SUSTAINABLE PROJECT LIFE CYCLE MANAGEMENT: ALIGNING PROJECT MANAGEMENT METHODOLOGIES WITH THE PRINCIPLES OF SUSTAINABLE DEVELOPMENT

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ABSTRACT

Industries are increasingly pressurised to incorporate the objectives of sustainable development into company policies and decision-making processes, i.e. social equity, economic efficiency and environmental performance. Furthermore, companies that compete globally are increasingly required to commit to and report on the overall sustainability performances of operational initiatives. Project management methodologies are not excluded from this pressure. As a recognised core business competency, project management methodologies must thus incorporate planning, execution and implementation procedures within the broader sustainability framework, i.e. internalising the externalities of a project.

An evaluation of the project Life Cycle Management (LCM) methodologies in industry has revealed that the three objectives of sustainable development are not efficiently addressed, especially in developing countries such as South Africa. Also, the current indicator frameworks that are available to measure overall business sustainability do not effectively address all aspects of sustainability at operational level. A prerequisite for aligning project management frameworks with the principles of sustainable development is a clear understanding of the various life cycles involved in a project and the interactions between these life cycles, and the external environment and society. In the context of the process industry, social aspects and impacts are rarely considered during project management, while environmental factors are typically only addressed by means of Environmental Impact Assessments (EIAs). In addition, the traditional project appraisal approach can lead to outcomes that are unacceptable from the point of view of intergenerational fairness, which is one of the core principles of sustainable development. However, a procedure to improve the consideration of environmental aspects in project LCM has been introduced in the process industry of South Africa. The procedure is demonstrated by means of a case study in the process industry.

A framework of social sustainability criteria that are relevant to projects within the process industry is further proposed. In contrast to previous social evaluation approaches, the framework focuses on the operational aspects of the process industry, i.e. where implemented projects impact society. The acceptance of the framework to decision-makers in petrochemical companies is discussed. Case studies are further suggested to evaluate the practicability of measurable social impact indicators for project LCM.

KEY WORDS:

Business Sustainability, Indicator Framework, Project Life Cycle Management,

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INTRODUCTION

In 1987 the World Commission on Environment and Development officially defined sustainable development as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" [1]. Since then the influence of the concept has increased rapidly, and it features more and more often as a core element of policy documents of governments and international agencies [1]. The 2002 World Summit on Sustainable Development highlighted this growing recognition of the concept by governments as well as businesses at a global level [2]. In the last decade businesses have also experienced an increased pressure to broaden their accountability beyond economic performance, for shareholders to sustainability performance for all stakeholders [3]. This is in line with the rationale of the definition of sustainable development in business terms, i.e. business sustainability as "*adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today, while protecting, sustaining and enhancing the human and natural resources that will be needed in the future"* [4].

Business, as one of the three pillars of society (the other two being government and civil society) [5], has a responsibility towards the whole of society to actively engage in the sustainability arena [6]. The pressure is therefore mounting for businesses to align operational processes with the three objectives of sustainable development, which are economic efficiency, social equity and environmental performance [7].

Adopting sustainable practices at corporate level influences projects, as companies are accountable for the impacts of an implemented project on the society, environment and economy, even long after the project has been completed [8]. In order for projects to achieve sustainable development objectives, the concepts thereof must thus be integrated into the planning and management over the whole life cycle of a project.

Current Status Of Sustainable Project Life Cycle Management

Project Management can be defined as "*the application of knowledge, skills, tools and techniques to project activities to meet project requirement*" [8]. In recent years projects have become strategic management tools and project management has become a core competency and a necessity for survival [9,10]. However, the nature of project management has changed since the 1960's. Companies in the new millennium are managing projects on a far more informal basis with less paper work by relying on techniques such as "checklists for end of phase reviews". Critical to these informal project management approaches are an appropriate methodology and an understanding of the life cycle phases [10]. A benchmarking study confirmed that companies, which are successful in project management, all use a company-specific, simple and well-defined project management framework that defines a staged approach for all projects under all circumstances [9]. The framework specifies major activities and deliverables for each project phase as well as guideline questions for the phase end reviews or gates. Figure 1 shows an example of such a staged project Life Cycle Management (LCM) framework in the South African process industry.

It is evident that economic aspects of sustainable development are efficiently addressed (see activities and deliverables in Figure 1). The social and environmental aspects are not directly stated. In the context of the South African process industry, the content of the deliverables were studied more closely in order to identify any environmental and social activities or aspects that are addressed. Figure 2 summarizes the main activities and appraisal issues concerned with environmental and social aspects over a project's life cycle in South Africa [11].

It is concluded that social aspects are not currently specifically mentioned in either the activities or deliverables of each phase, although social aspects can form part of an Environmental Impact Assessment (EIA). A survey under ten South African companies in the process industry supported this conclusion [12]. The selection of companies for the survey was based on the Financial Mail's Top Companies 2002 report. Environmental aspects are only addressed to a limited extent by following the formal guidelines of the national Department of Environmental Affairs and Tourism (DEAT) for conducting EIAs [13] during some of the project life cycle phases.

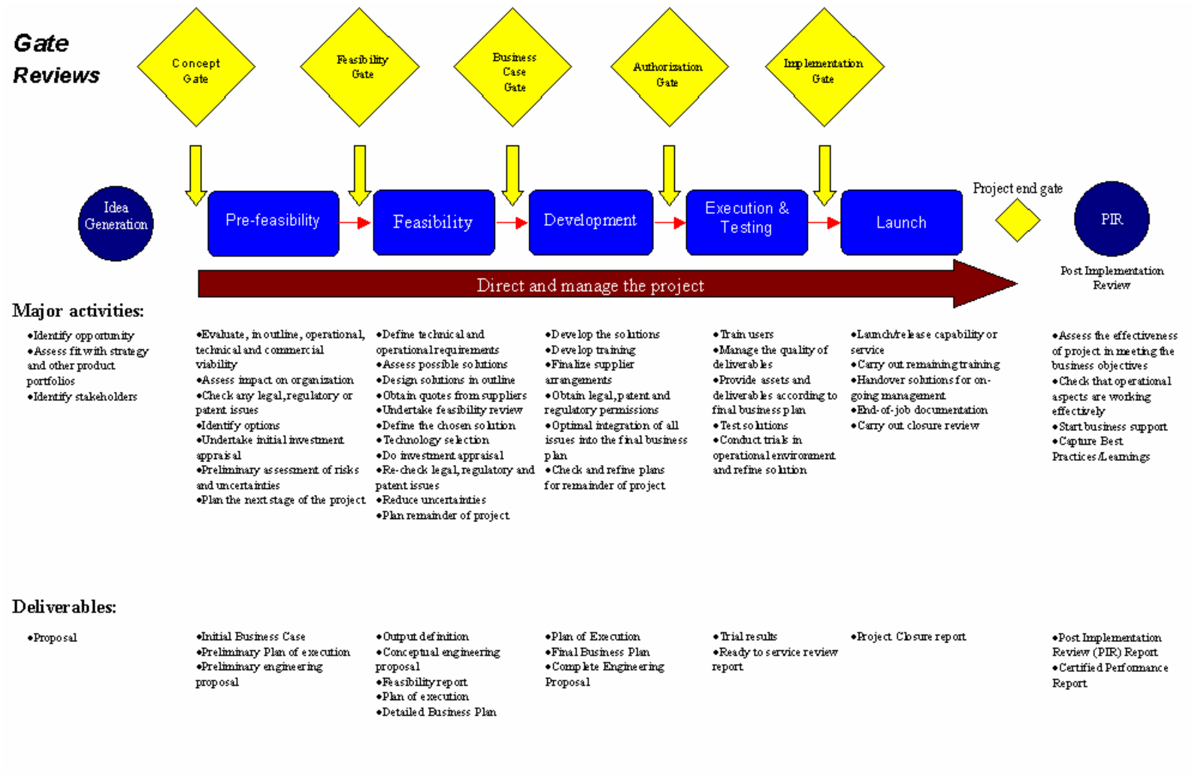

Figure1. Staged Project Life Cycle Management Framework (adapted from [9,10,11])

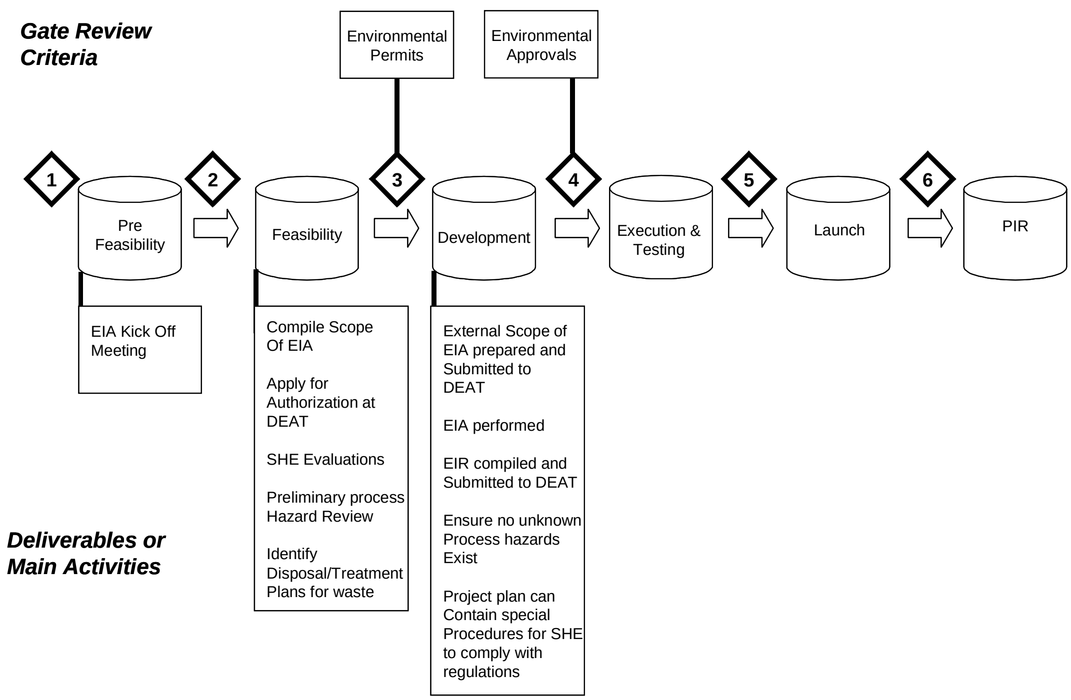

Figure 2. Extent of current environmental and social considerations in a project's life cycle

Furthermore, it is evident that social factors are currently not included in the normal project appraisal process, while environmental factors are only addressed by means of one question at two of the six appraisal gates. The project appraisal process thus does not efficiently address all aspects of sustainability. This is a worldwide phenomenon, since surveys have shown that the emphasis of the project appraisal process is on financial and technical viability, while social and environmental aspects are considered to lie outside the normal appraisal process [14]. In addition, the strong emphasis on efficiency in the traditional project appraisal process can lead to outcomes that are unacceptable from the point of view of intergenerational equity [15], which is one of the two core principles of sustainable development, the other one being intra-generational equity [16]. It is therefore concluded that current project management frameworks (in the process industry) require revision to align it with the principles of sustainable development and to ensure that a project is managed according to practices that will contribute to sustainable development goals [17,18].

A mechanism is therefore required to ensure that social and environmental considerations receive the same attention as economic factors within the project management framework. This paper proposes a framework of social and environmental criteria that should be incorporated and considered within project management. Furthermore, a qualitative procedure to evaluate the environmental factors of a project is demonstrated in order to provide the decision-makers at the phase-end reviews with the relevant information. The focus is specifically on the South African process industry. Also, further research opportunities are identified

Different lifecycles involved in a project

A prerequisite for sustainable project Life Cycle Management (LCM) is the incorporation of life-cycle thinking concepts within the management methodology. This implies that the methodology should include a procedure that ensures that any future social and environmental liabilities and costs that can result from completing the project are taken into consideration during the project appraisal. Since a project can be defined as "*a temporary endeavour undertaken to create a unique product or service*"[8], the life cycle of this "product or service" must also be taken into account. In the process industry the "product" of a project is usually either a new or improved process or operation that produces consumable products. The project life cycle and that of its product, the operational activity, is often viewed as one life cycle. There is, however, a vast difference between these two activities. Table 1 provides a comparison between the characteristics of a project and an operational activity [19].

Table 1. A Comparison of the characteristics of a project and an operational activity [19]

Project Activity	**Operational Activity**
• Produces a new specific deliverable • A defined start and end • Multidisciplinary team • Temporary team • Uniqueness of project • Work to a plan within defined costs • Canceled if objectives cannot be met • Finish date and cost more challenging to predict and manage	• Delivers same product • Continuous • Specialized skills • Stable organization • Repetitive and well understood • Work within an annual budget • Continual existence almost assured • Annual expenditures calculated based on past experience

There is thus three distinct life cycles involved, which are:

- **Project Life Cycle:** Pre-feasibility, Feasibility, Development, Execution & Testing, Launch and Post Implementation Review (PIR)
- **Process/Asset/Operational Activity Life Cycle**: Detailed Design, Construction, Operations/ Maintenance and Decommissioning
- **Product Life Cycle:** Preliminary Design, Detail Design, Pre-manufacturing, Manufacturing (which is the Operations phase of the Process Life Cycle), Product Usage and Phase-out and Disposal.

Figure 3 depicts the interaction between the different life cycles. It must be mentioned that the decommissioning phase of the operational life cycle will constitute a new project. It can be concluded that it is both the process and the product, which results from the project, which can have an impact on the environment and society. For this reason, these possible impacts must be analysed during project life cycle phases. The evaluation of environmental impacts primarily concentrates on the Construction, Operations and Decommissioning phases of the process; but aspects of the supply chain (or pre-manufacturing), product usage and product phase-out and disposal are considered as part of the operation phase of the process.

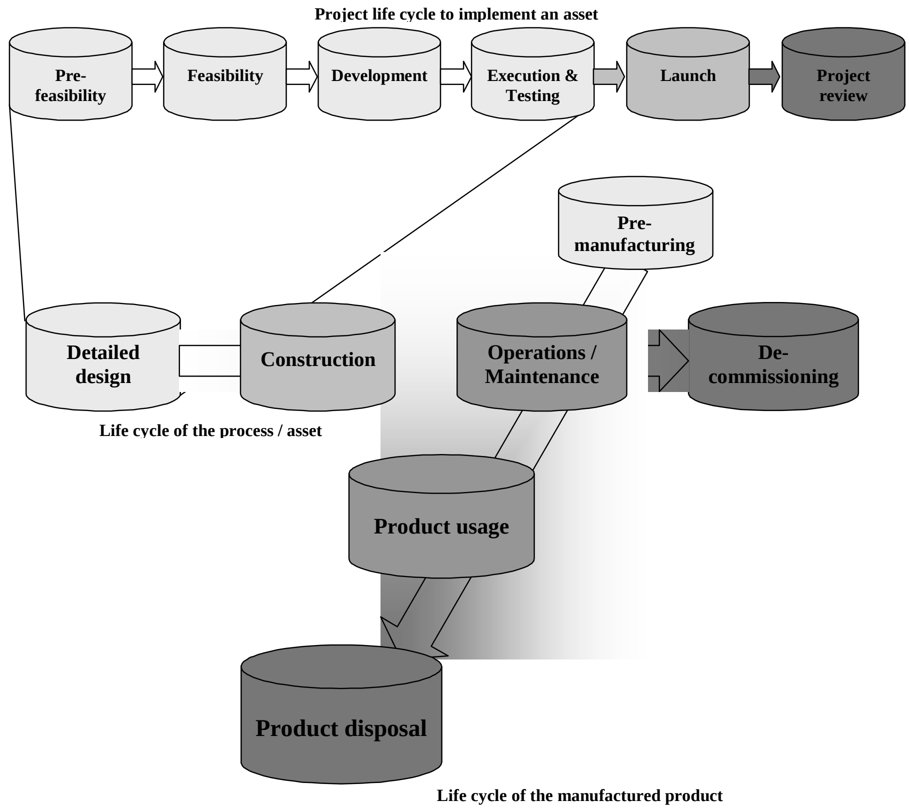

Figure 3. Interactions between project, process and product life cycles [20]

FRAMEWORK TO ASSESS THE SUSTAINABILITY OF PROJECTS

Although the concept of sustainable development is understood intuitively, it remains difficult to express it in concrete operational terms [21]. This might be due to the inherent vagueness in the concept itself [22]. Current integrated frameworks, which are used to assess sustainability on a national, international, community or company level have been reviewed to determine which aspects of sustainable development should feature in a framework that can assess the sustainability of projects [23]. Based on the review of the frameworks, a framework to assess the sustainability of projects is proposed (see Figure 4) [23]. (For more detail on the development of the framework see Labuschagne, et al [23]).

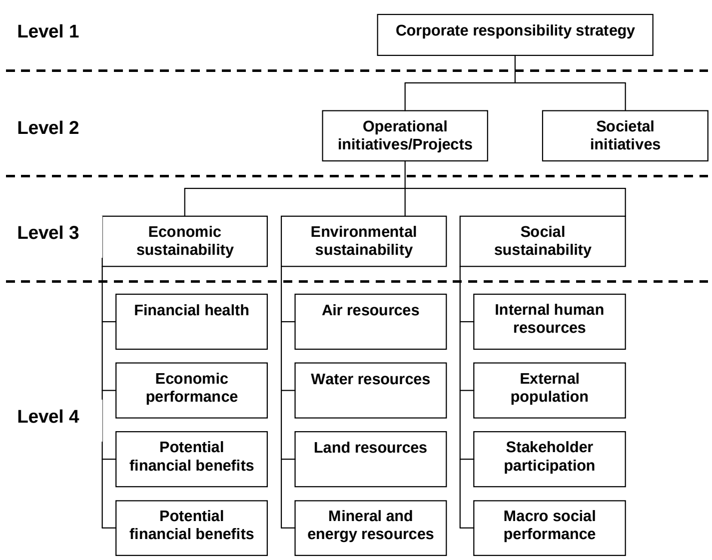

Figure 4. Proposed Framework to assess the sustainability of projects

Environmental Aspects of the Sustainability Framework

The criteria proposed for the environmental dimension of the framework has been guided by the priorities of the South African government with respect to the environmental aspects of sustainable development [24]. These criteria are similar to those that have been proposed to evaluate Clean Development Mechanism (CDM) projects within South Africa [25], and to assess the overall impacts of life cycles systems in the South African context [26]. It has an external focus with four natural resource groups as main criteria. The main criteria are summarised in Table 2 [20].

Table 2. Main Criteria of the Environmental Dimension [20]

Category/Criteria	Definition
Environmental Sustainability	**The environmental dimension concerns an organization's impacts on the environment due to an introduced technology. It has an external focus and addresses impacts on air, water, land and mined abiotic resources.**
Air Resources	Air Resources assess a technology's contribution to regional air quality effects (e.g. visibility, smell, noise levels, etc.) as well as to global effects such as global warming and stratospheric ozone depletion.
Water Resources	Water Resources assess the availability of clean and safe water by focusing on a technology's impacts on the quantity and quality of water.
Land Resources	Land Resources assess a technology's impacts on the quantity and quality of land resources, including aspects such as biodiversity, erosion, transformation and rehabilitation ability, etc.
Mined Abiotic Resources	Mined Abiotic Resrouces assess a technology's contribution to the depletion of non-renewable mineral and energy resources.

Procedure to incorporate Environmental Aspects

The main part of a formal Environmental Impact Assessment (EIA) is normally carried out during the development phase of the project life cycle (see Figure 1). Assessing environmental impacts during the preceding phases (pre-feasibility and feasibility) and gates 1 to 3 ensures a proactive approach whereby potential liabilities are identified at an early stage. An Environmental Evaluation Matrix (EEM) tool is introduced to assist in the gathering of environmental information for project appraisal before Gates 1, 2 and 3 of the project life cycle framework (see Figure 1). The matrix is completed in the phase preceding the gate and also serves the purpose of enforcing the "Design for Environment" principles [27]. The same matrix is used for all three gates. However, the level and detail, as well as the scoring methods, differ for each gate. The horizontal axis of the matrix lists the four identified environmental groups, while the vertical axis lists the critical life cycle phases with their main associated activities, i.e. construction, operation and decommissioning (see Figure 5) [20]. The one-on-one interaction (e.g. cell C1,1) between every main activity and each environmental factor is evaluated in order to rate the intensity of possible environmental impacts that may result from the interaction.

	WATER	AIR	LAND	MINED
CONSTRUCTION				
Supply Processes	C1,1	C1,2	C1,3	C1,4
Site Selection & Development	C2,1	C2,2	C2,3	C2,4
OPERATION				
Supply Processes	O1,1	O1,2	O1,3	O1,4
Primary Process	O2,1	O2,2	O2,3	O2,4
Complementary Processes	O3,1	O3,2	O3,3	O3,4
Products	O4,1	O4,2	O4,3	O4,4
DECOMMISSIONING				
Supply Processes	D1,1	D1,2	D1,3	D1,4
Process Implementation	D2,1	D2,2	D2,3	D2,4

Figure 5. Environmental Evaluation Matrix (EEM) [20]

Scoring guidelines for each element are provided for gates 1 to 3. The scoring guidelines are based on possible measurable causes of environmental effects that were determined for each main environmental criterion (see Table 2) as well as on suitable indicators that were identified to measure these environmental effects. It must be noted that only anthropogenic causes typical of the process industry have been considered, i.e. natural or other human activities are not included in the framework. The questions asked in the scoring guidelines focus on the following aspects (from a process industry perspective):

- Design – questions to verify that an optimal environmental friendly design, that meets the specifications, has been achieved during the project phase. These questions must ensure that all alternatives have been investigated. Design incorporates the design of the process, maintenance as well as planned maintenance shutdowns.
- Planned Impacts – question that address the quantity and intensity of direct and indirect impacts as well as ways to minimize these impacts.
- Unplanned impacts – under this aspect questions addressing accidental releases are included.

All three of these aspects are not applicable to all activities. The principles of Industrial Ecology and Streamlined Life Cycle Assessment serve as the foundation for the questions that are used in the scoring guidelines, which are primarily based on published “Design for Environment” approaches [27,28,29]. Only one question is asked at gate 1 and examples of worst-case scenarios are listed. The final score is either 1 or 5. The lowest value of one is chosen as any industrial operation has an effect on the environment to some extent; it is only the intensity of that effect that differs. At gate 2 a set of questions must be completed for each cell of interaction in order to rate the possible impact. It is assumed that the designers know only planned impacts, i.e. impacts that will occur on a continuous basis after implementation.

Gate 3 considers planned as well as unplanned impacts, e.g. accidental spills, and a risk factor for each question is determined from a scoring grid. A value of High, Medium or Low is assigned to the probability of occurrence, as well as the intensity of impact. These values are typically company-specific, e.g. a high probability and high intensity risk would be allocated a value of 5, and low probability and intensity a value of 1. Probability of occurrence is assessed through a conservative approach based on expert opinion, i.e. uncertainty is always rated as a high risk. The risk factor for each cell (interaction) is determined by adding the risk factors of each question in the cell’s question set.

The completed matrix shows a rating for the impact of each phase on every environmental factor as well as a rating for the total impact on each of the environmental factors. The matrix determines whether the interaction between a specific activity and specific resource can be viewed as a possible area of environmental concern. Possible areas of environmental concern are referred to as hotspots. Environmental hotspots and potential liabilities are identified based on the rating of the matrix element during a specific project gate review:

- Gate 1: Hotspots are elements with a rating of 5
- Gate 2: Hotspots are elements with a rating of 3 or higher
- Gate 3: Hotspots are elements with a rating of 9 or higher

The information about hotspots must be communicated to decision-makers and it must therefore be incorporated into the decision-making process. The hotspot information must also be communicated to the next phase as points to consider during the design. Thereby, it is ensured that process designers adequately address potential environmental liabilities, and gate reviewers consider the implications before proceeding with the project.

Case Study: Application of the Environmental Evaluation Matrix (EEM) tool

The EEM tool has been applied to a project in the South African process industry as a case study. The goals with the case study were to determine:

- The relevance of the tool by evaluating the environmental impacts applicable to process industries,
- The amount of value added to the decision-making process or knowledge base, and
- The ease with which the tool could be applied and used.

The project, identified by an industry partner, had successfully passed gates 1 and 2, but was stopped before it entered gate 3 due to changing market conditions. The draft Environmental Impact Report was nevertheless finished, and it was later used as a basis for a similar project the company undertook. The same system boundaries that were applied for the EIA were used for the purposes of the case study. Technical experts that were involved in the project were identified and completed the scoring guidelines questions of the EEM tool. Technical reports were used to determine what information was available when the project moved through gates 1 and 2. Feedback sessions were held with the process engineers who managed the technical aspects of the projects and who completed the scoring guidelines, as well as with environmental specialists within the company. The completed EEM for each gate is shown in Figure 6.

Gate 1:

		Water	Air	Land	Mined
Construction	**(10)**	**6**	**2**	**2**	**6**
Supply Processes		5	1	1	5
Site Selection & Development		1	1	1	1
Operation	**(20)**	**16**	**12**	**4**	**12**
Supply Processes		5	1	1	5
Primary Process		5	5	1	5
Complementary Processes		5	5	1	1
Products		1	1	1	1
Decommissioning	**(10)**	**6**	**2**	**2**	**2**
Supply Processes		1	1	1	1
Process Implementation		5	1	1	1
TOTAL	**(40)**	**28**	**16**	**8**	**20**

Gate 2:

		Water	Air	Land	Mined
Construction	**(10)**	**7**	**7**	**7**	**10**
Supply Processes		4	3	3	5
Site Selection & Development		3	4	4	5
Operation	**(20)**	**10.5**	**9**	**7**	**4**
Supply Processes		4	3	3	3
Primary Process		2	1	1	1
Complementary Processes		1.5	2	3	0
Products		3	3	0	0
Decommissioning	**(10)**	**5**	**5**	**5**	**6.5**
Supply Processes		0	0	2	1.5
Process Implementation		5	5	3	5
TOTAL	**(40)**	**22.5**	**21**	**19**	**20.5**

Gate 3:

		Water	**Air**	**Land**	**Mined**
Construction	**(50)**	**15**	**19**	**22**	**10**
Supply Processes		10	9	9	5
Site Selection & Development		5	10	13	5
Operation	**(100)**	**47**	**28**	**34**	**32**
Supply Processes		21	11	11	17
Primary Process		16	7	11	5
Complementary Processes		5	5	5	5
Products		5	5	7	5
Decommissioning	**(50)**	**20**	**10**	**11**	**10**
Supply Processes		13	5	6	5
Process Implementation		7	5	5	5
TOTAL	**(200)**	**82**	**57**	**67**	**52**

Hotspots

Figure 6. Environmental Evaluation Matrices (EEMs) for gates 1 to 3 for the case study

The strengths and weaknesses that have been identified and analysed from the case study, based on the received feedback, emphasise that the following must be considered to further develop and implement the EEM tool adequately:

- The generic scoring guidelines must be adapted. More details must be incorporated that are company-specific, i.e. understandable to designers and gate reviewers.

- The EEM approach can be applied efficiently within the time frames allocated for projects, but management must allocate a responsible team that comprises of the necessary technical and environmental expertise.

Additional case studies must be undertaken in order to evaluate the Environmental Evaluation Matrix (EEM) approach thoroughly, which will also establish baseline values for the EEM tool, i.e. how assessed projects compare with previous acceptable projects in a specific company. A case study of a "real-time" project, as it moves through the phases and gates, will also enable a conclusion on the impact of the EEM tool on the design and decision making phases.

The current version of the EEM tool can consequently be described as a framework to evaluate the environmental performance of projects for the decision-making process in the process industry. It does not, however, stipulate the means of introducing the results into the overall decision-making process. Two approaches could be considered: a valuation route whereby environmental impacts are translated into monetary values, and Multi Criteria Decision Analysis (MCDA) methodologies to compare the environmental impacts with other project-related information [20, 30, 31].

Social Aspects of the Sustainability Framework

Businesses are increasingly paying more attention to the social dimension of sustainable development, mainly due to an experienced shift in stakeholder pressures from environmental- to social-related concerns [6]. The last decade of the twentieth century marked some significant steps taken to draw the social dimension of sustainable development into the open [32]. However, the inclusion of social aspects in the sustainability debate and practice has been marginal compared to the attention the other two dimensions are receiving, especially from a business perspective [32, 33, 34]. It is believed that the state of development of indicators or measurements for social business sustainability parallels that of environmental performance approximately 20 years ago [35]. This is mainly due to the problematic nature of social indicators and measurements, which is due to two principal reasons, namely:

- Social issues do not have any underpinning in an objective speciality like ecology, and
- Social issues have a much higher cultural content, thus various perspectives can feature in one issue [36].

The business perspective is further complicated by the question of whether a particular social issue is relevant to the company, i.e. should the company be concerned about it and does this concern justify company involvement [37]? Since the aim with the sustainability framework is to evaluate the sustainability performances of projects, the social dimension of the proposed framework is concerned with the company's impacts on the social systems in which it operates, as well as the company's relationship with its various stakeholders. Definitions for the main criteria of the framework are provided in Table 3. Each main criterion consists of sub-criteria (see Table 4 for more detail and information).

Table 3. Main Criteria of the Social Dimension

Category/Criteria	Definition
Social Sustainability	**The social dimension concerns the technology's impact on the social systems in which it operates, as well as the organization's relationships with its various stakeholders during the development, operation and decommissioning of a technology.**
Internal Human Resources	Internal Human Resources focuses on the social responsibility of the company towards its workforce and includes all aspects of employment (e.g. employment practices, work conditions, workforce development, etc.)
External Population	External population focuses on the impact of the technology on a society, e.g. impact on availability of services; community cohesion, economic welfare, etc.
Stakeholder Participation	Stakeholder participation focuses on the relationships between the company and ALL its stakeholders (internally and externally) by assessing the standard of information sharing and the degree of stakeholder influence on decision-making.
Macro Social Performance	Macro Social Performance focuses on the contribution of an organization (and its technology) to the environmental and financial performance of a region or nation (e.g. contribution to exports).

Results of a Pre-Survey on Social Criteria

A pre-survey has been conducted in the South African process industry to establish the suitability of the social criteria, as well as the relevance of the criteria in the framework, in terms of sustainable business practices and specifically project Life Cycle Management. One company in the South African process industry has been used for the pre-survey. The 23 participants of the pre-survey were requested to rate the relevance of the different criteria in the proposed framework on a scale from 1 to 3, i.e. low, medium, and high. The participants were further required to provide an indication of whether the criteria are represented at the correct level in the framework (Figure 4). The results of the pre-survey are summarised in Table 4.

Table 4. Pre-survey results of the relevance of the social criteria for project sustainability assessment, and the appropriateness of the level of the different criteria in the proposed framework

Criteria	Relevance[a]		Correct level[b]	Geometric mean[c]
	High	Medium		
Internal Human Resources	69.57 %	26.09 %	86.96 %	2.6
• Empoyment Stability	47.83 %	43.48 %	82.61 %	2.3
• Employment Practices	26.09 %	69.57 %	86.96 %	2.2
• Health & Safety	82.61 %	17.39 %	52.17 %	2.8
• Capacity Development	60.87 %	30.43 %	86.96 %	2.4
External Population	56.52 %	39.13 %	86.96 %	2.4
• Human Capital	69.57 %	26.09 %	78.26 %	2.6
• Productive Capital	43.48 %	47.83 %	82.61 %	2.3
• Community Capital	26.09 %	43.48 %	82.61 %	1.8
Stakeholder Participation	47.83 %	47.83 %	86.96 %	2.4
• Information Provision	21.74 %	56.52 %	82.61 %	1.9
• Stakeholder Influence	26.09 %	69.57 %	86.96 %	2.2
Macro Social Performance	13.04 %	78.26 %	86.96 %	2.0
• Socio-economic Performance	65.22 %	30.43 %	82.61 %	2.5
• Socio-environmental Performance	39.13 %	56.52 %	82.61 %	2.3

a - Percentage of survey participants that rated the relevance of each criterion according to a high, medium and low scale. Percentage of participants that indicated a low relevance is the difference between the sum of the high and medium percentages and 100 %

b - Percentage of survey participants that indicated that the specific criterion is represented at the correct level within the framework (Figure 4)

c - Geometric mean values of the relevance ratings of the survey participants, i.e. a high rating was given a value of 3, medium a value of 2 and low a value of 1

The social criterion "Macro Social Performance" was identified as the least relevant to business sustainability. This can, however, be due to the definition used as well as the fact that the criterion is often seen as an economic sustainability criterion. The sub-criteria of "Internal Human Resources", "Stakeholder Participation" and "Macro Social Performance" were all received well. An outcome of the pre-survey was that 40% of the respondents stated that the criterion "Health and Safety" should manifest on a higher level within the framework. The outcome can be rationalised considering the extensive health and safety campaigns that have been launched in the South African process industry over the last two decades [38]. The sub-criteria of the "External Population" criterion was not received particularly well, especially the "Community Capital" criterion, which was deemed not relevant by more than 30% of the participants. This outcome indicates that the paradigm shift of businesses taking responsibility for their social impacts on external communities have not yet taken place under all role players within the South African process industry. The results of the pre-survey therefore show that some of the criteria definitions may have to be redefined in the structure of an extensive survey in the South African process industry.

CONCLUSION AND THE WAY FORWARD

Business sustainability is becoming a prerequisite for global competitiveness and companies worldwide are aligning their core competencies and business processes with the principles and objectives of sustainable development. The strategic importance of project management drives the integration of environmental and social sustainability objectives into a life-cycle project management framework. This paper proposed a framework to assess the sustainability performance of a project in the process industry. Furthermore, it provides a procedure to integrate the environmental aspects into current project management frameworks.

However, with regards to the social aspects of business sustainability the following work is still required to ensure compliance with true business sustainability:

- An extensive survey is underway in the South African process industry to establish the respective weighting values (and subsequent relative importance) of the different social criteria in the proposed framework for overall sustainability performances. The weighting values will be based on the perceptions of (project) decision-makers in the South African process industry.
- Indicators for the different social criteria and sub-criteria (see Table 4) must be defined, which are appropriate for the type of information that is available (pertaining to the operational and product life cycles) in each project life cycle phase separately.
- Case studies of the different operational and project life cycle phases are to be undertaken to establish the suitability of the indicators.
- The indicators must be incorporated into real time project appraisals and decision-making processes to assess the relevance of introducing the indicators into project management methodologies.

The indicators, case studies and subsequent project appraisal evaluations will therefore also focus on the process industry, and specifically large petrochemical companies. Sustainable project management, however, is only part of a truly sustainable business. Sustainable development must manifest in all business processes and competencies, which will require a paradigm shift in the South African industry.

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