On the concept of sustainability – Assessing the sustainability of large public infrastructure investment projects

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Assessing the sustainability of large public investment projects within the general framework of three pillar thinking is a complex affair. Such ventures involve multiple actors – e.g. planners from various disciplines such as engineers, economists and social scientists, in addition to politicians, users and other people affected– each carrying with them particular agendas and priorities, and corresponding understandings of the concept of sustainability. In this paper, we propose to frame the concept of sustainability assessment within the context of investment projects, in order to enable communication between the multiple actors, assess different impacts of an investment project against one another in a meaningful way, and, ultimately, to enhance the commensurability of investment project alternatives. Our main idea is that there exist different levels according to which the assessment of sustainability ought to refer – operational, tactical and strategic –, and that properly addressing these levels can permit the different actors to comprehend one another, and thereby allow for more clarity and positive action.

Keywords: sustainable business models; sustainability; life-cycle assessment

Subject classification codes: framework; strategic; benefit; long-term; risk

1. Introduction

The concept of sustainability (and the adjacent one of sustainable development) is multifaceted, and is used in different manners within different contexts. As Gomis et al. (2011, 174) point out, “sustainable business”, “sustainable technology”, “sustainable agriculture”, “sustainable economics” etc. are all buzzwords of the literature today. According to Adams, “[a]nalysts agree that one reason for the widespread acceptance of the idea of sustainable development is precisely [its] looseness. It can be used to cover very divergent ideas [....]. The concept is holistic, attractive, elastic but imprecise” (2006, 3). This differentiated use has in fact, according to Marshall and Toffel “nearly rendered the term sustainability meaningless” (2005, 673).

The ambition of this paper is precisely to carve out a more firm understanding of how to assess sustainability in the context of large public investment projects[1]. In doing this, we follow the OECD (1991, 5) which has introduced the concept of sustainability into the domain of project management. According to their model, sustainability is, together with efficiency, effectiveness, impact and relevance, a criterion according to which investment projects are to be assessed. This use of the concept of project sustainability is then to be understood as more restraint than the considerable wider concept of "sustainable development" as first defined in the celebre so-called Brundtland report of 1987[2].

The precision of which context we address is in fact crucial for understanding the point we are trying to make. Engineers, planners from other disciplines, and politicians, union representatives and environmentalists etc. tend to understand the concept of public project sustainability in widely different manners and from different perspectives. Some use the concept of sustainability in order to describe asphalt qualities (NAPA 2009), while others insist that road construction for personal vehicle use is not sustainable at all. It appears clear that an emerging comprehension of the role of the engineers is that engineers have a major responsibility for, and role in, the development of sustainable solutions (Rahimifard and Clegg 2008). Without knowing

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[1] Here we use the term large public investment projects to describe projects that are subject to the Norwegian Quality Assurance (QA) regime, initiated by the Norwegian Ministry of Finance. Today, public investment projects with cost estimates surpassing NOK 750 million are evaluated in this external, two-gate quality assurance scheme. More information on the Norwegian QA-scheme can be found at http://www.concept.ntnu.no/qa-scheme.

[2] The most quoted passage from this report, whose official author is the World Commission on Environment and Development, defining sustainable development as development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (1987, 16), illustrates this differentiation. The definition encompasses very broad societal processes that it is difficult to translate into single ventures like public investment projects.

the context of the discourse on sustainability, confusion and inapprehension menace between stakeholders.

In this paper, we propose therefore to sort the semantic landscape in order to permit these different actors to comprehend one another, and thereby allow for more clarity and positive action. Our analysis comes in fact as a response to a pressing problem. Firstly, it is not at all clear what one is to assess when one is asked to assess the sustainability of an investment project, and, secondly, it seems equally unclear how it should best be assessed. Several research traditions assess sustainability, but there seems to exist confusion concerning how to understand the concept itself. Something more tangible and robust is needed. In our view, both the difficulty of determining what principles constitute the essence of the concept and the problem of putting to practice the principles agreed upon stem from inherent characteristics of the concept itself, and provoke the need for analysis thereof.

2. Ambition of this paper and methodological restraints

We have examined how sustainability is addressed in ex ante evaluations of large investment projects. To do this, we carried out extensive literature studies, analysed ex ante evaluation reports from 24 investment projects having undergone scrutiny in the Norwegian Quality Assurance regime and interviewed 14 planners. Our respondents are employed in public agencies with responsibility for project execution, in ministries with responsibility for the future users and in external quality assurance consultancies. The results from this research project inspired us to write this paper.

The concept of sustainability being elusive, the methodological approaches intended to assess sustainability are multiform and manifold. We do not have the ambition to explain all such approaches within this paper, solely outline the ones we

find most pertinent for assessing the sustainability of large public investment projects. The ambition of this paper can be resumed in the following three points:

(1) We want to illustrate how the understanding of sustainability and the corresponding understanding of sustainability within the context of investment projects ought to be sorted according to separate analytic levels.
(2) Equally, we ambition to illustrate how the identification of theses analytic levels deepen the idea of three pillar thinking.
(3) Finally, we want to analyse how already existing analytic tools can serve to assess the sustainability of large public investment projects if properly understood.

Our aim is therefore not to present any fixed, readymade procedure for sustainability assessment within the context of investment projects; rather, we wish to clarify what one is to assess when assessing the sustainability of such projects, and how existing methodological approaches can contribute to such assessments. Sustainability assessment is complex, but a clarification of what to look for when assessing the sustainability of large investment projects ought to contribute to a more firm understanding.

3. Etymology and definitions of sustainability in a project context

Generally speaking, what we judge to be sustainable denotes the upholding of what we judge advantageous over a long time[3]. The kingdoms of France and Britain upheld for instance almost continually a state of war for over 100 years in the high middle ages;

[3] Two parts form the latin verb *sustinere*, notably *tenere*, that is "to hold" and *sus*, that is "up". Ensemble, we can see that the two conceptions thus form an idea of upholding something. Such a direct comprehension of the concept of sustainability proves problematic, since not only profitable/beneficial but also highly unprofitable or/and damaging processes can be maintained over very long time.

hardly anyone would call such a venture sustainable, especially considering the tremendous social and economic impacts of the strive. The concept of sustainability therefore needs to be understood as a prescriptive rather than a purely descriptive concept.

Aiming at surpassing the limits imposed by pure etymology, a common point of departure when discussing the concept of sustainability within the context of large public investment projects is the definition provided by the OECD (2002, 36) [4] . According to this, sustainability is in the context of development projects to be understood as:

> "The continuation of benefits from a development intervention after major development assistance has been completed. The probability of continued long-term benefits. The resilience to risk of the net benefits flows over time."

This definition enlists, in our view, the key elements pertaining to the analysis of sustainability also outside the development context. Such a definition is, however, by no means self-explanatory and invites comment.

Four essential components of sustainability can be found in the definition. Firstly, we can see underlined the need to secure long term benefits, that is, that the project fulfils its aim over the intended time-frame. Secondly, the concept of net benefits refers to the idea that wider (negative) impacts may overshadow the intended (positive) effects of the project or vice versa. It is by no means clear, however, how to balance different impacts against each other. The willingness to pay principle is one

[4] A wide array of definitions exists. In fact, their multiplicity does not only illustrate how complex the concept of sustainability is to define, but also the widespread experienced need for a definition. Hasna (2010) enlist 67 definitions from the plethora (strangely omitting the OECD definition, which constitutes the framework of our work). Our preference for the definition of the OECD stems from the possibility to operationalize it into investment project sustainability assessment practice that we have not found in other definitions.

alternative (as in Cost-Benefit Analysis) but it is not politically neutral and not always considered acceptable. Thirdly, the emphasis on resilience to risk underlines the need for robustness and predictability of the effects the project is intended to fulfil. We consider that the literature amply covers the three first elements of the definition described in this manner, without in any way underestimate the complexity involved in accomplishing them.

The fourth element, however, the insight that projects are built for a reason, that is that the sustainability depends on the achievement of benefits, is not entirely unambiguous, in that it is not always quite clear exactly what benefits the investment project is intended to obtain. Consequently, in order to judge whether an investment project can be considered sustainable ex ante, we need to decide what requirements and corresponding benefits it is intended to fulfil[5].

Passing from the acknowledgement of the key elements in the above definition, however, only takes us so far in our quest for the assessment of sustainability. In order to assess the sustainability of investment projects ex ante, methodological tools are needed that can provide us with concrete analytic elements according to which the project can be evaluated. As exposed in the following paragraphs, several such tools exist. Acknowledging in what they differ, is a key element to understanding in what manner sustainability can be assessed in the context of investment projects.

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[5] It is on basis of this ambiguity that the alternative definition of the Norwegian Ministry of Finance seems to have been forged, for which the sustainability of an investment is defined as: "[t]he degree to which the investment contributes to the realisation of goals and purposes after the project is realised and through the expected life cycle. A consideration of net benefit flows over time."(our translation; Norwegian Ministry of Finance 2008:5). As we can see, the main difference between the two definitions is the replacement of the term "benefit" with those of "goals" and "purposes". With "goal" is understood the effects from the users point of view (Samset, 2010:23). With "purpose", we understand the long-term consequences of the project (*ibid,* p.24). This replacement has the advantage of highlighting that the benefits – according to which the sustainability of an investment project is to be assessed – have to be referred to different *levels* of analysis.

3.1 The term sustainability – levels of analysis

An investment project is most often realised through a project, with given objectives (time, cost and quality). Railways, opera houses, roads, ICT system etc. are thus constructed according to given requirements of time, cost and quality. The project is, however, normally realised as part of a general process, intended to achieve certain goals for a certain target group. This is a first understanding of the benefit from the definition. In other words, it is important to realise that an investment project is carried out in a particular context. A railway is constructed in order to transport commuters from A to B. This process is itself to be understood as part of a more general societal process, whereby the transport efficiency and economic development are purposes. These we can consider higher-order benefits. In order to illustrate this point, we can consider the relationship between the project, the process and the societal process as indicated in figure 1.

INSERT FIGURE 1 HERE

Figure 1. Three sequential planning perspectives in a project based on cause-effect relationships: Step 1: Assets are provided to enable project operations to produce contracted deliverables. Step 2: The project's deliverables contributes to fulfilment of the project's first order (tactical) effects by satisfying the prioritized requirements based on selected prioritized needs of selected target groups. Step 3: Fulfillment of the project's first order (tactical) objective contributes to fulfill the project's second order (strategic) effects based on policy answering to the priorities of the larger society.

The deliverables and effects of investment projects can thus be linked to different perspectives. The perspective can be operational (project outputs), tactical (goals) or strategic (purposes). In our understanding, the same logic may be applied to the assessment of sustainability in the context of investment projects. When carrying out the

assessment, we maintain that all effects pertaining to sustainability should refer to the corresponding perspectives they belong to. Similarly, sustainability of an investment project should therefore refer to the same, but since the final success of a project depends on the perspective under consideration, a reference to the perspective is required. The reason for this is that a project can be deemed sustainable when considered in one perspective and not necessarily in another. A complete sustainability assessment of an investment project should consequently address all three levels before the final conclusion is drawn.

If we look at an example of a concept such as "sustainable asphalt", a sustainable solution to achieve a specific goal such as constructing and maintaining a road in an environmentally friendly way for instance by reducing pollution and even noise during the construction phase. This may render the project sustainable in the operational perspective, but not necessarily in the tactical and the strategic, where the latter refer to sustainable processes based on political deliberations, such as creating the framework conditions for level-headed economic development. Consequently, the first of these concerns – the choice of asphalt solution – can be deemed sustainable (or not) on an *operational* level. The second one – the choice of constructing a road in order that people in a region can communicate more easily – can be said to be sustainable (or not) on a *tactical* level. The third of the concerns – the ambition to create framework condition for improved economic growth – can be said to be sustainable (or not) on a *strategic* level[6].

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[6] The insight that assessment of sustainability ought to take into consideration the given context of the assessment is in fact not new. As Clift (2003:241) comments, "[i]n formulating and estimating the values of [sustainability assessment] indicators, it is necessary to distinguish between application to "in house" activities and to complete supply chains", or in other words, that having regard for sustainability means different things when used in different contexts. Clift does not, however, elaborate on the theme, nor does he pursue this insight into the analysis of the project in its context.

Our point is that it makes, in fact, perfect sense to characterise different effects at all levels as sustainable or not, but it is essential to avoid confusing these levels when assessing sustainability within an investment project's context or when choosing between different project alternatives. In fact, what can be described as sustainable on one level may not be sustainable on the next. In other words: We need to acknowledge the difference between *doing the projects more sustainable, and choosing the more sustainable projects*.

The number of elements that may be addressed in order to establish whether or not an investment project can be judged to be sustainable can reach significant numbers (Norman and MacDonald 2004, 252). Without comprehending to what level of analysis these elements pertain, the risk of confusion impends.

In our view, then, the main problem is not, as suggested (Marshall and Toffel 2005), that the concept of sustainability has become too broad, in that it includes too many views and opinions about desirable objectives and recognised inconveniences. Rather, we maintain that the problem in understanding the multitude of these elements is caused by a lack of sorting them according to whether they concern an operational level, a tactical level or a strategic level.

But what then to analyse when assessing the sustainability of large public investment projects? The answer to this must, in our view, be based on the understanding of sustainability as conceptualised within the perspective of three pillar thinking.

3.2 Balancing the three pillars of sustainability

Despite the apparent imprecision concerning the comprehension of the notion, a certain general agreement does nonetheless seem to exist. As Adams points out, the "core of mainstream sustainability thinking has become the idea of three dimensions,

environmental, social and economic sustainability." (2006, 2). Sustainability can be analysed with different aspects in mind, but the three dimensions can be used to categorize the identified sustainability factors or elements (Flores et al. 2008). When we in the following use the term "sustainability", we therefore acknowledge these three dimensions and that there exists a need for balance between the three[7]. A public infrastructure investment project will normally have both positive and negative impacts. For example, when political decision makers decide to start up a project with positive economic and negative environmental impacts, they have made a trade-off between these two kinds of impacts.

Most large investment projects will comporte impacts for the surrounding society, and some of these impacts will prove to be of a longer lasting nature than others. This applies for impacts within all three sectors. The main argument underlying sustainability assessments is that the project's predictable impact on none of the systems ought to be disregarded, neither the economic, social or environmental system surrounding the investment project.

In the development sector, wherefrom the origins of investment project sustainability assessment is commonly referred to, economic and social development is often main ambitions of the project. If the project is to be given a go ahead, environmental sustainability needs also be assured (OECD 1991). If the decision to invest is taken with a too narrow focus, for instance on the economic impacts of the investment only, significant social and environmental problems can accompany the investment project and may render the project negative to society as a whole. Such a project must accordingly be assessed as not sustainable.

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[7] For a discussion on the visual representations of sustainability, see Adams, 2006

Within the context of public investment projects, this insight proves particularly crucial, since the general goal of public sector is not to generate profit but to assure the present and future well-being of the citizens.

3.3 Assessing economic sustainability

An assessment of economic sustainability concerns mainly the profitability of the invested capital, cost efficiency, financing over time and flexibility.

From a corporate perspective, the profitability of invested capital can be measured by comparing costs and benefits of the investment over its (intended) life-span, in order to judge whether or not the profitability is 1) positive and 2) higher than for alternative investments.

From the perspective of a public investment project, the measure of economic sustainability alters. Public investment project – such as infrastructure projects or defence equipment procurements – are often characterised by being common goods, and organizing payment by use is often neither possible nor desirable. Financing such investment project therefore often needs organising forced financing, via taxes.

Cost efficiency concerns to a large degree the choice of factor inputs and technology, in addition to project governance and management. A central concept permitting for comparison is that of life cycle analysis, since projects are characterised by differentiated cost/benefit-structure over time. Such analysis permits displacing of focus from solely investment cost to future maintenance and operational costs.

Asian Development Bank (2009) outlines three concerns that ought to characterise assessments of public sector investment projects:

(1) Financing from public budgets.

(2) Possibility for financial contributions from user groups.

(3) Long-term incentives for interested parties to keep up/continue the investment project.

In our view, adjacent factors such as availability of manpower and other resources over an extended timeline equally need consideration. Otherwise, the operational phase of the investment project may be exposed to altered framework conditions, often resulting in increased demand for resources.

Lastly, flexibility needs consideration on the subject of economic sustainability. If the need justifying the investment project falls away, the framework conditions alters significantly, the cost development increases to an intolerable level, the economic sustainability of the investment project will depend on the cost and capacity to alter/terminate the project.

3.4 Assessing environmental sustainability

Environmental impacts can be categorised in several manners, for instance as irreversible or reversible. The former being such impacts that cannot be reversed even if one tries to do so, for example use of critical resources, extermination of species, irrevocable climate changes etc., whilst it is possible to reverse the latter. The differentiation between such impacts is rarely absolute, but will often depend on the temporal frame chosen in the assessment. Nature's healing capacity for emissions and other pollution is remarkable, but limits to this ability do exist. It is generally accepted that in case of doubt, a principle of caution needs being applied (as underlined in the so-called Rio Convention of 1992).

Another categorisation of environmental impacts is based on geography. Environmental problems can be local, regional, national and global respectively. One common reason that such impacts are not addressed in a sufficient manner is lack of private ownership. Coping with such problems therefore need public intervention, via

prohibitions or prescriptions, taxes, quotas etc. The global nature of some environmental impacts (for instance greenhouse gas emissions) necessitate global corporation, rendering the determination of effective measures complex.

A third type of categorisation concerns the usability for humans. Economic literature distinguishes between phenomena with and without use value. Such use value can denote consumption of biological produce (foodstuff, construction materials, pharmaceuticals etc.), recreational use, or more basically healthy surroundings. Phenomena without use value such as outlined here will then include nature's intrinsic value and the transmittance of this to future generations.

3.5 Assessing social sustainability

Social sustainability is generally considered the most problematic of the sustainability assessment fields. As McKenzie comments, "[s]ocial sustainability is far more difficult to quantify than economic growth or environmental impact and consequently it is the most neglected element of triple bottom line reporting" (2004, 7)[8]. This general remark implies that there are similar challenges within the context of sustainability assessment of investment projects.Paragraph: use this for the first paragraph in a section, or to continue after an extract.

Generally speaking, a socially sustainable investment project will contribute to what is considered positive societal development, both concerning society as a whole and the well-being of its citizens. In most societies, covering basal needs such as clothing, food, safety, justice, health etc. will be considered positive contributions. Equally, more abstract goods, such as gender equality, democratic rights and individuals' self-realisation will often be considered to be of this nature.

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[8] The term "triple bottom line" refers to the quantified conceptualizing of balance between the three pillars, as introduced by John Elkington in 1994.

Questions of equality and equal distribution of goods and disadvantages are of particular interest within this context. Dimensions of equality will typically be:

- Income
- Health
- Working conditions
- Geographical distribution
- Generational concerns
- Minority group concern
- Gender concerns
- Etc.

We note that the sheer size of public investment projects often should bring such concerns to the forefront of project assessment. It is equally notable that the distinction between universal values and interest group concerns is not fixed in any final manner. More generally speaking, there rarely exists any perfect consensus for the use of society's resources, a fact which renders the assessment of social sustainability problematic.

Such general considerations concerning the pillars of sustainability are not, however, sufficient to fully understand the assessment of sustainability within an investment project's context. In order to arrive at a reasonable understanding, the general understanding of three-pillar thinking needs to be coupled with a clear comprehension of what exactly large investment projects are expected to fulfil.

3.6 Assessment of sustainability - some analytic tools

Not surprisingly, since sustainability denotes a complex phenomenon, the methodological approaches utilised in order to assess vary. Below we list some of the

common tools for the assessment of sustainability. The fact that there are many such tools illustrates a general point: The different comprehensions of the term sustainability correspond to a plethora of tools. The tools tend to vary with respect to what level of analysis (operational, tactical or strategic level)) they base their analysis on, and if they include assessments of elements within one, two or all three pillars. If they include all three, there is also variation with respect to if and how different impacts are balanced. What these tools assess, tend in fact to reflect the concept of sustainability that permeates the evaluator. The point we are trying to make here, is that all these methodologies assess criterion that it is useful to assess; but without a proper understanding of what they are assessing, one in relation to another, some confusion seems bound to result.

INSERT TABLE 1 HERE

3.7 Uncertainty, risk and flexibility

No matter how sustainable the investment project is expected to become, altered framework conditions or technological development can render the investment project unfit for delivering the expected effect. This is independent of whether the original user group needs remain unchanged. A risk analysis for example in the form of a real option analysis ought therefore to form an integral part of the ex ante sustainability assessment. Real options provide the flexibility to alter the project design and/or use of the project. Different kinds can be envisaged: Delaying implementation, successive implementation phases (permitting for scaling the project to the real demand), and termination or liquidation possibilities.

Figure 2: No investment project is free from uncertainties and risk. Similar to sustainability, uncertainty takes on different meaning depending on the cause-effect level in view. The assumed effects at the different levels are associated with different risks generated by the environment outside the control by the project as the LFA matrix illustrates. To secure the project from failing to fulfil its objectives, the risks have to be assessed systematically and flexibility should be built into the project design. The figure above is freely based on sources written by Knut Samset (2003, 2010).

4. Discussion

Investment projects that prove sustainable on an operational level can still be unsustainable on a tactical and strategic level. It is by grasping this main idea that we can provide the vocabulary permitting to prevent constructing landmine factories with sustainable doorsills, or Hummer trucks using recycled plastic for the soft drinks holder. It is of little interest to you, as Clift comments (2003, 243), that your killer uses "environmentally friendly" lead-free bullets.

As we have argued, then, the concept of sustainability is not identical when comparing cases where experts assess what investment project alternative to select in order to fulfil the general policy of sustainability, and cases where experts examine how to render the chosen investment project as sustainable as possible. The difference is considerable between analysing whether sustainability is best assured by improving transport infrastructure or other investments (strategic level) by a high-speed railway or a major highway (tactical level), and the assessment of which asphalt qualities within one of the alternatives can be said to be sustainable (operational level). This is not, needless to say, undermining the importance of any of these approaches. Our point is solely that they refer to different levels of the hierarchy proposed, and that

consequently, our answers to questions pertaining to sustainability must also be expected to differ accordingly.

Figure 3: Assessment of sustainability must be assessed on all three pillars (the colours above representing Economy, Environment and Society) on all the following levels: Project output level (contracted delivery – operational level), goal (target group level – tactical level) and purpose (greater societal level – strategic level)[9].

There exists a general agreement in the literature today that sustainability may be characterised as a balancing act weighing economic, social and environmental concerns up against one another. Our discussion on the definition of sustainability enables a more tangible understanding of this balancing act, as we propose balancing on both the operational, tactical and strategic level.

At a *strategic* level, the choice of whether or not to construct a road includes questions such as: Does the society in general benefit from increased transport capacity in the proposed local area? Are roads the best transport solution from an environmental perspective? Will the construction of the road lead to the intended economic growth? May the local businesses be threatened by improved access to centralized institutions, and is this effect on the local society acceptable to the greater society? Will the project require balancing of international vs. national concerns, or balancing of national against regional needs?

Correspondingly, *tactical* considerations needs considering. They can include questions such as: Where to lay the road in order that the impact on environment rests

[9] Similar categorizations of activities and their objectives in hierarchy levels can also be found in other literature sources. OECD (2002) discusses the Logical Framework Approach with input, output, outcomes and impact. Within the context of corporate business, Mintzberg (1994:61) elaborates strategies into a hierarchy, with the corporate strategy on top that is supported by business strategies, which again are supported by functional strategies.

limited? Depending on the type of investment project, tactical balancing of acts will include weighing of local vs. regional and national interests, the needs of identified target groups against that of the larger society.

Finally, on an *operational* level, a weighing equally needs being carried out, balancing concerns of economic, social and environmental nature. It is on an operational level that questions concerning the likes of sustainable asphalt arise. Generally speaking, depending on the on type of investment project, such operational balancing acts will weigh durability and suitability against costs and emissions.

To the different levels of sustainability assessment, different questions are appropriate. What is essential to bear in mind is that to the different levels correspond different roles that express different interests: The questions concerning the strategic level refer to strategies expressed in valid policy documents issued by financing government offices and agencies. The tactical level, on the other hand, the needs will typically be defined by local politicians and government offices (project owners), local interest groups and other local stakeholders. The operational level will typically be dominated by architects, consulting engineers and contractors.

This is not to say that individuals, for instance individual architects or offices playing a role on one level, do not have a say in what are the basic concerns of the other levels. Policy makers may have good reasons to insist on specific operational specifications (supporting specific product development programs etc., onto which the strategic sustainability of the project is dependent). Correspondingly, practitioners will often be faced with the need to inform policy makers and strategists of, say, unwanted by-products of the production process that might undermine the sustainability of the whole investment project. The need for cooperation and coordination between policy makers, planners and practitioners will persist.

5. Conclusion

To conclude, it is well acknowledged that it is important to balance the economic, social and environmental impacts of an investment project to render it sustainable. Our point is that the discussions on and assessments of sustainability in addition should be structured on three levels: Operational, Tactical and Strategic.

Policy makers will often have differing ideas of what is most important to realise in an investment project, and to avoid for that sake. Correspondingly, the operators and the intended users of the investment project will also have differing ideas. As far as sustainability is concerned, a categorisation into economic, social and environmental impacts makes sense. In addition, the involved parties will probably feel a need for discussing sustainability from both strategic (especially the policy makers), tactical (especially the users) and operational perspective (especially the operators). The economic, social and environmental impacts can appear on both the strategic, tactical and operational level. Sustainability assessments have to sort out on what levels the different impacts appear, in order to avoid comparison of apples and oranges. Apples are apples, and economic impacts on the strategic level are economic impacts on the strategic level.

We have listed some of the common tools for sustainability assessment. The tools vary with respect to what level they look at (operational, tactical and strategic). At the same time they vary with respect to whether they consider impacts within one, two or all three pillars. If an assessment of sustainability is clear on at what level and within which pillar each impact appears, that will improve the value of the assessment. It will be easier to weigh the impacts up against each other, and compare them before making the necessary trade-offs between negative and positive impacts.

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Table 1. Short descriptions of some selected methods that are commonly used to assess sustainability of projects. The comments are made on the basis of the opinions of the authors only.

Analytic tool	Short description of some analytic tools commonly used for separate assessment of one of the three pillars of sustainability	Authors' comments
Environmental Impact Assessment (EIA)	EIA is a relatively standardized framework for environmental analysis of reforms and initiatives, used for more than 40 years and obligatory for project evaluation within the European Union. A thorough guidance exist, and the EIA has even own research journals contributing to further methodological advance. The ambition of the approach is to assure that environmental impacts of projects are taken care of.	Limited to impacts of one pillar only: Environment. It may address effects on operational, tactical and strategic levels
Ecological footprint	Ecological footprint is the name of an approach that elaborate an estimate over the level of productive farmland and water is needed in order to produce the resources we consume and to absorb the emissions that result from the consumption. This approach is well suited for comparing projects across sectors; it does, however, solely measure limited aspects of the environmental impact.	Limited to impacts of one pillar only: Environment. It may be applied on operational (design), tactical and strategic levels
Life Cycle Assessment (LCA)	LCA is a methodological tool used in order to measure the overall environmental impact of projects, based on a common unit of measurement that is not monetary. Emphasis is laid on capturing all impacts throughout the lifespan of the project, "from cradle to grave", including impacts stemming from the procurement of raw materials necessary, from the production and distribution of the manufactured goods, from the use phase and handling of the waste resulting. With this respect, it resembles the EIA, but is more standardized. Norris (2001) describes the differences between LCA and LCC.	Limited to impacts of one pillar only: Environment. It is usually applied to guide decisions in operational context only: In the project's design process.
Life Cycle Cost (LCC)	LCC is a methodological approach to assess all costs over the whole life span of an investment project. The analysis is used for consequence analysis of different design alternatives, either for limited components or for the whole project. Such analyses are becoming increasingly widespread, for instance in the construction industry, and proves especially important in cases where the cost efficiency relationship between the investment and the operations (Bjørberg, Larsen and Øiseth 2007). LCC can also be considered as a part of a wider economic analysis.	Limited to impacts of two pillars only: Economy and Environment. It is usually applied to guide decisions in operational context only: In the project's design process.
Financial analysis	Financial analysis is a methodological approach assessing the possibility for financing the project (investment cost and operations), with a corresponding financing strategy and plan for how the annual costs are to be met. Such an analysis can be divided into several components, in that a project can be partly financed directly by the users (e.g. toll roads), whilst the rest is financed by public funds. The level of user contribution needs being realistic, especially with attention to possible altered behaviour as response to levying of toll. Equally, public funding is not entirely predictable, being based on budgets that are normally adopted on a yearly basis. Public-private partnership and other forms of organization can alleviate the field.	Limited to impacts of (almost entirely) one pillar only: Economy. It is usually applied to guide decisions made on strategic and tactical levels only.

Cost-Benefit Analysis	Cost–benefit analysis (CBA) is a systematic process for calculating and comparing benefits and costs of a project, to see whether the benefits outweigh the costs, and thereby to determine whether it should be implemented. All benefits and costs are expressed in monetary terms (economic, environmental and social impacts) and we can therefore talk about the "net benefit" flows. Benefits are estimated according to a willingness to pay principle. All benefits and cost are adjusted for the time value of money and expressed in present values. See any textbook on CBA, e.g. Boardman et al. (2010).	Impacts of all pillars are in principle included and weighted against each other. Is normally applied on tactical level
Scenario tools	Scenario tools are conceptual tools enabling the understanding of possible development structures in complex systems assessment of economic impacts and future needs relating to an investment project. Different approaches exist, most being based on workshops and cross-sectorial participation. Computer simulation tools and models equally exist that serve to simulate trends. The results form an important input to reduce risk and uncertainty. Scenario analysis is often used as a tool for strategic planning, not only in projects. See for example Fahey and Randall (1998).	Often limited to impacts of one pillar only, depending on application. It can be applied to guide decisions made on strategic and tactical levels only.
Technology assessment	Technology assessment is not a term that denotes an analytic tool, but rather a tradition of analysis being introduced by the establishment of Office of Technology Assessment in the USA in the 1970's. The aim of the procedures is to introduce cross-sectorial and long-term analysis concerning the societal implications of introducing new technology. Technologies under development form the main centre of interest (Banta 2001).	Technology assessments are usually not applied to guide project decisions, but can be used to guide policy formulation.
Needs analyses	Needs analyses are pertinent to the assessment of public investment projects. They can be categorized according to their purpose, be they normative, demands oriented (economic analysis) or based on interest group analysis. Normative needs analyses are based on political consent and expert assessment of reasonable levels of assistance. Demands orientated analyses investigate the willingness to pay by user groups for the project, whilst interest group analyses examine the parties' understanding of their own needs. Næss (2005) recommend combining different approaches in order to achieve a certain method triangulation assuring proper analysis.	Need analysis may be used to map stakeholders' interests and priorities pertaining to project effects on operational (design) and tactical levels. It can also be used to guide policy.
Multi criteria decision analysis	Multi criteria decision analysis can prove pertinent to comparing different investment projects that not necessarily are presented according to the same scale. The Sustainability Impact Assessment (SIA) is one of these, but several alternatives exist that quantify and weigh results up against one another based on scores determined subjectively based on objective quantifiable data such as noise and travel length as well as assumed subjective values such as health and safety. See for example Concept Report no 18.	This analysis is highly subjective and rarely conclusive as different effects on operational, tactical and strategic levels are usually hard to compare and prioritize.
Stakeholder analysis	Stakeholder analysis: Most methodological approaches to sustainability assessment can involve stakeholder participation, ranging from consultative rounds to active involvement in the analytic process and evaluation. As the comprehension of the importance of stakeholder involvement increases, a range of tools and methodological approaches are developed in order to capture the opinions of and involve interested parties. These tools range from ICT-based communication, via personal	Stakeholder analysis is commonly performed as one of several steps to secure projects' relevance on operational and tactical level. In some

	interviews to large scale conferences and meetings. The aim of the analyses can equally range from mapping of points of views and needs, to active involvement in the decision-making.	cases, such analysis can have impact on policy formulation.
Corporate Social Responsibility (CSR) and Corporate governance	Corporate Social Responsibility (CSR) and Corporate governance are approaches from the private sector developed in order to render visible the societal role of enterprises. The relevance of such approaches to public investment projects must in our opinion be considered as limited, but their ambition to illustrate alternative conceptualization of an organization's operations than purely profit make us note them. Some private organizations elaborate so-called sustainability reports or environmental reports that are attached to the annual accounts.	CSR and Corporate governance are not applicable to projects as such, but usually for formulation of business strategies and profiling of companies that are responsible for the operational phase of projects only.