

PROJECT SUSTAINABILITY MANAGEMENT

Applications Manual
Second Edition 2013



FIDIC SUSTAINABILITY PACK



Fédération Internationale des Ingénieurs-Conseils
International Federation of Consulting Engineers
Internationale Vereinigung Beratender Ingenieure
Federación Internacional de Ingenieros Consultores



FIDIC is the international federation of national Member Associations of consulting engineers.

FIDIC was founded in 1913 by three national associations of consulting engineers within Europe. The objectives of forming the federation were to promote in common the professional interests of the Member Associations and to disseminate information of interest to their members. Today, FIDIC membership covers some 95 countries from all parts of the globe and encompassing most of the private practice consulting engineers.

FIDIC is charged with promoting and implementing the consulting engineer industry's strategic goals on behalf of Member Associations. Its strategic objectives are to: represent world-wide the majority of firms providing technology-based intellectual services for the built and natural environment; assist members with issues relating to business practice; define and actively promote conformance to a code of ethics; enhance the image of consulting engineers as leaders and wealth creators in society; promote the commitment to environmental sustainability; support and promote young professionals as future leaders.

FIDIC arranges seminars, conferences and other events in the furtherance of its goals: maintenance of high ethical and professional standards; exchange of views and information; discussion of problems of mutual concern among Member Associations and representatives of the international financial institutions; and development of the consulting engineering industry in developing countries.

FIDIC members endorse FIDIC's statutes and policy statements and comply with FIDIC's Code of Ethics which calls for professional competence, impartial advice and open and fair competition.

FIDIC, in the furtherance of its goals, publishes international standard forms of contracts for works (Short Form, Construction, Plant and Design Build, EPC/Turnkey) and agreements (for clients, consultants, sub-consultants, joint ventures, and representatives), together with related materials such as standard pre-qualification forms.

FIDIC also publishes business practice documents such as policy statements, position papers, guides, guidelines, training manuals, and training resource kits in the areas of management systems (quality management, risk management, integrity management, environment management, sustainability) and business processes (consultant selection, quality based selection, tendering, procurement, insurance, liability, technology transfer, capacity building).

FIDIC organises an extensive programme of seminars, conferences, capacity building workshops, and training courses.

FIDIC aims to maintain high ethical and professional standards throughout the consulting engineering industry through the exchange of views and information, with discussion of problems of mutual concern among Member Associations and representatives of the multilateral development banks and other international financial institutions.

FIDIC publications and details about training courses and conferences are available from the Secretariat in Geneva, Switzerland. Specific activities are detailed in an annual business plan and the FIDIC website, www.FIDIC.org, gives extensive background information.

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FOREWORD

Since the original version of Project Sustainability Management was introduced in 2004, there has been further demand for improved sustainability in the projects executed by the world-wide consulting engineering industry. This demand has been met by the introduction of a large number of new tools designed to help the industry meet these needs and FIDIC summarises and lists these efforts on its website. Most of these tools either deal with a specialised segment of infrastructure such as buildings, or reflect the interests and priorities of the region for which they were introduced.

All such efforts improve project sustainability, but they are difficult to transfer unchanged to other parts of the world in which the priorities might be different. The problem arises because of the inclusion of specific client need or emphasis that differs from place to place and client to client.

FIDIC is an international federation that provides resources suitable for any consulting firm located anywhere on the earth and, as a result, the material which follows is focused on issues that are specific to the practice of consulting engineering. The inclusion of client preferences and issues is left to the normal process of discussion that takes place on any project to define detailed terms of reference and scope of activities.

The world has suffered from a very significant financial downturn since 2008 and this has in turn threatened the sustainability component of projects in some areas. There is a perception that the inclusion of sustainability considerations costs more and increases risk, and in the short term this can often be true. More detailed design is required, and the process of carrying out a project in a new way can increase the risk that there will be surprises. In the long term however, operating expenses for sustainable facilities are normally lower, improved social acceptance of such projects helps expedite the licensing and approvals process, and improved resilience pays off to the owner.

Infrastructure facilities have lengthy lifetimes, and consultants have an important role and responsibility to their clients and to society to encourage thought and action aimed at the longer term.

This monograph has been written by John Boyd (Canada), and reviewed and edited by Jean Felix (France), Ike van der Putte (Netherlands), Robin Crouch (Germany), Jane Scanlon (Australia), and François Baillon (Switzerland), under the auspices of Alain Bentejac (France, EC representative).

1.0 INTRODUCTION

1.1 WHAT IS SUSTAINABLE DEVELOPMENT?

The concept of sustainable development – the idea that humanity has to greatly improve the resource efficiency and environmental protection of its development processes to provide for the world’s growing population – has been around for more than twenty years. Over that time significant improvements have been made in the way engineering projects are executed, but the formal issues of sustainability have not been explicitly embedded in the consulting engineering industry’s activities. Yet many of the issues of sustainability are at the core of engineering design and construction, operations and closeout, and in turn form the basis of most consulting engineering practice.

As the population of the planet continues to grow, the rate of progress in implementing sustainable development has not matched the need. The environment continues to be degraded by a growing population and by disastrous accidents, the level of climate altering greenhouse gasses continues to rise, species face new threats of extinction, megacities continue to grow uncontrollably providing inadequate services and creating huge social problems, large parts of the world’s population still have inadequate access to energy, clean water, and waste treatment – the list of deficiencies goes on (ref 1). Sustainable development in its various aspects may in fact be the critical challenge of the 21st century.

1.2 WHY IS IT IMPORTANT FOR ENGINEERS?

The performance of engineering tasks has traditionally been judged by its clients on the basis of suitability for intended purpose, minimisation of cost, and delivery to a fixed schedule. That model has been extended over the past thirty-five years to include protection of the environment. More recently, the issues of sustainable development have moved into the mainstream of political and business thought because the future availability of energy, water, and non-renewable materials will eventually be at risk and in spite of efforts to make environmental protection a core consideration of infrastructure development, the earth’s environmental carrying capacity is being overloaded in a number of key ways.

These changes are beginning to fundamentally shift the way engineering project performance is judged, and they add invisible design criteria that will ultimately affect every engineering project, whether for products, processes, facilities or infrastructure. The effect of sustainable development will be to bring broad resource, ecological and social issues into the mainstream of engineering design and it has become critically important that engineers understand these issues and look for ways to incorporate these considerations in all that they do.

The consulting engineer occupies an awkward position as the project landscape shifts to this new model – see figure 1. Clients rely on expert advice provided by their consultants yet considerations of implementing more sustainable solutions are not a standard part of what the industry provides, and indeed are not wanted by some traditional clients. Yet the consultant is increasingly called upon to defend project intentions not only to regulators but also to members of the general public, and the handling of this stakeholder interface can mean the difference between projects that receive approval quickly and efficiently and those that are subjected to costly delays.

If projects are to be more sustainable, then by implication they should be designed and built differently than they have been before. The defining characteristics of this change are twofold. The first is a holistic design process whereby the physical and social interaction of the project with all of its surroundings (including other projects) is examined. The second is a long-term design viewpoint (from cradle to grave) that incorporates a life cycle analysis of all of the project’s implications.

A good working knowledge of the products of research, from both universities and at government research agencies is also becoming more important, and a two-way interaction between the consultant and the researcher is fundamental to this change.

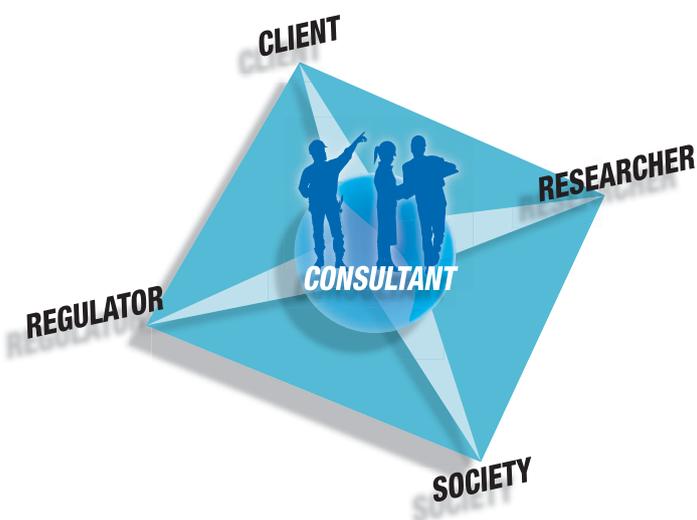


Figure 1 - Modern Project Relationships with Consultant



2.0 THE DEVELOPMENT OF FIDIC'S APPROACH TO SUSTAINABILITY

2.1 EVOLUTION OF THE FIDIC APPROACH

The concept of Sustainable Development, defined in the Brundland Commission report **Our Common Future** in 1987 is '**development that meets the needs of the present without compromising the ability of future generations to meet their own needs**'. It is a simple and easily understood idea. The process of translating that idea into action however, and even agreeing on what sustainability might look like if achieved, has proven to be much more elusive because the goals and mechanisms of sustainability depended on the values and background economic and political circumstances brought to the discussion by its proponents.

The United Nations and other international agencies have made a valiant effort to clarify the issue. Global description of the issues, described in Agenda 21 at the Rio Conference in 1992, were converted to the 'whole society' framework of the United Nations Commission on Sustainable Development (UNCSD) lists of goals and indicators that have been updated periodically since their original issue in 1996. This global perspective called for a balance between economic, environmental and social needs (the three pillars of sustainability) and saw international efforts as a major tool to achieve this balance. After 10 years of effort, the results were disappointing and an attempt was made to prioritise and set defined targets in the form of the Millennium Development Goals at the Johannesburg conference of 2002. Meanwhile, international funding agencies focused their efforts on achieving a consistent set of criteria for the environmental and social evaluation of the projects that they would fund irrespective of the national circumstances of the project location (the Equator principles) using the associated World Bank (IFC) Safeguard Principles. These tools were globally focused and recognised the constraints that the developing world would experience in making improvements to their performance. The current version (EP III – January 2014) of the Equator Principles –to which most of the world's banks have committed– obligates the recipient of any development loans in excess of \$10m USD essentially all projects to carry out the project in ways that are consistent with developed world methodology.

FIDIC has had a strong interest in sustainability from the beginning because development is the core purpose of the consulting engineering industry. There was early recognition that the best way for the industry to contribute to this issue was by executing their clients' projects in a more sustainable manner (Ref. 2). In an assessment carried out for the 2002 Johannesburg conference, FIDIC concluded (Ref 3) that the main impediment to progress in engineering sustainability was the lack of project indicators for sustainability. By 2004, the FIDIC Project Sustainability Management Guidelines (PSM I) were published (Ref. 4) to provide the industry with an approach to developing project specific indicators paying attention to the various UN and IFI reference materials available at the time. PSM called for the development of specific project goals and indicators through consultation with project stakeholders, and the use of such indicators for monitoring and reporting project performance.

FIDIC's focus on international agreement as the basis for its procedure was an attempt to cut through the conflicting issues and objectives proposed by various groups at the time, and to recognise that FIDIC's industry is international, requiring it to provide solutions for any nationality, any project location, and any state of development.

By 2004 there were a number of systems in place in individual countries intended to improve the sustainability of specific types of engineering works such as buildings (LEED and BREEAM), and civil engineering works (CEEQUAL) etc. In addition, there was an initial form of the Global Reporting Initiative (GRI) intended for transparent reporting by business and other organisations attempting to carry out their activities in a more sustainable manner. Since GRI affected the operations of many engineering clients, it too would have an impact on the execution of project work. All such tools contributed to the sustainable performance of projects.

Although there has been improved coherence in the ideas of sustainability over the more than twenty years since the ideas were first proposed, the relative importance or emphasis placed on the issues continues to be a local consideration. Unfortunately, the recent economic problems that have plagued much of the world since 2008 have resulted in sustainability being temporarily put aside in some countries in favour of expedient short-term solutions.

FIDIC PSM APPROACH

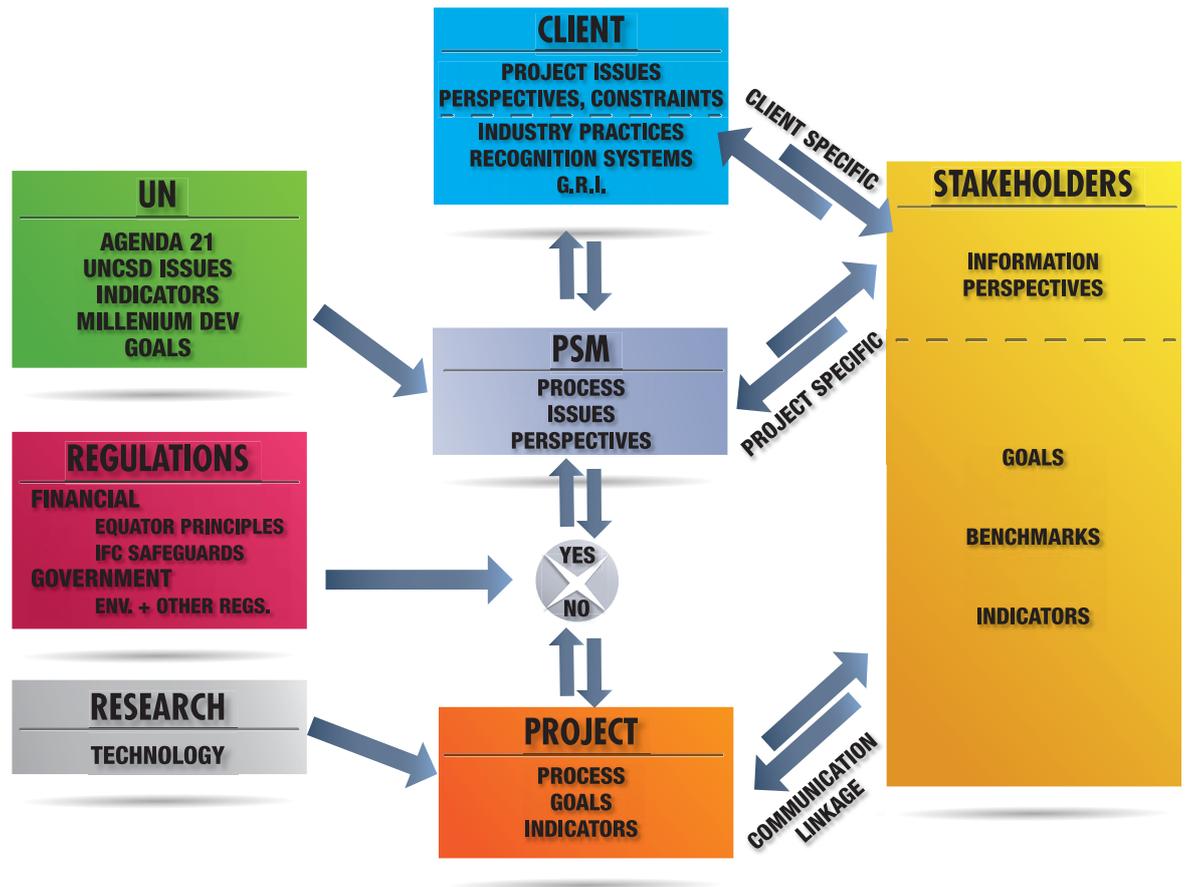


Figure 2 shows the connections between these approaches and PSM.

2.2 THE PSM II APPROACH TO SUSTAINABILITY

2.2.1 ISSUES AND PERSPECTIVES

FIDIC’s interest is global, and while sustainability is a global problem, the relative importance of specific issues to the project, and the nature of solutions to these issues tend to have a more local or regional focus. The regulatory environment is regional or country based. Clients of different types in different circumstances bring specific interests in sustainability to a project. As a result, early attempts by FIDIC to produce an all-encompassing set of indicators for sustainable projects were not successful. Instead, PSM I was based on the idea that the subject was more amenable to a global process aimed at defining project specific sustainability targets that would probably differ from project to project and location to location. Thus, from the perspective of an engineering practitioner, the process and a list of sustainability issues that should be considered when coming up with a project sustainability plan, defined the FIDIC guidelines.

The new version of the Project Sustainability Management Guidelines, PSM II, is similar to the earlier version in its approach but is much simpler and addresses the problems experienced with the first version of PSM (apparent complexity, focus on developing world projects). It is first and foremost, a list of core issues that engineers should consider when carrying out projects in a sustainable way, backed up by a number of processes for the broad inclusion of stakeholder input. Each item on the list brings with it a set of perspectives, which are the sustainability considerations that affect the way these issues should be considered on the project. A good part of this manual consists of descriptions of these perspectives and an indication of possible project responses as well as logical links between the perspectives of different issues.

It turns out that although the core issues are very familiar to practicing engineers, the perspectives that have to be applied to these issues to develop more sustainable outcomes are not. As an example, engineers are normally interested in energy demand, its distribution (reticulation), and its safety on a project. Sustainability

considerations require minimisation of energy usage, its replacement where possible with renewable sources, and the impact of the project on availability and cost of energy to others outside the conventional boundaries of the project. These broader considerations suggest a more integrated approach including the use of smart grids for optimisation.

Even the traditional measures of performance for consulting engineers – suitability for purpose, cost minimisation, and delivery to a fixed schedule – are affected by sustainability considerations, bringing a somewhat different emphasis and performance expectation. Suitability for purpose now includes not only the primary objective of the project (safe transit across a bridge for example) but also considerations of how the project fits into the community, the origins of the materials from which it is built, and their possible re-use and recycling once the facility is no longer required.

The economic performance of a sustainable project can only be judged by considering its complete life cycle because it is often in the later stages of operation of a project that investments in sustainability pay off in an economic sense. Indeed, the sustainability of economic circumstances that will pay for the project's continued operation throughout its existence must include its deconstruction and the rehabilitation of the site on which it sits. The economic justification of a project, and of the extra design time and risk inherent in carrying it out with new sustainable methodology relies on full project lifecycle analysis including the evolution of energy water and material costs over the project lifetime, along with consideration of such intangibles as community acceptance and support.

There have been few reports that identify the incremental costs of carrying out a project sustainably because the costs depend on the circumstances of the specific project. In some cases the costs of sustainable construction are lower than conventional solutions, and the operating costs are frequently lower. It is difficult to put a value on the improved resilience that a sustainably constructed project will provide, or the avoidance of licensing problems brought about by improved stakeholder acceptance, but over time they are undoubtedly significant. On time project delivery also becomes much more complex in an environment in which many of the stakeholders do not have a direct financial linkage to the project team and often do not understand the financial constraints on alternative project development strategies.

FIDIC's PSM II approach departs somewhat from that embraced by other groups. There are only six core issues to be considered in this approach – energy, water, materials, environment, health and safety, and human rights. The fundamental objective of the first three is to limit usage (and to replace conventional solutions with renewable and recyclable components). The fundamental objective of the last three is to preserve or improve the existing circumstances of the communities affected by the project.

Other issues of sustainability can always be broken down into these component parts using the FIDIC approach. As an example, consider transportation projects. Transportation is frequently identified as a sustainability issue by others but is not listed in PSM II. Instead, the reason that transportation might be a sustainability issue is considered under the core headings - minimising the use of energy by the transportation method (energy issue), minimising the release of greenhouse gasses (environmental issue), the safety of the transportation system to those using it and to the community in which it is located (health and safety issue), and other project-specific aspects that might impinge upon the six core issues.

Aggressive goals will be required to achieve the changes in project engineering associated with sustainability as will significant innovation. FIDIC encourages the adoption of such goals and the associated radical levels of innovation required to achieve them. The introductory paper on PSM II (Ref. 5) describes some of these issues and the logic of their inclusion in FIDIC's approach to the subject (dealt with further in section 4.1.4 Goal Selection, below).

2.2.2 PROCESSES

In addition to the issues and perspectives inherent in FIDIC's approach, there are a number of processes that form an integral part of the PSM II methodology. The most important of these is stakeholder consultation – indeed that practice is one of the distinguishing characteristics of sustainable project development. No single individual or organisation has the required knowledge and experience to be able to optimise the sustainability of a project on its own, and the process of bringing others into the planning and design development, the construction and operation, and ultimately the deconstruction and close-out is an essential part of what could be called sustainability optimisation.

Stakeholder consultation takes place throughout the entire project, with the initial objective of finding out what others know that might be of use, and of setting goals understood by the various communities affected by the project. Later interaction is used to develop reasonable targets for performance in regard to these goals and indicators and subsequently used to monitor performance. The indicators are reported to the stakeholder groups throughout project execution.

Others have also recognised this aspect of sustainable planning and have often included it under the heading of 'management'. FIDIC PSM II separates this aspect from the issues and perspectives of sustainability because although the processes represent current best practice, they do not, by and of themselves, deliver more sustainable outcomes.

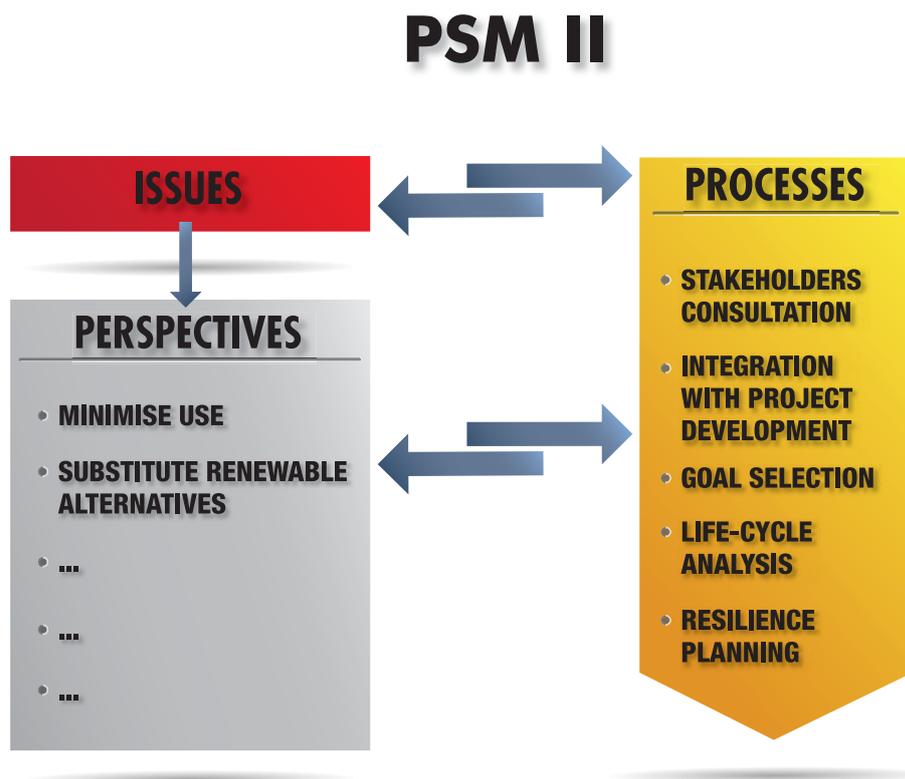


Figure 3 Impact of Processes on Issues and Perspectives

2.3 OTHER TOOLS

In addition to the further development of PSM, FIDIC supports the development of the Project Log Book, a mechanism for recording sustainability intentions and outcomes along with costs and development stages from the perspective of the project owners. We believe that such an approach will eventually enable the recording of an entire life cycle of a project from inception to close-out and will provide highly relevant information to others planning such endeavors. PSL, the Project Sustainability Logbook, published by FIDIC in 2012, in line with the PSM I methodology, proposed tables for the selection of objectives and issues for specific projects and their monitoring throughout their life cycle.

FIDIC is also developing a document describing the issues of sustainable cities and indicating some of the steps that have been undertaken around the world to improve city performance.

FIDIC is not the only engineering organisation to recognise the project sustainability problem. Engineering researchers, national associations of engineering consultants, groups with a particular interest in specific aspects of engineering (i.e. sustainable buildings), and individual companies have produced a plethora of tools, systems, logbooks, calculators and guidelines intended ultimately to help clients address the issues of sustainable projects. In a recent publication (Ref. 6) over 85 of these tools were referenced and more are on the way. It is FIDIC's view that all of these efforts are helpful and attempts to find common ground between them are particularly helpful.



In an effort to make these tools more available for the business and the profession, FIDIC will place information about them and contact details for them on its website. Additional information about FIDIC PSL (2013) (Ref. 7) for example includes references to international law, regulation, rating systems, and standards related to each of its sixty-three items.

Anyone with a new approach is asked to get in touch with FIDIC to take the necessary steps to have its own tools listed in this compendium.

3.0 HOW TO USE THIS MANUAL

3.1 WHAT IT PROVIDES

This manual provides a description of the PSM II guidelines for incorporating sustainability in consulting engineering practice. It is not a fixed system for measurement of the sustainability of a project because that process always involves local or regional considerations that do not translate clearly to an international audience. Others have provided such systems that work very well in their regional context (e.g. CEEQUAL, Envision, LEED, etc.).

PSM II describes the engineering aspects of sustainable development, in particular the different perspectives that sustainability brings to normal engineering activities. It focuses on the project aspects that engineers normally deal with and avoids the issues over and above the engineering ones that might be brought to the project by the client, by government, and by society in its broader sense. These issues are all very important and must be incorporated in the individual project terms of reference through consultation, but they are also too diverse to assume in the absence of specific project discussions with the stakeholders.

In order to deal with project and location specific issues, the manual also provides recommendations on processes that should be used by the engineering consultant to identify these issues and incorporate them into project activities. More detailed information on these processes may be provided by FIDIC in subsequent publications.

The manual also provides a description of other project processes that have been found to be useful in the development of more sustainable project outcomes. These include project management and leadership activities, the selection of project specific sustainability goals, and suggestions for handling the various stages of project development. While these processes by themselves do not make a project more sustainable, they contribute to an environment in which a favorable outcome becomes more likely.

3.2 WHAT IT ASSUMES

The manual assumes that the reader is conversant with the need for more sustainable development, its history, and the efforts that have been made to implement it both internationally and in the particular geographic region and country of the project.

3.3 PARTNERSHIPS FOR SUSTAINABILITY

Implementation of a sustainable project necessarily involves the efforts of a number of participants, each of whom brings a set of important requirements to the project effort. While it is true that society will not achieve a sustainable state without engineering successes on these issues, consultants engaged in improving the sustainability of their project must accommodate the efforts of others who are also involved. This includes clients, regulators, government, researchers, contractors, suppliers, and civil society, often represented by non-government organisations. Long-term relationships between these groups help to define the solution space for sustainability and are a key element of the development of engineering capabilities to meet the sustainability challenge.

4.0 ENGINEERING ISSUES IN SUSTAINABLE DEVELOPMENT

Engineering in a more sustainable manner involves recognition that the earth is not infinite, nor are the resources used to build things. Instead, in the context of the size of the population, the planet is a small enclosed system and everything that is done affects everything else, including the parts of society in which the project resides.

This mindset leads directly to the four key drivers of project sustainability: **conservation, protection, consultation, and prediction**. If resources are limited then successful projects will **conserve** those that are not renewable and seek to substitute alternatives that are. If the planet is finite then the environment must be **protected** from the release of contaminants, and changes that negatively affect surrounding ecologies must be avoided. Society has a place at that table – project decisions require the involvement (**consultation**) of the parts of society that are affected by them or the results will not be workable in the long term. Finally, in a world that is affected by what everybody else does, engineering projects are not just affected by current conditions but require foresight and planning (**predictions**) for conditions that the future might bring. As an example, climate change predictions show that in the lifetime of typical engineering projects, the surrounding environment (temperature ranges, severe weather conditions, rainfall and the like) will shift in a manner that will probably have an impact on the successful operation of the project. As a result designs must consider not only the current environment of construction and operation but also future conditions that are not currently experienced.

4.1 TASKS AND PROCESSES FOR SUSTAINABLE PROJECTS

4.1.1 INTEGRATING PROJECT SUSTAINABILITY WITHIN THE PROJECT DEVELOPMENT PROCESS

For maximum effectiveness, the project sustainability process should begin at the beginning of a project's conceptual planning stage because many of the very early decisions on the project have a significant impact on options available for making sustainable improvements. FIDIC's State of the World Report 2012 on Sustainable Infrastructure (Ref. 6) makes the point that conceptual decisions during the project initiation stage present the 'minimum constraints and maximum opportunity for sustainable thinking'. Conversely, failure to pay attention to sustainability at this stage can severely limit the options at later stages. The absence of early sustainability planning does not entirely preclude progress on sustainability, but concepts introduced at a later stage will be constrained by decisions made earlier. PSL, for example is designed to be used for projects or programmes from their initial stages.

The adoption of a whole life sustainability approach from concept to decommissioning is critical. Most of the financial benefits achieved from sustainability planning accrue during the operational stage and later decommissioning of a project – indeed the planning and design stage is likely to cost somewhat more than normal and there may be an increase in construction costs as well.

Because of the importance of the conceptual and even the pre-conceptual stages of the project, it is becoming increasingly common to assemble a diverse team of consultants at an early stage to identify opportunities for sustainability improvements. The objective of this team is to identify key early decisions that may have a major impact on the sustainability outcome. Their expertise should span the range of technical disciplines that affect early project decisions. At this stage the implications for different development site locations, identification of impacts (both positive and negative), assessment of current and future vulnerabilities and corresponding steps to improve resilience should be actively considered (Ref. 6). The client/owner should also regularly review its options including whether a more sustainable outcome would be achieved by not proceeding with the current project but by substituting and alternative. Initial steps should be taken at this stage to identify affected groups of stakeholders to be involved in later stages of the sustainability design process.

The list of sustainability issues and explanations that follow provide a checklist of considerations to be incorporated in this and subsequent phases of the project. Sustainability objectives are also initially defined at this stage.

The feasibility stage is typically focused on the resolution of choices that were developed during the conceptual stage including final site selection. Normally the determination of these choices is based on cost, schedule, risk, and resilience but sustainability projects bring a number of other considerations (the perspectives described in later parts of this monograph). By the end of this stage, design objectives should be established for each component of the project along with design indicators to be used as a communication tool for measuring the achievement of sustainability objectives with stakeholder groups.

Detailed design follows in which each component of the project is defined and described in the tender documents. Strategic sustainability objectives from the feasibility stage become part of the design brief that is assessed for 'constructability, operability and de-constructability' (Ref. 6) including the use of life cycle analysis to evaluate material selection.

Up to this stage, the sustainability of the project is still largely design based and theoretical. During the construction and operation of the facility, the performance of the construction and operating staff determine whether sustainability improvements are actually achieved. Continued interaction with the stakeholders to facilitate reporting on sustainability indicators provides the evidence for project achievements. A long-term management and operations system incorporating these indicators helps to guide the timely repair and replacement of components critical to project success. Most of the benefits accruing to the project as a result of its sustainability focus are derived at this stage. The Project Log Book (Ref. 7) approach facilitates the collection of such information and performance assessment.

Finally, the project is decommissioned with the main sustainability objective to minimise waste. Design intentions for dismantling, recycling and reuse of components or recovery in particular of non-regenerating materials are realised at this stage.

4.1.2 THE INCLUSION OF CLIENT OBJECTIVES

Each client brings its own set of sustainability objectives to a project. A government might have overriding intentions that are well beyond the scope of the engineering services required on the project but nevertheless, affect them. As an example, a municipal client might have the overall objective of increasing residential density in the interests of being able to effectively provide more sustainable services, or the development of an intermodal public transportation facility as an alternative to automobile usage. These desires sometimes affect the type and nature of the project itself, sometimes affect the sustainability focus and priorities for project execution, and often dictate the relative importance of the different sustainability issues to be considered.

A commercial client is also likely to bring its own priorities – particularly if it carries out annual reporting under the GRI protocol since the identification of the sustainability priorities of the organisation is part of that protocol. These priorities might be for energy or water use reduction, greenhouse gas emission reduction, the development of a more sustainable supply chain, or even a matter of particular attention to the interests of a specific stakeholder group in the company. Some of these issues might be matters that the engineering would pay attention to in any case, some might be a matter of setting priorities for certain aspects of sustainability over others, some might define the whole purpose of the project. Typical commercial objectives might include the use of a sustainability evaluation tool such as LEED or CEEQUAL to provide an externally recognised performance award, or the inclusion of industry specific goals and indicators to enable local performance to be judged against industry-wide protocols.

These considerations establish the requirement for early stage meetings between the project team and the client in which the client objectives are discussed and understood, and the engineering team describes the type of issues that it would normally consider in the execution of the work (the focus of this monograph). Sometimes that leads to a formal process to set priorities for the work, sometimes it is possible to make the decisions less formally. In any event this discussion of issues and priorities is an early stage requirement in any project.

4.1.3 STAKEHOLDER INVOLVEMENT

Stakeholder involvement is perhaps the key distinguishing feature of sustainable projects: in fact, one could argue that without stakeholder involvement a project cannot be sustainable. The level of stakeholder involvement may be dictated by regulation (especially in regard to the results of environmental assessment) or by loan covenants (in the case of development projects financed under the Equator Principals). Beyond the hard-wired processes incorporated in these considerations, careful consultants realise the necessity of bringing members of the local community into the project planning process early, both to take advantage of local knowledge (especially in regard to local culture and environment), and to minimise community impacts and surprises which almost invariably lead to project opposition. The essence of stakeholder involvement is to use the community as a partner to define agreed indicators of sustainable performance, and to report the results of monitoring those indicators as part of community dialogue.

A partial list of stakeholders who should be incorporated into the project dialogue is provided in the table below, along with some of the purposes of the consultation.

GROUP	PURPOSE OF SUSTAINABILITY CONSULTATION
CLIENT	Integrated sustainable issues list, plans and objectives, performance measures
EXTERNAL CONSULTANT	Holistic planning process
CONTRACTOR	Construction constraints, constructability, commissioning
FINANCIAL INSTITUTION	Loan sustainability covenants
REGULATOR	Construction and operating restrictions, approval process requirements
POLITICIAN	Local issues and sensitivities
SITE COMMUNITY	Impacts on food, shelter, law, culture, development, health and safety, sustainability indicators and performance,
CUSTOMER	User perspectives, external product impacts
SERVICES SUPPLIER	Service constraints, availability of renewable services
MATERIAL SUPPLIER	Sustainable procurement
OPERATOR	Operator perspectives, commissioning, training

Table 1 List of Typical Stakeholder Groups

4.1.4 GOAL SELECTION

The definition of sustainable development provided by the Brundtland commission – development that meets the needs of the present without compromising the ability of future generations to meet their needs – provides an easily understood concept that cannot be easily translated into a definition of what sustainability would look like if it were to be achieved. The ultimate goals for each of the issues therefore are a matter of opinion, and the opinions that are held by different members of society are a function of their socio-economic and political context and their values. The goals of PSM II (ref 5) arose from asking for a definition that would be indisputably sustainable – zero energy and water use, completely recyclable material use, no negative change in the environment, no negative impact on health and safety or on human rights. As well as being inarguable, they are probably also unachievable and unrealistic.

They do however, provide a clear definition of what comprehensive sustainability would look like from an engineering point of view and they show the level of innovation that would be required to achieve it. By defining the end point on a scale from current practice to perfection they also provide an indication of progress. A number of qualitative steps along this scale have been recognised – conventional performance, improved performance, metastable sustainability, full sustainability, and restorative performance. Conventional performance meets applicable laws and regulations and conforms to the current practice. Improved performance exceeds the current state of practice (by at least 10% as suggested here) but falls short of sustainability. Metastable sustainability is indefinitely sustainable under current circumstances but falls short of full sustainability as defined in the previous paragraph, while restorative performance exceeds the requirement for full sustainability and restores previously degraded conditions, bringing improved performance beyond the traditional boundaries of the project.

The selection of specific performance targets for the project for each of the issues under consideration should be part of the project process and should involve key stakeholders. The objective of the goal-setting process is to determine which of the issues and perspectives on the PSM II list are most significant in the context of the project. These become the key sustainability issues for the project. Performance targets that are set for these issues are matched to indicators that are used to measure and demonstrate to stakeholders the level of success in meeting the targets. The measure of significance is determined by answering the following questions:

- **Importance:** Given the local and regional context, are there any issues clearly more important than others? As an example, in a desert environment, savings on water use might be more important than energy savings or material use. Prioritise the issue and perspective list from most important to least important.
- **Impact:** Does the project have an impact on the issues? How important is the impact of the project on the issue? As an example if the project is the major energy user in the region, it is likely to affect the availability and cost of energy to others. Arrange the list of issues and perspectives in order of project impact.

- **Contribution:** Can the project contribute in a major way to the improvement of sustainability in this perspective? Technical considerations might restrict the extent of improvement from conventional practice, or conversely, a breakthrough in technology might allow for major improvements in project performance. Major sustainability improvements are more important than lesser ones.
- **Interest:** Is the issue a matter of interest to a stakeholder group – either internal or external to the project staff? Consider the stakeholder list from Section 4.1.3. This assessment will help focus stakeholder/project communications.

Typically the answers to the four questions would be shown on a qualitative scale – of great importance, of medium importance, of minor importance – and a final listing of the ratings for each question and for each issue and perspective would allow them to be put in order from most significant to least significant. Performance indicators would be developed for the most significant items on the list and these would form the basis of stakeholder communications throughout the project. This process would be carried out during the conceptual stage and checked and adjusted at the end of the feasibility stage described above.

ITEM	SIGNIFICANCE			
	IMPORTANCE	IMPACT	CONTRIBUTION	INTEREST
WATER USAGE AVAILABILITY AFFORDABILITY ETC.	- GREAT SMALL MEDIUM ETC.	- GREAT SMALL MEDIUM ETC.	- GREAT SMALL MEDIUM ETC.	- GREAT SMALL MEDIUM ETC.
ENERGY USAGE RENEWABILITY AFFORDABILITY	- GREAT SMALL MEDIUM	- GREAT SMALL MEDIUM	- GREAT SMALL MEDIUM	- GREAT SMALL MEDIUM
HUMAN RIGHTS FOOD SHELTER LAW CULTURE DEVELOPMENT	- GREAT SMALL MEDIUM ETC. ETC.	- GREAT SMALL MEDIUM ETC. ETC.	- GREAT SMALL MEDIUM ETC. ETC.	- GREAT SMALL MEDIUM ETC. ETC.

Figure 4 Showing the significance of each perspective on a hypothetical project

4.1.5 PREDICTION OF CHANGES TO PROJECT CIRCUMSTANCES – RESILIENCE PLANNING

The issue of sustainable development is predicated on the assumption that humanity will not be able to maintain its development capabilities indefinitely because of the consequences of environmental damage (climate change and other forms of contamination), and the increasing scarcity of non-regenerating materials. Many studies of these effects have suggested that conditions will worsen appreciably within the next ten to twenty years – well within the lifetime of the projects that are being engineered at present. As a result, one of the critical processes that should be undertaken in the course of project sustainability evaluation is a formal assessment of the effects of such changes on design i.e. on the resilience of the project or conversely on its vulnerability to change.

4.1.6 MANAGEMENT AND LEADERSHIP FOR PROJECT SUSTAINABILITY

There are many other processes that might be used to provide a train of documentation that identifies and records efforts to make the project more sustainable. These might include the development of environmental management plans, appointment of senior project representatives with authority and responsibility for the sustainability aspects of the project, and the formal commissioning and testing of sustainability sub-systems to verify performance (since they are by definition not part of conventional project design).

FIDIC is of the opinion that such practices reflect good project management and do not by themselves make a project more or less sustainable. The development of a report on sustainability considerations for example will not result in a more sustainable project unless the identified opportunities are acted upon. PSM II therefore leaves the inclusion of such processes up to the individual practitioner. The interested reader is referred to documentation of the CEEQUAL and ENVISION systems (Refs 8 and 9).

4.1.7 PHASES IN PROJECT DEVELOPMENT, OPERATION, AND CLOSE-OUT

Reference has been made above to the inclusion of other stakeholder capabilities in the project development process. While the owner in conjunction with the consulting engineer are primary drivers of sustainability in the initial stages of project development, the contractor takes over that role during construction and makes numerous choices that affect the short term sustainability of the site –material selection and delivery, energy and water use and site discharge, emissions of dust and noise and light pollution, community health and safety and relationships to name but a few. Many of these issues would be addressed in the contract documentation for the project, and therefore should be considered at the appropriate stage in the design process, but others reflect the sensitivity of the contractors to the whole sustainability issue and might become part of the bid evaluation and selection process for the project.

Once the project is completed and commissioned, with verification that the sustainability systems function as they should, it is handed over to the operating staff of the owner. It is critical to the success of the project that these staff members understand and use the new systems, and their performance overall should be logged as part of the Project Log Book records (Ref. 7). Other aspects of the client-owner's performance will also affect the ultimate sustainability of the effort, especially in the health and safety and human rights areas. This performance is often outside of the purview of the consulting engineer although the provision of appropriate design to allow this performance, and the inclusion of appropriate methodology in operating manuals is not.

Throughout the lifetime of the facility there will be phases of upgrading and renovation that should provide a suitable opportunity for review of intended sustainability performance measured against reality (as recorded in the Project Log Book) and at these times, improvements should be made that are consistent with the original intentions. Once the facility is no longer needed, it should be deconstructed with due attention to the intended recyclability of its components. The site should then be restored to a suitable brownfield state appropriate for future use.

4.2 THE ISSUES OF PSM II

There are six major issues to be considered as part of PSM II – energy, water, materials, environment, health and safety, and human rights. The sustainability objective or driver for the first three is to conserve (energy, water, materials) and the driver for the last three is to protect (environment, health and safety, human rights). Table 2 shows the relationship between the drivers, the issues, and the perspectives. It should be noted that the six issues and their perspectives cover the range of indicators identified in the original version of PSM.

DRIVERS	ISSUES	PERSPECTIVES
CONSERVE	Energy	Usage, renewability, availability, affordability
	Water	Usage, availability, affordability
	Materials	Usage, recycling, durability, renewability, waste
PROTECT	Environment	Physical, chemical, biological, ecosystem
	Health and safety	Workers, community
	Human rights	Food, shelter, law, culture, development

Table 2 List of Issues and Perspectives

The human rights issue requires further clarification. Each of the perspective of the human rights issue has its own set of aspects shown in Table 3. It might appear that engineering projects do not directly affect human rights, or that human rights are covered by law and custom, but that is not necessarily the case. As an example, natural and built heritage protection is a major consideration of many projects around the world. The impact of engineering projects on food availability is another example. The diversion of significant quantities of corn to ethanol production had an impact on food availability and costs. Forced relocation is an aspect of many megaprojects. Legal issues are also important and engineers can have an impact on criminality by putting in place controls over the construction bidding process to minimise corruption and fraud and by operating their own companies in an ethical manner. The benefits from development should overwhelm the negative impacts, an objective that is helped by detailed impact evaluation and efforts to free the project from irritants such as noise, odour, light pollution, etc.

ISSUE	PERSPECTIVE	ASPECTS
HUMAN RIGHTS	Food	Availability, cost
	Shelter	Availability, cost, forced relocation
	Law	Equality, security, criminality, exploitation, freedom of association
	Culture	Protection of natural and built heritage
	Development	Community benefits, convenience, freedom from irritants

Table 3 List of Human Rights Perspectives and their Aspects

5.0 DETAILED DISCUSSION OF ISSUES, PERSPECTIVES, AND GOALS

In the following, additional details of the issues, perspectives, and goals along with suggestions for reporting are provided in a standard format. Each issue begins with an indication of the overall (primary) sustainability objective (section A) for the issue. In many cases there are substitutions (section B) of more sustainable alternatives that are possible eg substitution of renewable energy sources for non-renewable ones. In the next section (C), the imperfect achievement of the primary objectives gives rise to a set of consequential circumstances that affect other sustainability considerations. Related issues (section D) indicates other sustainability issues and perspectives that might be affected by the solutions chosen for the issue under consideration. Finally (section E) concludes with a brief discussion of the goals and measurement of sustainable performance related to the issue discussed.

The first three issues (energy, water, materials) have the overall objective of minimising the usage of non-renewable resources. It should be noted that while these are considered to be the most appropriate objectives on a single project basis, optimisation of the production, distribution, and use of these three types of resources across numerous users is a valid sustainability objective inherent in smart grids and the like. The last three issues (environment, health and safety, and human rights) have the objective of protecting the integrity of the planet and the communities affected by the project.

While it would be useful to be able to provide a score or numerical measure for the sustainability of the solutions developed to deal with each issue, this ultimate definition of sustainable performance remains elusive in anything other than qualitative terms. As a consequence, in the discussions that follow an attempt is only made to differentiate between the five states of sustainable performance described in section 4.1.4 above (conventional, improved, metastable, full sustainability, and restorative). In regard to the primary issues and their objectives, the achievement of perfect sustainability can be recognised as a zero impact criterion, even if it is unachievable in practical terms. Suggestions are made in the text about other levels of achievement. Unfortunately, once trade-offs are introduced,, measurement becomes more subjective. As an example, the replacement of a certain amount of water use from raw uncontaminated sources with grey water re-use is a definite improvement in the sustainability of the project design and might be reported as an improvement in raw water usage. In order to accomplish this improvement, additional materials and chemicals might be required for the project both to condition the grey water source and to treat it for ultimate discharge. The tradeoff in material use and environmental risk would have to be balanced against the raw water use improvement and the question of net improvement is difficult to answer in clear and unambiguous terms.

Given a context in terms of a set of project circumstances, coupled with community or stakeholder values, choices will have to be made to address certain issues or perspectives over others, and in the sense of being preferred options, these solutions have higher sustainability than the alternatives. The measurement of sustainability, even within a single issue, can therefore be inordinately complex.

In the past the only community with a say in the final project outcome was the owner and applicable government regulators. The essence of sustainability is to attempt to include other stakeholders in providing relevant knowledge and to give them a say in the ultimate decisions.

5.1 ENERGY

5.1.1 PRIMARY SUSTAINABILITY OBJECTIVE (A)

The primary objective of this sustainability issue is to minimise the use of energy in all stages of the project. While the primary target for improvement is energy use during the operating phase (since this is likely to be the major use over the project lifetime), improvements during the construction phase and projected improvements for decommissioning and closeout are also relevant to project sustainability performance.

The measure of improvement would be based on energy used on recently developed similar facilities (current practice) and expressed as a prediction of whole project performance or broken down by units of production backed by life cycle assessments carried to international standards. Improved performance would constitute a significant improvement (>10%) on current practice. Metastable sustainability would correspond to low energy use within the available resources at the site in which as much energy as possible was supplied from renewable sources. Sustainable performance would correspond either to zero use or to renewably supplied

energy sourced entirely from the project site. Restorative performance would involve the application of unused waste energy from another facility (i.e. use of waste heat from another facility).

5.1.2 SUBSTITUTIONS (B)

Once energy use on the project is minimised, performance would be improved by substituting increasing amounts of renewable energy up to a maximum of 100% (see above).

5.1.3 CONSEQUENTIAL SUSTAINABILITY OBJECTIVES (C)

In addition to minimising absolute energy use, the project should also minimise the impact of project energy use on availability and hence affordability of energy to others. Clearly if the primary objective is achieved to the level of metastable or complete sustainability, then impacts on availability and affordability are likely to be moot. If the primary sustainability achievement is limited to improved performance, then the impact is likely to be dependent on the magnitude of project energy use expressed as a percentage of total available energy. On a major engineering project impacts on others may not be avoidable and steps should be taken by the project to compensate others for these impacts, either by improving energy availability through the generation of additional supplies in excess of project needs, or direct compensation for cost increments.

5.1.4 RELATED ISSUES (D)

Depending on the source of energy, there may be consequences of the project energy use on other sustainability issues such as greenhouse gas emissions (environmental contamination), health and safety in regards to transmission requirements, and waste generation and utilisation or storage (environmental or materials considerations).

Within the issue of greenhouse gas emissions, preference should be given to fuels that release CO₂ as part of a normal growth-decay cycle (biomass generation) as opposed to fossil sources. If the use of fossil sources is required then attention should be given to the efficiency of power generated per unit greenhouse gas emissions and other waste generation components (gas in preference to oil in preference to coal). Power sources with carbon sequestration should be rated on the basis of greenhouse gas release post sequestration.

There is an additional related sustainability issue that is handled under the heading of material use below – the embodied energy of materials used in the project. The objective is to reduce total embodied energy.

5.1.5 GOALS AND THE MEASUREMENT OF ENERGY SUSTAINABILITY (E)

The primary measurement (A) is the specific project performance placed on a scale from typical usage for a project of this type at one extreme to sustainability at the other and reported as the percentage improvement over normal practice.

Secondary reporting might involve the percentage of total energy use that comes from renewable sources generated offsite and onsite.

5.2 WATER

5.2.1 PRIMARY SUSTAINABILITY OBJECTIVE (A)



The primary objective of this issue is to minimise the net water use in all stages of the project including construction, operation, and close-out and to prevent all negative aspects of water discharge during construction and operation including contamination and flooding (dealt with elsewhere under the Environment issue).

As with the energy issue, the measure of improvement is a measure of the net water used in comparison with other recent projects of a similar type (current practice) and might be expressed as a prediction of whole project performance or broken down by units of production backed by life cycle assessments

carried to international standards. Improved performance would require a significant improvement (>10%) on current practice. Metastable sustainability would correspond to low water use with replacement from renewable sources, such as a groundwater source with injection of replacement water elsewhere in the aquifer or a surface water source with replacement elsewhere in the catchment. Sustainable performance would correspond either to zero use or to renewably supplied water sourced entirely from the project site. Restorative performance might involve the environmental improvement of a contaminated source from another facility or the regeneration of water related ecological conditions as a result of the project.

Recycling is a significant sustainability perspective of the water issue. Purification and reuse of project water could reduce net overall usage and result in improved project sustainability.

5.2.2 SUBSTITUTIONS (B)

Once the water use is minimised, further improvement might involve recycling of used water following appropriate purification and the collection of site precipitation and its use within the project as applicable. Generally, as mentioned above, the substitution of recycled or grey sources for pure water to some stated percentage would be considered to be an improvement of the overall sustainability of the project performance.

5.2.3 CONSEQUENTIAL SUSTAINABILITY OBJECTIVES (C)

In a similar manner to the energy issue, the impact of the project on others in terms of effects on availability and cost should be considered. The higher the percentage of the available resource used by the project, the more likely that these associated impacts would be significant. If significant, the project should provide alternative water supplies or assistance in the form of economic support to compensate for project impacts. In addition to impacts on community members, impacts on the environment and ecology from short and long-term effects of water usage should be considered and compensated if circumstances warrant.

5.2.4 RELATED ISSUES (D)

In the same way that embodied energy should be calculated for materials used on the project, embodied water should also be calculated for all materials used and backed by a life cycle assessment to international standards.

The most important related issue is the impact of water use on the environment. This might involve issues of used water discharge such as the requirement to match natural circumstances in terms of quantity and flow rates, the preservation or improvement of groundwater and surface water chemistry, and the preservation of biological and ecological conditions upstream of the collection point and downstream of the discharge point. Physical changes at the project site such as surface paving would have an impact on natural groundwater recharge, and on surface water discharge flow rates and if significant, might require artificial recharge or accumulation and controlled discharge to compensate.

5.2.5 GOALS AND MEASUREMENT OF WATER SUSTAINABILITY (E)

The primary measurement (A) is the specific project performance placed on a scale from typical usage for a project of this type at one extreme to sustainability at the other and reported as the percentage improvement over normal practice.

Secondary reporting might involve the percentage of total water use that comes from grey sources, precipitation, and recycled project water.

Additional reporting should indicate overall improvements made in surrounding surface and subsurface water environments and compensation for the effects of the project water use on others.

5.3 MATERIALS

5.3.1 PRIMARY SUSTAINABILITY OBJECTIVE (A)

There are two primary objectives in the issue of material usage. The overall objective is to minimise the use of materials (especially non-renewable ones) on the project. The second is to deal with wastes in a manner that attempts to minimise, recycle insofar as possible, and handle generated waste safely for disposal.

As with the issues of energy and water, the measure of improvement is the net material used by category (metals, concrete, wood and other bio-generated substances, chemicals) in comparison with other recent projects of a similar type (current practice). Improved performance would require a significant material use reduction and/or a significant shift from non-recyclable to recyclable materials (>10%) based on current practice. Metastable sustainability would correspond to the use of sustainable materials with all non-sustainable materials completely recycled from existing sources. Sustainability would correspond to full replacement of non-sustainable with sustainable materials. Restorative performance would involve the use of previous wastes from other projects as materials incorporated in the new project.

Recycling is a significant sustainability aspect of the materials issue. The concept includes the use of recycling to provide some of the materials used in the present project and planning for the use of non-recyclable materials such that they could be recovered during project decommissioning for use elsewhere.

Durability should be maximised and is a major consideration in material use both in planning for ease of maintenance and minimising generated wastes during operation, refurbishing, and closeout. The current practice of designing for unit replacement with the old unit going to waste rather than repair and recycling is not a sustainable practice.

5.3.2 SUBSTITUTIONS (B)

Once material use is minimised, efforts should be made to substitute renewable materials for non-renewable ones, and recycled materials for those that are non-renewable. Chemicals used in the project should wherever possible be intrinsically safe materials (ref. chemical industry efforts) replacing unsafe ones. Planning should include the eventual decommissioning of the project and the reuse of its materials. Project durability with planned recycling of components should be a factor in design as should the selection and sourcing of more sustainable materials including considerations of transport of the materials to site. The issue of sustainable procurement is beyond the scope of this document however the reader is referred to the interesting and growing literature on this issue.

5.3.3 CONSEQUENTIAL SUSTAINABILITY OBJECTIVES (C)

In a manner similar to the energy and water issues, consequential impacts on availability and affordability of materials used in the project should be considered and where appropriate, compensated. The use of scarce material resources should be avoided if possible. Sustainable procurement practices should be used to the extent possible.

5.3.4 RELATED ISSUES (D)

Health and safety for workers and community in the transportation, and handling of materials, in exposure to harmful materials, and in the handling and disposal of residual wastes are related issues as are health and safety considerations during component replacement undertaken for improved durability.

Minimisation of energy use in transportation and in the manufacturing and disposal process (including water use) are factors in material usage and waste avoidance.

Downstream environmental consequences and their avoidance in the manufacture and use of project materials and in the safe disposal of residual waste materials should be considered.

In the event that waste materials from other projects could be used, credit should be given for restorative behavior.

5.3.5 GOALS AND MEASUREMENT OF MATERIAL SUSTAINABILITY (E)

There are two streams of primary measures (A) – material use, and waste generation and disposal. In regards to material use they include overall material minimisation measured as material quantities used in comparison with similar projects, substitutions to avoid non-renewable material use, and project durability measured by maintenance and repair performance related to similar projects. In regards to waste, an inventory of all wastes produced by the project during construction and operation (including wastes removed from site for the reconfiguration of site topography) should be maintained and compared with similar projects. The project should be credited with any reused waste materials either from onsite or offsite sources. Waste disposal should be to industry best practices but it should be recognised that the ongoing generation of inorganic waste material is inherently unsustainable.



5.4 ENVIRONMENT

5.4.1 PRIMARY SUSTAINABILITY OBJECTIVE (A)

The overall objective is to preserve the environment from damage resulting from the project. For convenience the environmental perspectives are divided into physical, chemical, biological, and ecosystem considerations.

5.4.1.1 PHYSICAL CONSIDERATIONS

The objective is to preserve wetlands and other surface water bodies, preserve significant topographic features, and to avoid the removal of excavated materials from site. Dust and airborne solid contaminants as well as discharge of suspended solids in water should be avoided.

5.4.1.2 CHEMICAL CONSIDERATIONS

The objective is to prevent chemical contamination or leakage including escape of liquids, gasses (including odours), dissolved or suspended solids. Chemical considerations include greenhouse gas emissions, water pollution to surface or subsurface water bodies, and chemical changes to surface or subsurface materials on site (such as by the burial of construction materials on site).

Inorganic waste disposal is considered to be inherently unsustainable and the diversion of materials from waste facilities is considered to be a contribution to sustainability. Organic waste disposal may be considered to be a processing activity that recycles undesirable wastes.

5.4.1.3 BIOLOGICAL CONSIDERATIONS

The objective is to prevent damage to living organisms, particularly rare and endangered species.

5.4.1.4 ECOLOGICAL CONSIDERATIONS

The objective is to prevent loss of habitat, or alteration of the biological balance between species.

5.4.2 SUBSTITUTIONS (B)

In the course of construction a certain amount of environmental damage is inevitable and ongoing damage might be a consequence of the operation of the facility over time. The extent to which this consequence can be mitigated by replacement and cleanup of such damage to a restored state including habitat replacement, and site restoration from contaminant leakage should be evaluated and reported.

5.4.3 CONSEQUENTIAL SUSTAINABILITY OBJECTIVES (C)

This aspect covers the impact of project activities on others. In the event of environmental damage, both the community and the natural environment will be affected. In order to avoid these impacts, defensive design measures may be employed to facilitate cleanup or contain failures and spills on the assumption that such events are inevitable over time (defensive engineering).

The environment in which the project is constructed will also change over the lifetime of typical engineering structures and consideration of such changes to surrounding conditions caused by, for example, changing climate circumstances should be embedded in sustainability planning for the project.

5.4.4 RELATED ISSUES (D)

Related issues include health and safety considerations caused by spills or release of dust. The inconvenience of noise and light pollution are considered under the freedom from irritants aspect of human rights below. The physical aspects of water use are considered under that issue above. Similarly, the energy issue covers usage and sources of energy while the chemical and greenhouse gas aspects are considered here under Environment. Materials use is handled under that heading whereas volatile organic compound (VOC) releases, for example, are considered to be chemical contaminants and are dealt with under the Environment heading.

5.4.5 GOALS AND MEASUREMENT OF ENVIRONMENTAL SUSTAINABILITY (E)

The primary measure is environmental change brought about by the project. The perspectives discussed above help to guide the thought process. In most jurisdictions some residual amount of environmental contamination is permitted by regulation, based on the concept that such small amounts of damage are not of lasting consequences. In a way this is a metastable sustainability concept and operates on the assumption that future investigations will not find that this causes damage, or that the combined leakage from numerous operations in the same vicinity will not collectively cause damage. The only certain target going forward is that of zero change referred to here as sustainability. Once again improved sustainability corresponds to a greater than 10% improvement on recent similar projects and if both the recent projects and the current ones are to regulation, then in this case improved sustainability might actually deliver better performance than the metastable sustainability based on regulation. It is important to realise that many of the environmental disasters that have occurred in the past developed after periods of facility operation that met local regulation at the time.

5.5 HEALTH AND SAFETY

5.5.1 PRIMARY SUSTAINABILITY OBJECTIVE (A)



The primary objective is the preservation of health and safety of the workforce on the project, the community housing the project, and the users of the project facilities or products. The target is zero impact. Part of this issue is a construction and operational consideration but part is tied to the design of equipment, facilities, and processes.

5.5.2 SUBSTITUTIONS (B)

Depending on the circumstances of the project, steps may be taken to respond to this issue by improving community and workplace access to health facilities and resources and improving training and emergency response capacity. Both of these approaches are intended to improve consequences from a health and safety failure. Other steps such as rerouting of transportation corridors around built up areas,

protective barriers, improved processes, improved lighting, better protective equipment, signal systems, and the like should be used to avoid health and safety issues in the first place and represent a more sustainable solution.

5.5.3 CONSEQUENTIAL SUSTAINABILITY OBJECTIVES (C)

As a result of the objective of improving overall health and safety of the affected communities (workers, host communities, users), changes might be required for any or all of the sustainability issues described above. As an example, the safe transportation of materials and wastes might require special routing to avoid built-up areas and special packaging or isolation to minimise the chance of uncontrolled escape of potentially hazardous materials. Any form of environmental emissions might have long-term health and safety implications. Protective equipment and facilities might relate to energy or water reticulation. In the event of health and safety damage, some form of compensation might be offered but this is at best a stopgap that really does not boost the sustainable performance of the project.

5.5.4 RELATED ISSUES (D)

Other issues covered elsewhere that may affect the health and safety outcomes of the project include environmental releases, material and waste transport, water and energy supply design, and waste handling.

5.5.5 GOALS AND MEASUREMENT OF H&S SUSTAINABILITY ASPECTS (E)

Assessment requires comprehensive record keeping and analysis at all stages of the project even before its inception in order to establish baseline conditions. Industry commonly measures health and safety impacts on employees by hours of accident free time or numbers of accidents per unit time or per unit productivity. A periodic review of the records or of a single particularly damaging event usually triggers an assessment of practices and facilities that may result in changed equipment, protective materials, training and new practices designed to avoid the harmful repetition of such events.

In the context of sustainability, in which the surrounding community, the workforce and project users are involved, impacts should be measured over a fixed time and should trigger an assessment process such as that described above – perhaps carried out with the help of third parties. In many respects accidents are easier to deal with than health issues because of questions about attribution (ie did the individual suffer the health affect because of project related circumstances or because of something independent of the project).

Once again progress is measured by improvements in comparison with similar projects carried out elsewhere.

5.6 HUMAN RIGHTS

5.6.1 PRIMARY SUSTAINABILITY OBJECTIVES (A)

Many of the human rights sustainability perspectives relate to practices and policies that should be in place in the engineering firm, the contractor, the client organisation(s), or even the overall society within which the project is undertaken. These include gender equality, minority rights, freedom of association, the right of security and protection under the law, freedom from exploitation etc. The purpose of the perspectives dealt with in this section of the manual is to address the preservation of human rights specific to project development aspects.

5.6.1.1 FOOD

The project should not interfere with food availability or affordability i.e. a project that negatively impacts the availability and use of land for farming.

5.6.1.2 SHELTER

The project should not interfere with the availability or affordability of shelter. Projects that supply shelter for a temporary or permanent workforce should be of a comparable or better standard than that available elsewhere in the community prior to the project. Major population shifts to serve the purposes of the project should be avoided and where unavoidable, long term planning for these changes should be incorporated in project plans. Forced relocation should be avoided to the extent possible. Most countries have provisions for the compulsory purchase or seizure of land for the purposes of the state following the payment of just compensation. These rules should be rigorously followed but it is more sustainable to avoid the necessity in the first place.

5.6.1.3 LAW

Project processes such as the solicitation and evaluation of bids or the integrity of proposals should be designed to minimise the chances of bribery and corruption through the use of integrity management programs (for example, the FIDIC PIMS protocol).

Design features to improve staff security should be incorporated in the project , such as the provision of adequate lighting along external pathways and in parking facilities, secure building access if appropriate. For the most part, legal rights should be incorporated in the laws of the jurisdiction within which the project operates, but in the event of inadequate protection, there are sustainability advantages in operating to a higher standard than is required by local regulation.

5.6.1.4 CULTURE

The project should be designed to protect the natural and built heritage of the site and the indigenous rights of the surrounding communities.

5.6.1.5 DEVELOPMENT

The project should be designed to maximise benefits to the surrounding community and to the extent possible to avoid inconvenience and irritants to the community. Such irritants and inconvenience might include dust, noise, odours, light pollution, or increased traffic.

5.6.2 SUBSTITUTIONS (B)

Depending on the nature of the human rights issue, there may be substitutions that are possible to restore balance on the issue ie reduction of available farm land may be compensated by making other lands available to the affected parties. Changes to heritage facilities can be partly compensated by incorporating elements of the replaced facility into current designs. Special efforts may be required to ensure that maximum benefits from the project accrue to the affected communities.

5.6.3 CONSEQUENTIAL SUSTAINABILITY OBJECTIVES (C)

Depending on project conditions, some of the human rights described above may be unavoidably impacted, especially during construction. Compensation immediately related to the impact should be offered as a way to improve overall project sustainability. The compensation should match the scale and duration of the human rights violation.

5.6.4 RELATED ISSUES (D)

Issues related to the sustainability of human rights include environmental protection, especially contaminant releases, handling of waste materials, impact of water use and discharge, and energy use. Attempts to minimise the use of energy, water, and materials helps to ensure that their availability and affordability are not compromised by project activities.

5.6.5 GOALS AND MEASUREMENT OF HUMAN RIGHTS PERSPECTIVES (E)

Perhaps more than any other set of issues, ensuring the sustainability of human rights that might be affected by the project requires a robust and continuous system of interaction with stakeholders. Initial contact with stakeholder groups provides an opportunity to inform project planners about the likelihood of impacts, and to garner knowledge about issues which those involved in planning and executing the project may not be aware of, yet which are well known to members of the local community of stakeholders. Later interactions are used to set and agree performance targets for project indicators and to report measured performance on these indicators. In the case of human rights violations, the normal process is to establish a mechanism that permits reporting of issues as they occur and ensures that such issues are dealt with effectively within the project organisation with results reported to the community at large.

The sustainability goal is to avoid diminishing human rights, but anything that involves change affects somebody in a way that they might not want to be affected. In this instance, metastable sustainability amounts to acceptance of a project balance between the stakeholders and the instigating organisation. In simplistic terms, full sustainability amounts to no change whatever and is not possible considering the fact that project development is intended to create change. Acceptance of the changes as desirable by the stakeholder community would perhaps be a better definition of sustainability in this case. Improved performance is a recognisably better outcome than recent projects carried out under similar circumstances, but the magnitude of the improvement is probably not rigorously measurable. Restorative performance reestablishes rights that were previously not recognised.

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