

This paper aims to contribute to the debate concerning broader definitions of project 'success' by principally presenting the findings from a major OMEGA Centre[1] research programme conducted at University College London (UCL) as it relates to MTP performance with respect to multiple dimensions and challenges of sustainable development. The OMEGA Centre research alluded to (referred to as the 'OMEGA 2' Project) is a five-year research programme of *The Study of Decision-making in the Planning, Appraisal and Delivery of Mega Transport Projects* with a focus on providing lessons for key decision-makers. The research was undertaken by the OMEGA Centre and its international partners between 2007 and 2012[2] (see appendix 1 for list of partners).

This article is presented in three further sections and a conclusion: Section 2 introduces the rationale and methodologies behind the OMEGA 2 Project. It considers how the study sought to develop a deeper understanding of the challenges of reconciling 'successful' mega infrastructure development with principles of sustainable development. The section also locates the aspects of the study methodology and findings presented in this paper. Section 3 presents a framework built from the Centre's normative research, which was intended to highlight a set of key principles for evaluating the treatment of sustainable development for a cohort of 27 MTP case studies. Section 4 presents the findings from applying this framework to evaluate these projects and subsequently offers a series of lessons derived from the research regarding the 'success' (or otherwise) of MTPs *vis-a-vis* these principles. The paper concludes with several comments and recommendations for politicians, public sector officials, representatives of private sector MTP stakeholders and other key project stakeholders.

2. Mega Infrastructure Projects as Agents of Change

2.1 Challenges of sustainable development

Infrastructure, rigorously defined as fixed capital assets supporting production, and circulation of goods, services, and people (see Laepple, 1973; Skayannis, 1990), has over the years become ever more complex and can now be seen not only as individual assets, but variously, as collections of interlinked assets and supporting systems. As these assets become the base of elaborate corresponding services, more complex systems are created which today frequently assume large spatial dimensions. An important classification, both in literature and practice, distinguishes between infrastructure assets broadly in terms of their size and complexity. In this spirit, echoing the stance of the OMEGA Centre when referring to megaprojects, Marrewijk *et al* (2008) look beyond project management issues to consider 'large scale, complex infrastructure projects that are usually commissioned by governments and often delivered through partnerships between public and private organisations. These authors emphasise the fact that such projects involve multiple partners, high uncertainties and considerable political stakes. Their take of these large-scale investments acknowledges the influence of critical external issues of politics and funding (often at the national scale and beyond), and the inherent uncertainty (and thus riskiness) associated with their development. Considering, however, the range of potential impacts wrought by these projects on their multi-dimensional and multi-temporal contexts, this perspective (as enlightened as it may be) falls well short of providing a sufficiently holistic framing that adequately addresses wider concerns of sustainability.

This is so because traditionally, the underlying rationale and narrative of many mega infrastructure projects (especially from the perspective of the State) has been the delivery of economic growth on the basis of the economic benefits they are predicted to generate or support. Of late this premise has been increasingly challenged, compromised and conditioned (at least in the rhetoric) by the presentation of a broader agenda of multiple development aims in support of declared United Nations (UN) visions of sustainable development which in essence have the potential to re-define the order of development priorities that mega infrastructure projects should contribute to. The Brundtland Report's (UN, 1987) definition of sustainable development[3] implies an important shift from sustainability (as a primarily ecological concept to a framework that also emphasizes the economic and social dimensions of development[4]. The report underlines the belief that sustainable development is not just a matter of balance (between its social, environmental, economic and institutional dimensions)

but also reflective of a need to respect the ecological limits of development as far as they are known (Rees and Wackernagel, 1994; Wackernagel and Rees, 1996).

The traditional criteria of project appraisal relating to cost overruns, completion dates, and rates of return to investors are therefore increasingly seen to represent inadequate measures of project 'success' for the 21st century as sustainable development concerns become more critical and more widely recognised. In response to these new demands on the framing and evaluation of mega infrastructure investments, particularly MTPs, the OMEGA Centre undertook a series of research projects concerning megaproject decision-making of which the OMEGA 2 Project (focusing on international practices in MTP development), is discussed in this article.

2.2 The OMEGA 2 Project and sustainable development

The fundamental underlying question posed by the OMEGA 2 Project was: 'What constitutes a 'successful' MTP'? When success is redefined in light of the aims of such projects and the anticipated challenges presented by the 21st Century, predicted by a growing body of scholars and scientists to reflect a rising tide of global and local inter-connected uncertainties and associated risks (see Lash et al, 1996; Beck, 1999; Taleb, 2007; Renn and Walker, 2008; Beddington, 2009). The framing of this question thus sought to extend the enquiry into the 'success' of MTPs well beyond the conventional project management concerns of the 'iron triangle (as important as they may be) to consider, amongst other issues, the relevance of sustainable development visions and challenges to project outputs and outcomes.

The research undertaken by the OMEGA Centre and its international partners was largely confined to the experiences of MTPs in countries of the post-industrialised world.[5] The research looked to identifying, extracting and sharing knowledge and potential lessons for better MTP development practices on the basis of a synthesis of the findings derived from interviews conducted with some 300 persons representing key stakeholders of the 27 project 'case studies' reviewed (see Table 1 below). The research sought to generalise from the case study findings a set of evidence-based lessons in response to the research questions set. Whilst the sample size of persons interviewed was not 'statistically significant', in-depth case studies, as suggested by Flyvbjerg (2006), are a valuable research method by which to respond to specific research questions identified by the OMEGA 2 project.

Table 1: 27 OMEGA International Case Studies

The underlying philosophy of the research undertaken in support of the OMEGA 2 Project is illustrated in Figure 1. The figure highlights how the research approach adopted was informed by previous investigations regarding the treatment of risk, uncertainty and complexity in decision-making for megaprojects across different sectors and among various disciplines (see OMEGA Centre, 2008). It highlights the need to better understand the principal underlying themes, issues and challenges of MTP policy-making, planning, appraisal and delivery to make such infrastructure projects more effective agents of sustainable change. It also advocates four (rather than three) key platforms of sustainability which the OMEGA 2 Project considered critical in preparing responses to the multitude of sustainability challenges against which project 'success' may be assessed. The addition of the fourth dimension (i.e., institutional sustainability), acknowledges the need for committed and capable institutions with longevity to adequately resource and facilitate success within the other three dimensions (OMEGA, 2011).

The OMEGA 2 Project adopted three overall research hypotheses formed around issues of sustainable development. These sought to accept/reject the notions that: firstly, traditional economic and financial criteria are inadequate measures of success in the context of today's sustainable development concerns; secondly, the emerging agenda related to vision(s) of sustainable development is multi-dimensional and concerns the inter-related concepts of eco-environmental, economic, social, and institutional sustainability; and thirdly, the level of competence in decision-making, in the context of strategic planning and resilience considerations in particular, requires sound treatment of risk, uncertainty and complexity plus sensitivity to context(s).

The research methodology by which responses to the overall research question and hypotheses were identified is presented in Figure 2. In this paper, we present findings concerning two core elements of the study methodology that sought to evaluate the case studies in terms of how well they responded to sustainable development visions as follows:

1) The identification of a normative framework of sustainable development principles, derived from the findings of two exercises: Firstly, a synthesis of OMEGA 2 project commissioned papers on 'MTP Sustainable Development Challenges'. These were prepared by OMEGA research team members on the basis of an international literature review which offered insights into selected international key challenges that MTPs typically encounter when pursuing sustainable development goals. Secondly, a review of sustainable development

principles and objectives prevailing at the time of the OMEGA 2 project and considered relevant to MTP development [6]. Key elements of the resulting framework are presented in section 3 below.

2) The analysis of project 'achievements' relative to identified principles, challenges and issues of sustainable development amongst the 27 case studies, as represented by the normative values and criteria drawn from the OMEGA 2 project and other cited literature. These achievements were identified from the case study databases, comprising project profiles (compiled from secondary data) and interview data (derived from interviews with key stakeholders of case study projects) with the latter reliant on pre-hypothesis and hypothesis-led interview techniques. Evidence of adherence to the identified sustainable development visions, challenges and issues was sought through a qualitative analysis of interview transcripts using spreadsheet software. Key findings from the analysis are presented in Section 4.

The findings from this two-stage process also sought to formulate preliminary 'lessons' that could inform how MTP performance, outcomes and impacts could be further enhanced in relation to the normative values for sustainable development for 21st century projects. These are also presented in section 4 below.

Figure 2: OMEGA 2 Project research methodology

3. Infrastructure and sustainable development

This section identifies key themes highlighted and addressed by the OMEGA Centre research concerning 'MTP Sustainable Development Challenges' published in the form of Working Papers in support of Stage 1 of the OMEGA 2 Project. It discusses practical issues of incorporating sustainability in MTP development within each of the four dimensions: environmental, economic, social, and institutional. Sustainable development principles prevailing at the time of the OMEGA 2 Project, as deployed in the evaluation of the 27 OMEGA 2 case studies (see Section 4), are also presented for each of the four dimensions.

3.1 Environmental aspects of sustainability

Of the four dimensions of sustainability, the environmental was, relatively speaking, the most well developed at the time of undertaking the OMEGA 2 Project. This is perhaps unsurprising, given that social awareness of environmental issues since the early 60's. The USA's National Environmental Policy Act (NEPA) of 1969, for example, required environmental consideration in large-scale projects thereby enacting Environmental Impact Assessments (EIAs) as a

formal requirement in legislation for the first time (EAGJ, 2000). The NEPA proved influential, provoking other countries to legislate for EIA[7]s including, for example, Australia (1974), France (1976) and Hong Kong (1977).

EIAs belong to a class of impact assessment methods which, at the time of the OMEGA case studies considered here, tended to mainly consider the biophysical aspects of a project (Fuller, 1999). They applied a suite of sampling or surveying tools (air, water and soil sampling, and surveying of local ecosystems) to evaluate the aggregated environmental impacts of a project. EIA is generally considered more efficient and effective when implemented as early as possible, for example at the policy or project-planning phase (EAGJ, 2000), although different countries have adopted different approaches to its application (*ibid*). An effective starting point of the MTP sustainable development evaluation presented in Section 4 would be to discern at what stage of the planning phase the EIA was carried out for each project. This is important as Low (2007: 7) highlights the fact that environmental impact assessments for MTPs all too often take place after the project has been designed. This observation has also been made by Kracht and Munafo (2008) and Bertolini and Salet (2007) in German and Dutch MUTPs, respectively. The authors contend this is too late in the process because the political costs of cancelling a project at a late stage are too great.

Low (2007) also argues that it is essential that EIA's should form an integral part of the project planning, and be incorporated from the early stages of the project lifecycle. He claims that it is not necessary to have all the details of an MTP worked out before the assessment process can start as these assumptions can be entered into on a cyclical basis, akin to iterative planning. However, even if the EIA processes are properly integrated in MTP planning, there remain major technical difficulties in doing this due to the uncertainties that surround many of the variables that feed into the assessment. As Brecher and Nobbe explain (2007: 5), the EIA process in the United States and similar procedures in other nations have been found to contain serious faults. Whilst EIAs should, first and foremost, improve the quality of decision making and promote broader societal goals, there are significant shortcomings with the application of EIA in practice. Duinker and Greig (2006) note that EIA can be seen as a regulatory hurdle by promoters who, operating to tight business margins, may aim to obtain approval in the most efficient way possible. The work of Steinemann (2001), for example, highlights how this practice can lead to a focus on overly narrow alternatives, reducing the identification of more environmentally sound options. Alternatives can also be somewhat subjectively identified based upon agency agendas, path dependent behaviours and solution templating. Objectivity can be further undermined through the use of 'straw men' or project alternatives predesigned to be rejected by the process. Problem definitions may furthermore

be less than rigorously identified, leading to proposals treating symptoms rather than causes and structural outcomes. So that in the water sector, for example, new water treatment plants are favoured over 'non-structural' or demand side policy responses that include adjustment to water rates or installation of 'smart water meters'. Issues also arise concerning the lack of meaningful public involvement in the decision-making process, with this involvement usually coming too late to influence the development of alternatives (Adelle and Weiland, 2012). There are also significant reservations expressed in the literature regarding the limitation of EIA to consider the prediction and management of the impact of uncertainties and cumulative effects over time (Canter and Ross, 2010; Morgan, 2012), including the treatment of geographical boundaries (Brecher and Nobbe, 2007) and ecological thresholds (Duinker and Greig, 2006).

Concerning the issue of ecological thresholds and impact causes, EIAs have been further criticised for their excessive local focus, and inability to quantify impacts which occur beyond the project boundary itself, such as emissions generated by bus feeder routes to a new metro line. Neither can such biophysical assessments account for the indirect impacts of energy use or natural resource depletion using standardised metrics (Colins and Cooper, 2015). In contrast, Ecological Foot-printing (Wackernagel and Rees, 1996) is a method which can consider both the direct and indirect resource use beyond the project itself. The method provides an assessment of the quantum of bio-productive land required to provide the resources used by a target population. Ecological footprints can also consider greenhouse gas within the analysis, with 'global hectares' as the units of measurement, representing a hectare with a world average biological productivity. Adoption of this method introduces two critical elements in the evaluation of environmental sustainability. The first is the adoption of a metric with a direct recognition of the earth's finite resources (i.e., global hectares). The second is that it considers aspects of justice and equity, in the extent to which a target population is living beyond its means. Whilst there have been criticisms of the method (regarding, for example, the accuracy by which it represents the impacts of human consumption, the limits to what can be included within the metric, and limitations to considering the responsibilities for impacts) it allows a more holistic view of environmental impacts than EIA alone but raises some challenging questions regarding whether mega Infrastructure projects such as MTPs are inherently unsustainable in ecological terms.

To illustrate typical shortcomings in the EIA process, especially concerning its objectivity, Low (2007) cites an implemented project in Melbourne in 2008-9 (the Port Phillip Bay Channel-deepening Project) which carried substantial environmental impacts to marine habitats, and to human and wildlife health through disturbance of toxic sediments. Two environmental

assessments were carried out: the first of which was considered unsatisfactory, and a supplementary assessment which led to a 15,000-page report. Yet while …'the logic of the process could hardly be faulted, nor the thoroughness with which the impact assessment was conducted..', the assessment was 'really little more than an informed guess buried within a mountainous report on the science of the conceptual models and the process of analysis' (Low, 2007: 22).

Low (ibid: 26) concludes that environmental impact assessments themselves carry two major (and contradictory) risks: those of assessments leading to 'risk-aversion' (i.e., over-cautiousness) discouraging beneficial action; and those risks that are conversely a danger …'of [the public and decision-makers] being reassured and manipulated by analysis into a belief that all negative impacts have been 'managed' or can be ignored'. He explains 'The [Port Philip Bay] example…revealed how the process of 'rational' choice can be subverted by political choice. …. (and thus argues) that the application of rational techniques of impact analysis is *not* sufficient to assure or even improve overall rationality'. He contends that the key to rationality is depth of argumentation, examination of alternatives, continuous involvement of all stakeholders, and power of rationality over vested interests

Responding to the limitations of EIAs and the importance of sustainable consumption of finite resources, Table 2 presents the environmental policies and guidelines relating to sustainable development visions which the OMEGA research team considered prevailed at the time of the OMEGA 2 Project. These have been subsequently used to evaluate the 27 MTPs a discussed in Section 4.

Table 2: Environmental policies and guidelines relating to sustainable development visions that prevailed at time of OMEGA 2 Project

3.2 Economic aspects of sustainability

Economic efficiency remains to this day the principal concept for traditional project appraisal practices in the infrastructure field, particularly for transport (see Banister and Berechman, 2000; Hayashi and Morrisugi, 2000; Grant-Muller et al., 2001). Pretorius and Ng (2008) focus on the difficulties of comparing costs and benefits of major projects over time – especially the differences between public and private sector approaches, and the problems of incomplete information and inter-generational effects. They point out that private sector organisations typically make their budgeting decisions within a relatively well-defined envelope and as a

result, as far as the private sector's objectives are concerned, 'it is… easier to evaluate project outcomes', as they 'function in relatively narrow markets with 'good' price information, with relatively good knowledge of competitors, and relatively clear incentives.' (ibid: 7). In so doing, many social, environmental and institutional issues become externalised. The authors also explain that private sector projects often have a more limited number of stakeholders (who are usually well defined). The public sector, by comparison, must consider the 'entire public' as potentially a 'stakeholder', inevitably composed of multiple varying and sometimes conflicting groups and interests.

With regard to the public sector, Pretorius and Ng explain that not only are there numerous and not-clearly defined stakeholders; there is also limited information about prices and costing, leading to the derivation of economic prices using valuation methodologies, some of which are highly controversial. Contingent valuation, for example, is one of the methods used to derive 'travel time savings', an important benefit for most transport projects. This valuation method, however, has been rigorously criticised due to: its vulnerability to response bias, leading to over-estimation of values; large differences observed between willingness to pay and willingness to accept; and the embedding problem where respondents fail to respond from stable or well defined preferences (Hausman, 2012). Furthermore, because these economic factors are essentially confined to those that can easily be translated into monetary terms, economic appraisal methods are seen to be biased toward the premise of 'what cannot be monetized is not important' (Vasconcellos, 2003). There are also debates concerning the morality of reducing life, health, amenity and elements of the natural environment to monetary values and issues of accuracy in estimating economic prices of goods (Adams, 1995, Heinzerling and Ackerman, 2002 and Hansson, 2007).

Given the above, and that MTP objectives are also much broader and complex, Pretorius and Ng (2008) conclude that 'public sector capital budgeting decisions are conducted several orders of complexity away from the rarefied private sector atmosphere described above, despite drawing on a common methodology and that from the point of view of sustainability, these limitations take on a far graver nature, which requires consideration at the level of social institutions and governance' (*ibid*: 14). They contend, in other words, that market-based approaches alone applied to public sector projects are especially *inadequate* and as a result, social impact appraisal and related decision-making is also necessary. They furthermore conclude that the larger the project, the more complex it becomes, thereby increasing the scope for unintended consequences and reducing the ability of its decision-makers to influence impacts.

The same authors also identify the distribution of project impacts of MTPs in particular as 'a fundamental challenge to public policy-making and allocation of public sector capital when sustainable development is an objective' (*ibid*: 17). Indeed, failure to resolve the distributional consequences of projects is one of the most serious deficiencies of conventional economic evaluation (OECD, 2006). This has especially been the case for large-scale infrastructure projects which typically entail complex decision-making and encounter numerous problems associated with the need to address multiple (sometimes conflicting) objectives of the numerous project stakeholders (van Wee and Tavasszy, 2008). Whilst distributional effects can be both spatial and temporal, intergenerational distributions are a particular concern. A key issue in assessing such effects is the choice of discount rates[8]. The higher these are, the lower the valuation of future impacts, compared with present-day costs and benefits.

In choosing a discount rate, private sector organisations in particular are *compelled* by the market to maximise their returns, otherwise they will be 'punished'. As a result, they typically choose higher discount rates as set by the market (representing the opportunity cost of the capital), plus a premium to reflect project risks and debt obligations (including those of shareholders). The rates they use, however, are 'significantly above risk-free rates, which places concern for inter-generational project impacts practically beyond [private sector] horizons' (*ibid*: 22). Private sector discount rates of 15% (not un-typical) mean that most project impacts occurring after 12-15 years have little influence on total present value which suggests private sector investment decisions mainly focus mainly on the short term. This is a fundamental issue for MTPs which are typically large and expensive projects, designed especially with long term benefits in mind. As the same source explains: 'A project aimed at reversing global warming but requiring substantial present investment will be summarily rejected. This logic pits the interests of future generations against the present generation tasked with making such investment decisions' (ibid: 22-23). In an attempt to overcome these limitations, lower rates are often used for public sector projects. Known as 'Social Discount Rates', these are, however, challenging to operationalize effectively and there is considerable debate about what an appropriate rate should be.

The justification for discounting future consequences of project outcomes in appraisal exercises in effect entails the implicit adoption of a decision-making model characterized by a history of steady economic growth and a general absence of any catastrophic events or irreversible harm. By using discount rates to reduce benefits and costs over many decades to almost zero, the natural environment is assumed to be almost totally replaceable with human-capital and that there is thus no real need for precautionary investment in

environmental protection. The challenge here is that while discounting any such harm may be useful from a financial point of view, it cannot reasonably be used to discriminate between present and future generations. In these terms, economic analysis is inherently flawed as an appraisal tool. This is especially so where (and when) sustainability concerns as defined by the Brundtland Commission need to be addressed, particularly issues of inter-generational sustainability and equity (Eckstein, 1958; Baumol, 1968; Van Wee and Rietveld, 2013).

Given the above, it is plain to see why efforts at promoting sustainable development urgently require economic development practices to be reframed and balanced against the environmental, social and institutional dimensions of sustainable development. To this effect, Table 3 below sets out sustainable development visions and guidelines which prevailed at the time of the OMEGA 2 Project that were considered by the research to be of relevance to the economic sustainability of the 27 MTP case studies reviewed.

Table 3: Economic policies and guidelines relating to sustainable development that prevailed at time of OMEGA 2 Project

3.3 Social aspects of sustainability

As part of the OMEGA 2 Project, Kaparos and Skayannis (2007) examined the social dimensions of sustainability as they relate to MTPs, focusing on 'social cohesion' in particular. In so doing, they emphasised its multi-dimensional and multi-level nature and highlight specific attributes. These include equitable distribution of direct and indirect transport benefits and costs, impacts on poverty alleviation, levels of participation and political impacts (with emphasis on the decision-making process involved, and exclusion).

'Social cohesion' also has different geographical levels. For example, the European Union (EU) frequently uses the term in policies to tackle national, regional and sub-regional disparities. Neighbourhood cohesion (or rather the lack of it) is a well-known issue. A little less well known perhaps is the concept of 'global cohesion'. This is usually interpreted as international policies for debt relief, poverty reduction and other social challenges. There can, however, be tensions between different levels of cohesion. For example, a MTP that adversely affects a community's cohesion may on the other hand benefit national cohesion (*ibid*).

The concepts of 'social sustainability' and 'social cohesion' are not only complex but overlap in many respects with other dimensions of sustainability, notably environmental, economic and institutional sustainability. Notwithstanding this, Kaparos and Skayannis warn against

over-extending the sustainability concept. They argue that 'The main risk is of the concept losing its meaning when trying to deliver too many objectives that may be conflicting in the real world' and as a result might become arbitrary and defined ad-hoc by users *(ibid*: 4). Low also warns against the loose application of social sustainability, suggesting it '… seems to have replaced the term social justice' (Low, 2007: 6).

The difficulties of incorporating social dimensions of sustainability in Cost Benefit Analysis (CBA) and Multi-Criteria Analysis (MCA) as appraisal tools are similar to those of incorporating environmental dimensions, and are well-documented. Kaparos and Skayannis add to the challenges already alluded to the difficulties in choosing and measuring project performance indicators; risks of double-counting (for example, a benefit such as improved accessibility may also lead ultimately to costs such as employment or housing displacement); and a potential bias towards higher income groups. By valuing the time savings of the more affluent more than the less well-off, the outcomes of CBA exercises favour projects that save the time of the former more than the latter … 'at the expense of poor people who can afford to pay little to defend their environments' (Kaparos and Skayannis, 2007: 7).

In light of the above, and also because these concerns are politically sensitive, social factors have tended to receive less attention both in project appraisal exercises and in appraisal guidance as in the case of those promoted by TRANSECON (2003), and TRB (2001). Consequently, Kaparos and Skayannis (2007: 9) recommend that Social Impact Assessments should become a formal part of the planning and appraisal of MTP's, with the same legal status as EIAs (Taylor, Goodrich and Bryan, 1995). This, however, can introduce multiple sets of discrete appraisal exercises provided for different audiences with little inter-connectivity - an experience encountered in much current international infrastructure appraisal, especially in Europe. To add to the challenges, Kaparos and Skayannis (2007) caution that even when MCA appraisal methods are employed, serious technical and theoretical difficulties in incorporating wider cohesion impacts are again encountered, particularly concerning impacts such as strengthening the participatory processes, innovations in partnership working and (institutional) capacity-building. This conclusion emphasises the importance of public scrutiny and of involving key stakeholders in MTP appraisal processes (indeed in all significant infrastructure projects); a concern which also relates to institutional dimensions of sustainability discussed in the ensuing sub-section of this paper.

Finally, and perhaps most importantly, as the following quotation suggests, the authors query the opportunity costs of MTP's as they relate to social cohesion and ask: 'If sustainable cohesion is a primary societal goal, are MTPs [the best] road to that goal? Investment in other

sectors such as education, health and facilities for disadvantaged social groups may give a better 'social return'. If 'cohesion' is a primary policy objective, then the decisions of governments, development organizations and regional institutions (such as the EU) to invest in large transport projects need to be challenged…and there must be established procedures enabling voices from the social arena to challenge the developments before they become conceptualized' (ibid: 10). In light of these discussions and a review of social policies impacting sustainability contemporary at the time of conducting the research for the OMEGA 2 Project, Table 4 presents policies and guidelines employed in the evaluation of the case studies and reported on here.

Table 4: Social policies and guidelines relating to sustainable development that prevailed at the time of OMEGA 2 Project

3.4 Institutional aspects of sustainability

As regards institutional sustainability (a relative newcomer as an additional pillar of the sustainability concept), Kaparos and Skayannis (2007: 4) contend that this serves as an 'umbrella' to the 'three E's' (i.e., the environment, economy, equity dimensions of sustainability) 'in the sense that policies and interventions (regarding efforts to achieve sustainable development goals) can only be sustained by social structures and institutions' Institutional sustainability can be described as the institutional structures and processes that have the capacity to function effectively over the long term, passing on cherished visions and aims of sustainable development. 'These institutions include the administrative and legal systems of governance through which government develops and implements public policy which in turn frame and regulate the operational capacity and approach of public and private organizations at all levels throughout society, and the effectiveness with which they engage together in planning and development of projects on a sustainable basis' (OMEGA Centre, 2010: 12). Institutional impacts on MUTP sustainability are discussed in several of the Working Papers – Low and Sturup (2007); Leheis (2007); Bertolini and Salet (2007); Brecher and Nobbe (2007).

Brecher and Nobbe (2007: 6) claim that sustainable transport development requires a comprehensive approach to planning and its governance which integrates interests in transport, land-use and economic development, and co-ordinates different transport modes. Notwithstanding this, they explain that in USA, '… governmental institutional arrangements discourage such a comprehensive approach.' The authors describe the US pattern of government with regard to the provision and regulation of transport infrastructure as 'picket

fence federalism,' meaning that it possesses strong vertical integration of functional departments and weaker horizontal integration at the levels of national, state and local government. The result, they argue, is the discouragement of comprehensive planning and decision-making that views transport modes as alternatives or complementary (*ibid*: 6-9). These negative impacts are illustrated in the experiences of the Metropolitan Planning Organisations (MPO's) in USA as generally weak, diffuse assemblages of local officials.

The same source identified four major shortcomings of MPOs, namely: the state's control over their decisions, the limited money/resources they directly control, their poor organizational capacity, and their highway and minority groups' positive and negative board decision biases, respectively. Given these circumstances, this source contends that MPO's are seen not to be carrying out the functions that were originally intended for them and to have little political independence as compared to State Departments of Transportation with the result that '…..projects with an urban transportation focus are often neglected' (*ibid*: 16). In other words, in the USA there are strong institutional barriers to co-ordinated planning, and the structures tend to reinforce existing infrastructure development biases (notably highways).

There are close institutional parallels in Australia to the USA. According to Low and Sturup (2007: 5) public service agencies, *par excellance* in the transport sector, are organised 'in vertical bureaucratic 'silos' with very little horizontal communication among them, let alone co-ordination of their activities and responsibilities …. which have their own organizations with different degrees of power (and incompatible strategies)'. Elaborating on this, the same authors argue that 'Land use planning, likewise, normally exists in a silo of its own. There have been efforts to integrate the planning and management of public transport but there is no integrated structure comparable, for example, with the European *Verkehrsverbund*.' The same source finally contends that the separation of land use planning from highway planning and the responsibility of urban developers for infrastructure on green field sites (including local roads), has rendered 'road-based public transport as the only applicable (transport) solution' to Australia's urban mobility challenges (*ibid,* 2007: 15).

It should be noted that the measures advocated earlier for more effective assessments of stakeholder participation, transparency, accountability and monitoring in MTP decision-making all focus on social and political actions. In this sense, as Low points out (2007), the greatest obstacles to these assessments are *not* primarily technical but human-related. In other words, the real challenge with MTP planning and appraisal is not so much in collecting the data but how this data is analysed and the applications of the findings of this analysis by relevant institutions. In light of these and the above observations, a review of international

policy and good practice statements by the OMEGA 2 project yielded the institutional policies and guidelines as outlined in Table 5 below to inform the evaluation of the 27 case studies.

Table 5: Institutional policies and guidelines relating to sustainable development that prevailed at time of OMEGA 2 Project

4. MTP case study analysis of response to challenges of sustainable development

This section presents the findings from the evaluation of the 27 MTP case studies conducted as part of the OMEGA 2 Project to understand the extent to which they have contributed toward selected sustainable development principles and guidelines cited at the time of undertaking the research. The analysis employs the evaluation framework as set out in Section 3 and offers lessons derived from the analysis regarding the 'success' (or otherwise) of the MTPs *vis-a-vis* these selected sustainable development principles and guidelines.

4.1 Addressing sustainability concerns: project achievements

An important finding of the analysis of the project objectives of the 27 case studies (see OMEGA Centre, 2011) was that 74% of these MTPs were not formulated according to the sustainable development principles/guidelines as defined by the research. The same source revealed that only 7% of these MTPs were judged to have been conceived with sustainability in mind at the time of their planning. Given these statistics, the majority of the case studies could therefore *only* be evaluated against concepts and principles of sustainability that were developed *after* their delivery. In these terms, the outcome of the analysis is perhaps more helpful in indicating which of these MTPs could be candidates for retrofitting to meet goals of sustainable development retrospectively.

Despite this lack of sustainable development considerations being taken into account during the planning stages of the 27 MTPs reviewed, 96% of them undertook EIAs. However, the focus of these impact studies was seen by OMEGA 2 Project researchers as too narrow in terms of the breadth of issues covered and too limited in their applicability, especially at the early stages of MTP decision making. The findings of this research also expressed concern regarding the questionable rigour of how these EIAs were generally undertaken. An examination by this same research, concerning the stage in the project life cycle when EIAs were undertaken, found only 23% of the 27 MTPs examined included EIAs undertaken during

the project conceptual stage; the point at which an EIA's outcome has the greatest potential impact on a project's decision making (ibid).

A comparison between the year of enactment of EIA legislation, the year of commencement of the earliest project planning phase of the case studies, and the earliest year of project ratification for each of the countries studied is provided in Figure 3. This graph shows that only 4 of the 10 countries concerned have projects where the commencement of the planning phase pre-dates the enactment of EIA legislation. This suggests that 76% of the projects studied had the potential for EIAs to be undertaken at *any time* during the planning stage (including the concept development stage), whereas only 23% did so in reality.

Figure 3: Year of enactment of EIA legislation against earliest planning and ratification start dates per country of MTP case studies

As earlier emphasised, the above findings need to be seen in the context that the majority of the case studies reviewed were planned at a time when sustainability (based on the notion(s) and multi-dimensions it later attained) was *no*t included in MTP agendas as a term defining a planning goal. While only a relatively narrow component of environmental sustainability goals employed by the OMEGA 2 Project evaluation framework were found to have been addressed by the case studies through EIAs undertaken at various stages during their project life cycle, it should be noted that these projects were planned *prior* to the introduction of Strategic Environmental Assessments (SEAs). This limited the potential for consideration by MTPs of effective alternatives which would otherwise have helped embed broader sustainability principles within such projects.

Of the four sets of principles of sustainability presented by the OMEGA 2 Project evaluation framework, the subsequent evaluation found that project adherence among the 27 MTPs reviewed to be most prevalent regarding environmental principles, followed by economic, and then by social. Institutional (and governance) principles related to sustainability had a very low reported level of coverage (see Figure 4). From anecdotal evidence and discussion set out in Section 3, however, the dominance of environmental concerns over other dimensions of sustainability is unsurprising. A discussion explaining this ensues immediately below.

Figure 4: Distribution of evidence to support adherence by MTP case studies of four sets of principles of sustainability

Addressing environmental sustainability concerns: project achievements

The OMEGA 2 Project investigated how a collection of eight environmental sustainability principles were considered by the 27 MTP case studies reviewed. Figure 5 reveals that the most common principles with evidence of adoption related to the: reduction of waste and environmental degradation, sustainable consumption and production, and the conservation of cultural heritage and natural resources. Few of the MTPs sought to minimise their future vulnerability to climate change which can expose projects to significant levels of environmental risk if not addressed. The Channel Tunnel Rail Link (CTRL), more recently referred to as HS1, for example, has been built traversing a number of low-lying flood plains in South East England. Regarding the incidence of the eight environmental sustainability principles by project, the majority of projects were found to fulfil between 35% and 50% of these principles.

Figure 5: Adherence to different aspects of environmental sustainability principles among MTP case studies

4.2 Addressing economic sustainability concerns: project achievements

Regarding the three economic sustainability principles cited in the OMEGA 2 Project in its sustainability evaluation framework, the most common with evidence of adoption among the 27 MTP case studies relate to claims that economic developments were compatible with environmental objectives. These were reflected in 33% of the projects (see Figure 6). Few of the case study projects, however, appeared to exhibit any accelerated decision making on the grounds of key environmental benefits being present. The most reported significant coverage relating to economic dimensions concern project financial sustainability. The however appears to have been of a short-term nature and of rather limited financial scope. This was evident in the case of the CTRL which (among other things) failed to take account of competition to the rail link from low-cost airline operators. In terms of incidence by project, the evaluation of the case studies found that only a few exhibited evidence of adherence to more than two of the five economic sustainability principles mentioned.

Figure 6: Adherence to different aspects of economic sustainability principles among MTP case studies

4.3 Addressing social sustainability concerns: project achievements

In terms of the eight social sustainability principles introduced by the OMEGA 2 Project evaluation framework, it became evident from an examination of the case studies that very few exhibited an adherence to these in any significant number (see Figure 7). On the evidence

presented, none were found to involve extensive public participation or public consultative exercises. The evaluation study found low levels of project adherence to social sustainability concerns except in the case of the Perth to Madurah Railway in Western Australia. Furthermore, only the Japanese and Australian MTPs reviewed exhibited any degree of consistency towards the adoption of one or more social sustainability principle across all three of the national case studies reviewed in each country.

Figure 7: Adherence to different aspects of social sustainability principles among MTP case studies

4.4 Addressing institutional sustainability concerns: project achievements

Figure 8 shows the incidence of the six principles of institutional sustainability across the 27 MTP case studies. What this figure reveals is that very few of these projects appeared to exhibit an adherence to any significant number of these concerns. Furthermore, none of these MTPs where found to include evidence of the use of policy to support the sustainable use of assets.

Figure 8: Adherence to different aspects of institutional sustainability principles among MTP case studies

4.5 Summary of key findings from the analysis of the 27 case studies

A key finding from the above analysis is that 93% of the projects studied could *not* be identified as having taken into account in any significant manner sustainable development principles based on the notion and multi-dimensions such principles had attained at the time of the OMEGA 2 Project. Furthermore, while the majority of the MTPs reviewed undertook EIAs, only 23% of these included EIAs during the project conceptual stage considered the point at which an EIA's outcome had the greatest potential for a positive impact on a project's decision making. This represents lost opportunities that need to be revisited especially in retrofitting exercises. It is evident that the process of Strategic Environmental Assessment (SEA), whilst not available for the majority of the case studies[9], may have improved the situation, given that it helps to lay down the ground work for sustainable development at the earliest stages.

From the exercise which sought to quantify the frequency by which the Case Study samples adhered to the four dimensions of sustainability as defined by the OMEGA 2 study, it was found that project adherence was most common with environmental principles, followed by

economic principles. Social and institutional principles were found to have a very low adherence. Relating these findings to the overall research question and hypotheses of the OMEGA 2 Project - which poses the question 'What constitutes a 'successful project'? - the above discussed issues raise the question of what can/should be done as a result of the findings (and by whom, where and when) - beyond looking to develop and apply enhanced versions of SEAs to MTP developments?

The OMEGA 2 Project findings suggests that there is a lack of a shared vision of what 'sustainable development' means, and that unless this matter is addressed, it threatens to undermine the potential for MTPs to contribute positively to sustainable development outcomes.

5. Conclusions and recommendations

The lack of clarity and consensus poses a number of critical challenges for MUTP planning, appraisal and delivery, including questions about whether they can effectively meet the needs of intra and inter-generational equity (and socio-economic equity), as well as global concerns about such matters as fuel scarcity and climate change.

What is also readily apparent is that sustainable development visions are *not* presently seen as providing adequate frameworks for either setting MUTP goals and objectives or judging their subsequent success or failure (both for new projects and in relation to the retrofitting needs of existing MUTPs). This is principally due to the perceived difficulties in defining 'sustainability' in an operationally useable manner and by the inherent difficulties that exist in reconciling aspirations associated with the four different dimensions of sustainability which often are seen to be in conflict in MUTP planning, appraisal and delivery.

This situation is made more problematical by the existence of significant institutional/organisational and professional barriers and specialist silos that inhibit the application of a more 'holistic' approach to MTP development – so critical to sustainable development visions for MTPs. Moreover, certain such projects (especially road-based MTPs) are characterised by an inbuilt conflict particularly between concerns for environmental sustainability and the manner in which they are funded whereby they exhibit a financial dependence of revenues that entail environmental risks.

In framing the research presented in this paper, it was judged necessary to suggest a series of recommendations for different MTP stakeholders which can only briefly be mentioned here. These mainly concern:

- Discussions and debates about the role that MTPs and their attendant agent of change functions can play in relation to delivering sustainable development visions, and the means by which such visions can be translated into a form capable of being readily operationalised.
- The need to undertake further work on the elaboration of sustainable development visions for MTPs in a manner that embodies concerns of all four dimensions of sustainability and deals not only with conflicts that arise between the different dimensions but also with means of funding and financing the projects.
- The need to make progress in removing organisational barriers to integrated thinking (and action) and dissolving specialist silos that frustrate the type of holistic approaches advocated (and required by) sustainable development approaches to MTPs.
- The focus that should be placed on the different roles of individual MTPs in terms of the type of development they are to promote vis a vis: alternative modes and/or technologies to be relied on, alternative energy sources they are to use, alternative territorial and sectoral restructuring strategies they are to promote/sustain etc.
- The importance of education and training of students and professionals who plan to become (or are already) engaged in and contribute to MTP planning, appraisal and delivery in a manner whereby this not only better promotes the fulfilment of sustainable development visions but also fosters action research in the field.

Each of the above points, we argue, should be strongly presented to politicians, public sector officials, representatives of the private sector and community groups plus other key MTP stakeholders deemed significant to the success of such projects. Each of these groups should be expected to contribute from their own perspective(s) and according to their competence, insights and experiences that can take MTP developments forward so that they are fit for purpose to address 21st century challenges and opportunities as we understand them. Politicians have the responsibility to identify and acknowledge important issues, lead discussions and debates about these issues and how they can be addressed and arbitrate and exercise political pressure where/when necessary and in so doing determine sustainable and resilient strategies for the future. Public sector officials, meanwhile, should be expected to provide diligent and responsible advice to politicians and promote debates, discussions and research to better identify and inform policies and plans for the preparation and implementation of MTPs. These need to be pursued within organisational change(s) for the

public sector that provide the necessary resources that are affordable both within the short and longer terms. Representatives of private sector interests in MTP developments should simultaneously assist/take part in the debates regarding critical issues encountered, advise on conflicts and strategies from both its perspective and that of the public sector with other stakeholders likewise contributing.

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1 The OMEGA Centre at UCL was established amid concerns internationally about the capability of MUTPs to be provided not only on time and within budget, but also to deliver the benefits they promise, especially given the significant scale of costs and uncertainties associated with their development. The fact that a transfer of management and financial risk from the public to private sector would introduce new disciplines and greater reliability for such projects has not been borne out on the scale expected has spawned additional concerns.

2 The body of this paper presents the relevance of these findings as they stood in 2009. The relevance of these 10 years on, in 2019, will be tentatively explored during the concluding remarks.

3 'Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' Brundtland Report (UN, 1987).

4 As will be discussed below, in the OMEGA project the institutional dimension was added.

5 The decision to confine the scope of the research programme to the Developing World rests on the adopted premise (examined further in the research programme) that decision-making for mega projects is greatly affected by its 'context'. This was an important finding of the Centre's VREF 'Smaller Project' undertaken prior to the commencement of the OMEGA 2 project (see Working Paper 4: Generic lessons for Improving The Treatment of Risk, Uncertainty and Complexity in the Planning and Mega Urban Transport Projects, OMEGA Centre, 2008). It was felt on this basis that to extend the research to case studies in the Developing World would seriously compromise the findings of the research undertaken, notwithstanding the fact that some could prove generic.

6 SDVs and challenges as a policy framework were insufficiently developed during the formative years of the 27 MUTPs studied to justify inclusion in the project planning and appraisal process. It was consequently deemed unreasonable to assess project achievements on this basis - except insofar as matters such as 'environmental concerns' were taken into account

7 SEA, a legally enforced Strategic Environmental Assessment, did not affect the majority of the case studies. For example, the European SEA Directive 2001/42/EC required that all member states of the European Union should have ratified the Directive into their own country's law by 21 July 2004, at which point the vast majority of the OMEGA 2 case studies were post implementation

8 The Social Discount Rate (SDR) represents an estimate of how society values consumption at different points in time. It is a central plank of calculating net present values for the application of Cost Benefit Analysis.

[8] For example SEA was legislated by the European Union in 2001 (directive 2001/42 /EC) to come in force in 2004, so it was not a material consideration during the planning of the 15 OMEGA case studies located within the EU

Appendix 1 – OMEGA Partners.

Australia	University of Melbourne - The Faculty of Architecture, Australasian Centre for the Governance and Management of Urban Transport (GAMUT)
France	Ecole Nationales Ponts et Chaussees, Paris - Laboratoire Technique Territoires et Societes (LATTS)
Germany	Free University of Berlin - Institute for Geographical Studies, Urban Studies Section
Greece	University of Thessaly, Volos - Department of Planning and Regional Development
Hong Kong	University of Hong Kong - Department of Real Estate and Construction
Japan	Tokyo Institute of Technology - Department of Built Environment
Netherlands	University of Amsterdam - Institute for Metropolitan Studies
Sweden	Lund University - Department of Technology and Society
USA	New York University, New York City - Rudin Centre for Transportation Policy and Management