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Exploring Alternatives of Accounting for Environmental Liabilities in the Company's Balance Sheet

Fernando A. Bortuluzi[1], Feni Agostinho[1], Cecília M.V.B. Almeida[1], Silvia Bonilla[1], Biagio F. Gianetti[1]

[1] Post-graduation Program on Production Engineering, Paulista University (UNIP), São Paulo, Brazil, Rua Dr. Bacelar 1212 CEP 04026-002
{Feni Agostinho, feniagostinho@gmail.com}

Abstract. Environmental concerns have recently reached the stock market, in which investors want analyze the company's related-risks in causing environmental damages. Usually, the Company's Balance Sheet (CBS) is summarized, disallowing a clear interpretation of environmental issues. Moreover, methods used to valuate environmental liabilities are often subjective, which create communication problems. The aims of this work are (i) to explore alternatives for CBS structural presentation to clearly represent environmental liabilities, which allow efficient communication with society and investors, and (ii) to assess a methodological alternative of valuating environmental liabilities under economical terms. The "Petrobras" S.A. Brazilian Oil Company is taken as a case study by accounting its oil spill related-incidents occurred in 2000 yr. Results show an improved CBS structure that could be used to represent the company's environmental related-issues. Additionally, emergy accounting appears as a powerful alternative to replace contingent valuation in quantifying environmental liabilities.

Key-words: emergy accounting; integrated report; Petrobras S.A.; oil spill.

1 Introduction

History has many examples of companies that passed from successful to failure examples, such as the American Company Enron in the 90's, and, recently, the American Lehman Brothers and the Brazilian EBX group. These examples expose a similar problem: the weakness of the current model to represent the Company's Balance Sheet (CBS). Since 2010, the top-100 worldwide companies are discussing the creation of a new CBS structure, considering an integrated thinking and a more holistic perspective. This proposal is being labeled as Integrated Report (IR) [1], which goal is to clearly represent the company's targets at long term and the strategies to get there. In this sense, several important aspects as human, natural, and intellectual capitals are also being considered instead of exclusively financial results. The IR, which intends to be in harmony with sustainable development, is severely criticized in some studies [2] due to the difficulties in integrating biophysical accounting with the many existing cores of financial accounting conventions.

Similarly to IR, some studies [3] have already argued that provisioning for environmental damages should be present in the CBS, otherwise, distorted information is obtained in which the liabilities are undervalued and equity overvalued. Not accounting for liabilities at the same year of occurrence – usually due to judicial

delay – can also affect the company's future performance and result in economical losses; and investors will not have in traditional CBS enough indicators for the efficient evaluation of the company's economical performance, especially regarding to judge risks on investing in the company.

The traditional financial accounting techniques are unable to measure resources and services provided by biosphere, as well as all the environmental impacts caused by releasing high concentrated wastes on natural environment. This accounting limitation is due to a lack of market value of environmental goods and services. Some studies [4] have warned about the need for developing and standardizing trustable methodologies to quantify the environmental performance of companies. The valuation of environmental liabilities, for a long time, is realized under subjective approaches, which do not represent real values for repair or substitution [5]. In this sense, the environmental liabilities must be objectively quantified (i.e. under biophysical approaches) to be included into the CBS. Efforts were made to quantify liabilities by using eMergy methodology [6], and to integrate eMergy with bookkeeping techniques [7, 8]. However, none of them have explored the inclusion of the quantified liabilities into the CBS in a way they can be accessible to interested pubic and clearly represented by scientifically accepted methods.

This work explores alternatives for representing the environmental liabilities into the CBS, focusing on an efficient communication about the company's economical performance for the general society and investors. For this, raw data from [3] is used considering as case study the published 2000's CBS of the Brazilian Oil Company "Petrobras" S.A. Emergy accounting [5] is suggested as an alternative scientific methodology in providing a biophysical perspective to quantify environmental liabilities.

2 Methodology

2.1 Case Study Description: Brazilian Oil Company "Petrobras"S.A.

The case study is considered mandatory to solidify the ideas under discussion and to point out how and where the liabilities could be estimated and included. Negative externalities caused by oil spill incidents are considered due to their high impact on environment and society. It is worth to say that Petrobras S.A. is signatory of the International Integrated Reporting Council. The oil spill incidents that occurred in Brazil 2000 yr were accounted and described in detail by [3]. In short, about 78,740 oil barrels spilled under three different incidents, each one resulting in different damages.

2.2 Studied Alternatives for Presenting Environmental Liabilities into the Balance Sheet

Two alternatives of presenting environmental liabilities into the CBS are assessed and compared to the traditional CBS labeled as Baseline; considering the current Brazilian law for financial accounting techniques (no. 6,404/1976), as well as recent alterations by laws no. 11,638/2007 and 11,941/2009. It is worth to say that these

alterations aimed to get closer and be compared with definitions and structures of international rules. The Baseline and the two alternatives discussed in this paper are the following:

(a) Baseline: Traditional accounting approach considered in Brazil according to law no. 6,404/1976. This approach does not foresee any inclusion and/or disclosure of environmental liabilities into the CBS.

(b) Alternative #1: Accounting approach suggested by [3] aiming to improve the regulations of law no. 6,404/1976. These authors intended to establish an alternative way to include the environmental liabilities into the CBS by expressing clearly the related economic amount and its influence on the company's "equity" indicator.

(c) Alternative #2: The suggested accounting approach in this work according to law no. 6,404/1976 and its alterations by laws no. 11,638/2007 and 11,941/2009. The intention is to establish a clearer structure for CBS compared to that proposed by [3]. Initially, it is emphasized that alterations of law no. 6,404/1976 have created a category "intangible" within the subgroup "noncurrent assets", which represents the value of immaterial assets (e.g. exploration rights, copyrights, franchise rights, trademarks, licenses, and softwares).

2.3 Studied Alternatives for Environmental Damages Valuation

The role of using contingent valuation in the assessment of natural resources damage and public-decision making has become a major topic of debate for the economic community [9], although it is the most used method to valuate environmental damages [10,11]. Additionally, as emphasized by [12], the use of stated preference valuation methods is necessarily sensitive to individual emotional concerns, resulting in high heterogeneity among individual's samples.

Alternatively to traditional economic approaches, the use of biophysical approaches to quantify environmental damages is increasing in scientific literature, in which eMergy accounting is receiving special emphasis. Emergy (spelled with an "m") is "the available energy of one kind previously used up directly and indirectly to make a service or product" [5; p.7]. A full description of emergy methodology, meanings and rules is beyond the scope of this paper, but deeper information are available at several published scientific works including, among others, the classical book of H.T. Odum [5].

Emergy is used in this work to estimate the environmental damages caused by the oil spill incidents of Petrobras S.A. Brazilian Oil Company in 2000 yr. For this, the previous emergy evaluation of Exxon Valdez oil spill in 1991 done by [6] is used as reference for the emergy of damage estimation caused Petrobras S.A.; from this work, we have estimated an average value of 8.15E22 seJ representing the impacts on natural biome caused by 258,000 oil barrels spilled in 1991 during Exxon Valdez incident. The emergy per money ratio of Brazil in 2000 yr of 7.80E12 seJ/$ [13] is used to convert the emergy of damage from solar emjoules (seJ) into emdolars (Em$) units, which can be later compared to the values of environmental liabilities quantified under economical approach as published by [3].

3 Results and discussion

3.1 Assessing Alternatives for Presenting the Environmental Liabilities into the Balance Sheet

Table 1 shows the balance sheet as divulgated by Petrobras S.A. related to its performance in 2000 yr. It can be noted the lack of detailed information regarding the economic investment on prevention of environmental incidents in the "assets" group, as well as the absence of a detailed description of economical obligations in the "liabilities" group related to the environmental damages caused. It is worth to say the existence of laws (no. 9,605/1998) regarding the inclusion of these items into the CBS at that time, which foresaw criminal responsibility for environmental impacts. The lacunae in Table 1 represented by symbol "?" indicates items that were not foreseen by the accounting regulation existing in 2000 yr, thus they were not considered in the Baseline structure for the CBS evaluated. The existence of these lacunae highlights the inability of this CBS structure in showing clearly the company's liabilities – when considered! -, which disallow deeper evaluations about the company's economic performance by society and investors.

Table 1. Traditional (Baseline) annual balance sheet of Petrobras S.A. for 2000 yr (values in 1,000 $)

Asset (A)		Liabilities (B)	
Total current assets	11,670,386	Total current liabilities	12,604,377
Total LG receivables	9,245,301	Total LG obligations	9,122,181
Permanent assets		?	?
Investments	5,300,076	?	?
Properties	9,020,700	?	?
?	?	Equity (C)	13,802,668
?	?	?	?
?	?	?	?
Deferred	292,762	?	?
Total (A)	35,529,227	Total (B) + (C)	35,529,227

LG = long-term

Table 2 shows the structure for CBS as suggested by [3]. This structure highlights several information regarding actions for environmental damages prevention, including investments of 300,546 million $ in environmental protection and damages prevention projects. It is also clear the amount of liabilities occurred by Petrobras S.A. due to the caused environmental damages, reaching a value of 1,602,681 million $. This CBS structure shows higher values for "total long-term obligations" than Table 1 (from 9,122,181 to 10,724,863 million $), besides lower values for "equity" (from 13,802,668 to 12,199,987 million $), which could lead to a negative image of company for investors, at least for short-time period. Under a general view, this modified CBS structure can be considered more objective and detailed than the Baseline CBS structure, allowing better understanding by society and investors about where and how money is circulating within company's boundaries, mainly on the environmental-related aspects.

Table 2. Modified (Alternative #1) annual balance sheet of Petrobras S.A. for 2000 yr (values in 1,000 $)

Asset (A)		Liabilities (B)	
Total current assets	11,670,386	Total current liabilities	12,604,377
Total LG receivables	9,245,301	Total LG obligations	10,724,863

Permanent assets		Environmental provision	1,602,681
Investments	5,300,076	*Penalties*	122,950
Properties	9,020,700	*Indemnities*	1,479,730
PEE	300,546	Equity (C)	12,199,987
EPP	?	?	?
?	?	?	?
Deferred	292,762	?	?
Total (A)	35,529,227	Total (B) + (C)	35,529,227

LG = long-term; PEE = Program for environmental excellence; EPP = Environmental performance projects

Table 3 shows the improved structure suggested for CBS. It includes all essential information for a deeper understand about company's economic performance. Besides highlighting the environmental liabilities as also suggested in Table 2, this new structure goes a step forward by detailing other items in the "equity" group to make available and transparent for investors the numbers regarding the reduction of company's goods and services – since this aspect is already regulated by law 11,638/2007. The item "environmental result" shows the value of -1,602,681 million $, which allows an easy-to-understand interpretation about the real impact resulted from the caused environmental liabilities. Moreover, the direct relation between the investments in environmental programs presented in "assets" group (e.g. program for environmental excellence and environmental projects) and the "environmental results" shows a ratio of 1:5, suggesting that low investments in programs for environmental damages reduction could result in higher liabilities.

Table 3. Improved (Alternative #2) annual balance sheet of Petrobras SA for 2000 yr (values in 1,000 $)

Asset (A)		Liabilities (B)	
Current assets	11,670,386	Current liabilities	12,604,377
Noncurrent assets	23,858,840	Noncurrent liabilities	10,724,863
LG receivable assets	9,245,301	Environmental provision	1,602,681
Investments	5,300,076	*Penalties*	122,950
Properties	9,020,700	*Indemnities*	1,479,730
PEE	300,546	Equity (C)	12,199,987
EPP	?	Shareholders	8,251,100
Intangibles	?	Earnings reserve	5,551,568
Deferred	292,762	Environmental result	-1,602,681
Total (A)	35,529,227	Total (B) + (C)	35,529,227

LG = long-term; PEE = Program for environmental excellence; EPP = Environmental performance projects

Table 2 shows that "equity" (12,199,987 million $), which represents the company's economic power, is not detailed in that kind of CBS structure. On the other hand, Table 3 shows the existence of three items for "equity" group: (i) "shareholders", which indicates all money invested by shareholders; (ii) "earnings reserve", indicating the company's activity results; (iii) "environmental result". This last presents clearly the amount of money lost by company due to environmental damages. Inserting the item "environmental result" into the CBS represents, in an easy-to-understand way, the company's expense with environmental damage issues and its commitment in making this information as clear as possible.

Although recognizing that suggested CBS could be considered as a better way to present the company's financial annual dynamics, there still are two lacunae containing the symbol "?": "EPP" and "intangibles". The first one was not considered because Petrobras S.A. had no investment value declared in 2000 yr. The second one ("intangibles") was not considered because this item was created by law no. 11,638 in 2007. "Intangibles" can be considered as a key aspect in this new structure for CBS, because it could provide higher capacity for company's indebtedness or even to overestimate its results according to market functioning. The company's indebtedness capacity can be increased as much as higher its "assets" value, thus the item "intangibles" plays important role because it is composed by the value of immaterial goods (i.e. the immaterial goods tends to be higher as much as higher the company's value in the market).

The CBS structure as suggested in this work by Table 3 aims to make available, in a clear way, all the information regarding the company's financial issues, as envisaged by the general principle of accounting. On the other hand, it must be highlighted that the effect of this kind of CBS structure on the investors' perception is not evaluated, for instance, the issues regarding the investor's confidence by investing in the company (low risk) and the consequent cash injection. However, the study of [4] has indicated a strong relation between a clear divulgation of company's liabilities and the investments reduction by shareholders. All these aspects are being considered more and more by the IR [1] in the search for a more holistic CBS, in which using a systemic strategy could lead to the attraction of "faithful investors" for long time periods. In this scenario, the shares volatilization in the stock market would be strongly reduced as well as the risk in the investment.

3.2 Evaluating Alternatives to Quantify Environmental Damages in Economic Terms

Table 4 shows the in-dollar values of environmental liabilities estimated by economic and emergy perspectives for the oil spill incidents of Petrobras SA in 2000. Two important aspects should be highlighted in this table: (i) the difference between the economic cost of 1,602 million $ (established by court and other national committees for the environment under a willing-to-pay and other subjective approaches) and emergy-based cost of 55 million Em$; (ii) the difference between the emergy-based cost associated exclusively to biota damage of 55 million Em$ and its equivalent when accounting for all information associated after public pressure (3,170 million Em$).

Table 4. Estimative of economic and emergy costs related to oil spill incidents of Petrobras SA.

Description	Value	Unit
Exxon Valdez oil spill in 1991 (258,000 barrels)		
Natural resource loss [a]	8.15 E22	seJ
Petrobras S.A. oil spill in 2000 (78,740 barrels)		
Natural resource loss [b]	2.49 E22	seJ
Economic cost associated [c]	1,602,681,000	$
Emergy cost associated to biota damage [d]	55,619,435	Em$
Emergy cost associated to biota after public pressure [e]	3,170,307,796	Em$

[a] from [6]; it include birds, marine mammals, intertidal producers and invertebrates, phytoplankton, and zooplankton; average value obtained from a Monte Carlo simulation considering a uniform probabilistic distribution function under 10,000 interactions.
[b] assumed as 3.28 times lesser than Exxon Valdez oil spill due to ratio of barrels spilled
[c] from [3]; values set out by court action several years after the Petrobras' oil spill incidents
[d] obtained by dividing the natural resource loss of 2.49E22 seJ by the Brazilian emergy per money ratio in 2000 year of 7.80E12 seJ/$ [13]
[e] according to [5; p.130], the information role related to oil spilled by Exxon Valdez incident resulted in an emergy amplification of 57-fold; this amplification ratio was assumed as the same for Petrobras S.A. case study for calculation purposes

The three different estimated values for the environmental damages caused by Petrobras S.A. in 2000 yr are important as quantitative reference to be included in the CBS, within the item "environmental provision". Table 3 shows the Petrobras' balance sheet by including the liabilities as estimated under an economical view (1,602,681 million $), resulting in a company's "equity" of 12,199,987 million $. Now, considering the liabilities value as estimated under an emergy view (55,619,435 million $), the "equity" is increased by 12.7% reaching 13,747,049 million $, resulting in higher credibility of company by investors and economic development. On the other hand, by considering the liability as estimated under emergy perspective after public pressure (3,170,307,796 million $), the "equity" is reduced by 12.8% reaching (10,632,360 million $), resulting in disrepute of company by investors and low economic development.

According to [5], since half of the world´s empower (emergy flow per unit time) comes from the renewable environment, the amplification value obtained for environmental liabilities after public pressure of 3,170,307,796 Em$ might have been appropriated as a good opportunity to compensate the environmental damage, but mainly to educate companies avoiding future oil spill incidents. This goes in parallel with [11] statement in which, more than educational purposes, there is a need for complementary remediation to compensate for the loss of services during the restoration period. We recognize that there are still some conceptual barriers that must be overcome to reach consensus among the scientific community about the most suitable economic value that should be charged due to environmental liabilities, but emergy methodology suggest to be a powerful alternative which reflects the biophysical donor side perspective.

4 Conclusions

(a) The suggested structure for CBS could be considered as more appropriated compared to other two assessed ones to show in detail the economical performance of companies, mainly regarding environmental aspects. Through this improved structure, society and investors can have better-based information about how company is operating or being managed and its concerns related to environmental damages, which could result in a beneficial image to investors at long time periods.
(b) Quantifying environmental liabilities in economic terms claims for additional efforts among the scientific community. Defining the real objectives in estimating the

economical compensation values should be the first criteria, i.e. establishing purposes for repairing the environmental damage or also including educational purposes. Anyway, emergy accounting suggests to be a powerful approach in quantifying environmental damages.

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