Impact of EMS (ISO 14001) on a Manganese Mine Operations in Gabon: Case Study

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Abstract

The impact of Environmental Management System (EMS) Through ISO 14001:2004 on a Gabonese Mining Company (Comilog) was assessed. Companies around the world nowadays get certified to different environmental standards and some tend to get more than environmental benefits. This study takes a closer look at a manganese company based in Moanda, Gabon. The study investigated the level of implementation of EMS through ISO 14001:2004 as well as the comparison of productivity prior and after a formal implementation of the standards.

Keywords
ISO 14001, environment, productivity, improvement, safety

1. Introduction

In all facets of business operation, there seems to be a strong tendency to go cleaner and clearer in the way of production in order to be environmentally friendly. The number of companies certified to ISO 14001 has increased considerably over the years. An environmental certification gives that favourable image that any business, especially the one in tough competition, would want to have from stakeholders. However, the productivity of an organisation already operating with set management practices is due to encounter changes due the implementation of a new management system compare to the one that its activities considering an environmental standard. Changes can either be positive or negative depending on how the implementation is done. For this study, the Compagnie Miniere de l'Oggoué (Comilog) was chosen as the case study company. It is a mining company operating in Gabon, Central Africa, which was certified ISO 14001 in 2012 and the organization has been in operation since 1962. The researcher focused on departments where the environment aspects were significant and relevant. Thus a comparison of productivity of departments, before and after certification, was carried out.

2. Background of the Study

Unlike quality standards, which seeks to enhance the way of doing business, the environmental systems standards addresses environmental sustainability issues. Thus engaging in environmental protection does not necessarily mean a boost in the productivity. While some researchers have shown that it does, some companies saw no particular changes and others have seen considerable ones in some aspects of the company or in the whole organisation. Moreover quantitative researchers draw up some positive results out of some of their studies but miss this closer view at organisations when evaluating the implementation. This paper, however, presents a closer look at a company, where the researchers have spent some months making a lot of on-field observations. Comilog was chosen as a case study organization as it is one mining company which recently implemented environmental system standards after more than 40 years of operation. Organisations go green for numerous reasons, sometimes by wish or by force. Regardless of the of the reason for embarking on EMS, this route addresses the impact one's on pollution on the environment and not production issue, which is main aim of a company. As such this study seeks to evaluate the impact of adding environmental considerations into a company which has already been running for long time with such systems in place. In order to do so, the researchers had to initially find information about the company's type of EMS in place and its effectiveness. Thereafter the relevant services departments' productivity had to be compared before environmental actions and after. Conclusions were therefore generated and drawn from the comparison.

3. EMS Overview

In order to sustain the development of future generations, the Rio de Janeiro's Earth Summit of 1992 saw many countries, among which was Gabon, signing and agreeing upon the fact that a more serious approach toward the environment must be applied globally (Ruzevicius, 2009). Thus Environmental Management System (EMS), which is a step by step management tool was muted to enable organisations to set, achieve, and evaluate progress toward environmental objectives and targets (Rendell & McGinty 2004, Florida & Davison 2001, Edwards 2004). The mandate of this initiative is to include the care for the environment into an organisation's daily activities.A number of systems were conceived over the years but the two most known to date are ISO 14001 and EMAS. ISO 14001 is an environmental standard designed by the International Organization for Standardization. It is "*the part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes, and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy*" (ISO, 2009). EMAS stands for European Eco-Management and Audit Scheme. Just like ISO 14001, the objective is the protection of the environment from business activities. Moreover this particular one is said to be more rigorous than the previous in terms of effort to reduce environmental impact for it considers the best technology available on the market to set environment measures and tolerances. As such companies have to upgrade their equipment whenever new ones are available (Morrow & Rondinelli 2002).

Following the Deming's Plan-Do-Check-Act approach on Quality Management, the EMS model comprises Environmental Policy, Planning, Implementation, Checking / Corrective Action and Management Review. These five steps are then divided in what is known as the "seventeen elements of EMS" namely (1) Environmental policy, (2) Environmental aspects, (3) Legal and other requirements, (4) Objectives and targets, (5) Environmental management program, (6) Structure and responsibility, (7)Training, awareness and competence, (8) Communication, (9) EMS Documentation, (10) Document Control, (11) Operational Control, (12) Emergency Preparedness and Response, (13) Monitoring and Measurement, (14) Non-conformance & Corrective and Preventative Action, (15) Records, (16) EMS internal Audit, (17) Management Review (Rendell & McGinty 2004:8, Stapleton, Glover and Devis, 2001:15). Literature highlights the three levels of implementation of an EMS as varying according organisations' size, means and preferences (Rendell & McGinty, 2004). The first level of implementation involves a third party certification, where the third part oversees that the implementation is done to required standards. Thereafter, services of a certification company or a registrar is required to assess the conformity of one's EMS to ISO 14001 standards. It comes at a price in form of the registrar fees (Rendell & McGinty 2004, Yiridoe & Marett, 2004). The second level excludes the hire of the registrar. Thus, one cares more about applying standard requirements but do not go for registrar services, generally because of the expensive fees that it implies (Rendell & McGinty, 2004:11; Yiridoe & Marett, 2004, Nishitani, 2009). Then there is the partial EMS implementation which is the third level, and is mainly implemented by companies with not much means. It is the implementation on a

section of the company rather than the company as whole (Rendell & McGinty, 2004:12; Nishitani, 2009). There are several challenges which militate against the implementation of an EMS system. These are internal and in form of the company's ability, readiness and capacity. And they also include lack of resources, defining company environmental policy, costs, time constraints, lack of in-house knowledge, lack of human resources, and identifying environmental aspects. On the other hand, present are external barriers i.e. outside elements that can affect the willingness of any organisation to consider EMS implementation such as: cost of ISO 14001 certification and consultation fee, lack of incentives, lack of government support, as well as high demands on documentation (Massoud, Favard El-Fabel & Kamleh 2010, Halila 2007, Hilary 2004).

A company considering to adopt EMS should consider the following costs:

- Cost of acquiring information necessary for completing the certification requirements;
- Costs associated with record keeping and documentation, and changes in practices necessary for meeting the requirements of the ISO 14001 EMS;
- Employee training, and the opportunity cost of down time due to non-conformance;
- Auditing costs: include both internal and third party auditing costs to verify that the policies and practices established by the organization and required by the standard are being followed; and
- Registration cost paid to an accredited registrar (i.e., national agency that oversees ISO standardization) (Yiridoe & Marett, 2004, Nishitani, 2009).

The nature EMS certification is such that it has to be maintained and most importantly continuously improving the operations and the business. The common costs associated are as follows:

- Periodic audits,
- Continuous management and improvement of the EMS, and
- Marketing and promoting awareness of the environmental implications of and trust in certification (Yiridoe & Marett 2004, Nishitani 2009).

A number of benefits are also accrued by certified companies such as tangible to intangible in the external and internal as shown the below Table 1 (Zushi & Sohal 2004, Matuszak-Flejszman 2009, ISO 2009)

Table 1 ISO 14001 Certification Benefits (Zushi & Sohal 2004)

Benefits from ISO 14001	**Tangible**	**Intangible**
Internal	raw materials saving energy saving, improvement in production system availability, reduction of rejects, reduction of waste treatment costs, exploitation of rejects reduction of idle times, public incentives, health care, insurance cost reductions increased in capacity decreased some logistics costs, increase in resource usage efficiency	Increased motivation amongst the employees. Improved communication across the organisation Sustainable competitive advantage Improved process safety' Increase efficiency and effectiveness improved regulatory compliance
External	Increased insurance from the financial institutions Attracting financial investment companies and reducing insurance premiums Improved long-term relationship with the suppliers/contractors and sub-contractors Reduction in fines due to compliance with legislation	Improved corporate image market opportunities, Better relations with stakeholders Elimination of customer dissatisfaction Due-diligence and removing trade barriers

EMS ISO 14001 standard has experienced a tremendous expansion over the years. Indeed from about 30 300 issued certificates by half 2001, 2006 recorded 125 000 certificates said to be 16% higher than the previous year (Morrow 2002, Matuszak-Flejszman 2009). According to ISO, there were 154 572 in 2007, 284 654 in 2012 and 301 647 in 2013 (ISO, 2013). Out of 171 countries already involved in ISO 14001 certification, China is the one with a bigger number of issued certificates with, 91 590 certificates by the end of 2013 (ISO, 2014). Most certification takes place in manufacturing companies than service ones as pollution occurs mores in the transformation of raw materials and extensive use of machinery. Motivations for manufacturing tend to be more external (e.g. government requirement) and for service more internal (Zushi & Sohal 2004, Chan & Wong, 2006).

4. Methodology

The study was undertaken to assess the impact of ISO 14001 implementation in the performance of the case study company. To gather data necessary, the researchers familiarized with the basics of ISO 14001 and how it was implemented at the company. The methods which were mostly used to collect data were on-field observations, semi-structured interviews, audio-visual materials and company records (Leedy & Ormrod 2013: 151). The researchers had the opportunity to be at the company for six months doing the on-field observations. As for this research interviews were mainly starting as semi-structured where the researchers wanted to know the environmental situation of a department, the actions taken and the impact on the resultant productivity. In order to build a good synthesis the researchers sought to speak to more than one employee of the same department. Company records were referred to as proof of work done as also required by the ISO 14001 standards.

5. Case Study

The Compagnie Minière de L'Ogooué (Comilog) is the second largest producer of high-grade manganese, and it commands about 15% of the global market. The mine is located on the Bangombé plateau in the Haut-Ogooué Province of Gabon. These manganese reserves are said to represent approximately 25% of the world reserves of rich ore. Comilog produces and exports a range of commercial manganese ore and sinter ore from its Moanda deposit, which is used mainly for metallurgy, manufacturing of batteries and chemical industry.

There are three main ore types:

Metallurgical: The metallic ores represent the largest share of the non-agglomerated production. They are primarily intended for use in steel. The average grade of the ore family varies from 44 to 51% of metal ore with thresholds for other chemical elements such as phosphorus, silica, alumina, iron, etc.

Manganese dioxides: Manganese dioxide ores represent 3 to 5% by volume of production and are intended for the manufacture of batteries. These minerals are characterized by their high grade of manganese dioxide (81% MnO2), with maximum tolerance levels for other items.

Chemical: The chemical minerals represent 15% of the production volume. They are intended for the hydrometallurgical and chemical uses. These minerals from metallic ores are characterized by a finer particle size. They are developed in part by washing and screening the extracted ore at the quarry on the Moanda deposit and secondly by means of a technique called Dense Media Separation.

Agglomerate: The agglomerate developed in Moanda industrial complex (MIC) is a value-added product from the fine ore as its very low manganese grade and granulometry does not allow commercialisation in this state. These fine ores are enriched and then agglomerated to obtain a product with high manganese (58% Mn).

The company acquired its ISO 14001 certification in 2012 i.e. after 50 years of operations without a proper environment management system even though some actions had been taken before. The company was facing pressures from the government and the local population. Indeed the main problem faced by the company was the one of the Moulili River, 32km long river which saw itself filled up by manganese fines rejected by the main washing plant into the natural environment. The river's bed had been heavily silted and the population drinking this water suffered sicknesses. Another environmental challenge was that the company caused soil pollution, excessive use of natural resources and many others.

6. Results and Discussion

6.1 Formalisation of EMS

The Environmental Management System of the company went into a formalisation process from 2010 when top management decided to go for ISO 14001:2004 certification. As such the company rented the service of a coach, a third party which conducted two evaluation audits in January and March 2012 and a pre-certification audit in early

July 2012. Each audit was concluded by comments to help improving the EMS to be ISO 14001:2004 compliant. At the end of July the same year, the company rented the services of a more renowned consultant, which is represented in 140 countries. This showed the seriousness of the company regarding the desire to go public. Thus the first certification Audit revealed one major and five minor nonconformities. And after six months, a follow-up audit was done to finally certify the company's EMS's conformance to the ISO 14001:2004 standards.

6.2 Impact on core production

As mentioned above, before the formalisation of the company's EMS some actions had been taken before. In 2000, firm had to initiate the construction of the CIM (Moanda Industrial Complex) which became the main raw material washing plant for production wastes. Indeed this washing had been releasing water-laden with manganese fines, mud and sand. Because manganese is insoluble it formed a huge spoil tip right under the washing plant and invaded the Moulili River (Fig1).

Figure. 1 Moulili River Deposit Tip (Thierry Ngoundou Boulamatari 2015)

As a result, the CIM has been contributing to the production of the company, representing 20% average of production from a tonnage perspective from the year 2001 (Fig 2) and added the Agglomerate Manganese in the product range.

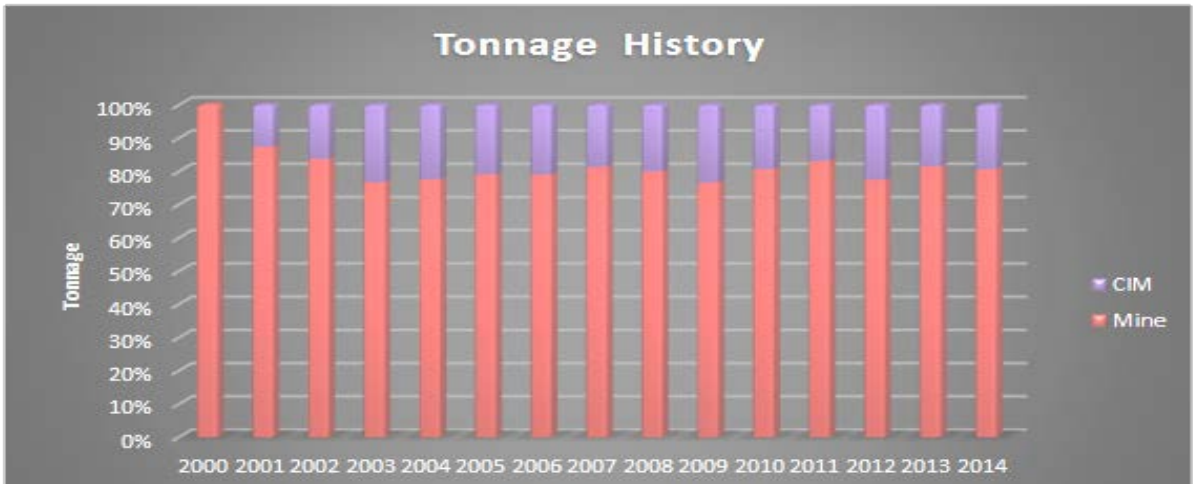

Figure.2 Tonnage Contribution

The company also decided from the year 2010, which was the beginning of the certification process of its EMS, to cure the river affected by its previous operations. This helped the CIM stop taking sand (needed for its transformation) from the Oggoue River (with 99% of Silicon), a natural resource, and use the sand from the Moulili river while curing it. Moreover the Moulili's Sand (MS) appeared to be more beneficial than the Oggoue's Sand

(OS) in the sense that it contained some manganese already. It is important to remember that this sand comes from the extraction of the ore and the washing process. This sand was obtained by separation of ultrafine (0 to 0.1 mm), manganese sand (0.1 to 1 mm) and manganese fines (1 to 10 mm). Then it was beneficiated and reached a grade level of 46% Mn and 5 to 7% silica (SiO_2), 5 to 6% Al_2O_3. On the environmental point of view, the company is no more using the Oggouee Sand which is a natural resources but is now helping the Moulili River to regain its normal shape. On the operational view, the quantity of beneficiated manganese needed for the sintering process decreased because of the manganese present in the MS for a given quantity of agglomerated product. The left beneficiated manganese has since then sold to external customers, thus added into the company's product range.

6.3 Impact on maintenance department

In the department of maintenance the formalisation of EMS brought some more task in the work process. In an agreement with a supervisor and as a way to measure difference occasioned by the changes in operations, the following work process came out. One shows the work before and the other one after the formalisation.

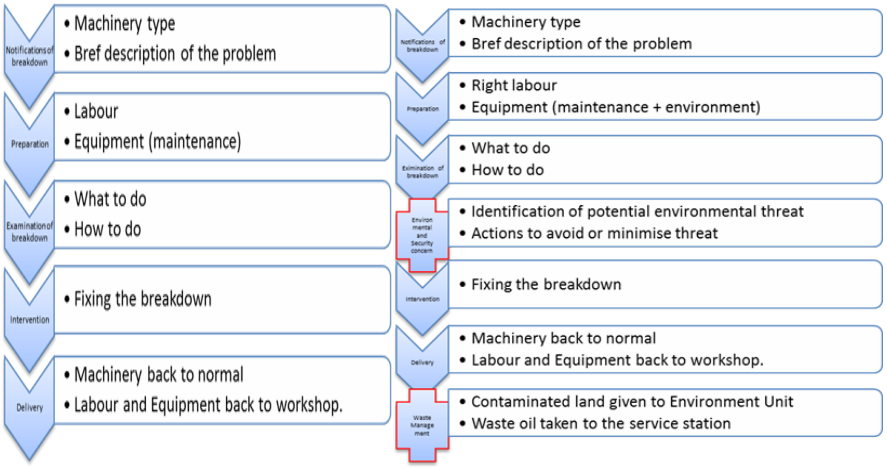

Figure. 3 Comilog Maintenance Incorporating Enviromental Aspects

In the above Figure 3, two compulsory steps were added because of the company's engagements towards the environment. In environmental protection, things must done in a way that if everything goes well, not a single drop of oil or grease for instance falls on the ground. As a result the mechanics must make sure that all the necessary equipment at hand and all operational procedures are respected. It shows how much environmental concern it taken into consideration. However on a productive front, it has a positive impact on the maintenance work backlog. The maintenance work backlog is a measure in means of hours of the work to be performed by a maintenance department (Wireman 2005, p. 33). Consequently if the work backlog increases, the production department will have less machinery available, thus production slows down.

The maintenance department was alerted by the ISO 14001 external auditors about the excessive recurrence of hydraulic hose breakages. In fact the company used heavy machinery in which oil is essential and circulates through hoses at high pressure i.e. up to 5000 psi (34.5 Mpa = 345 bar). Even though these hydraulic hoses are built to handle such a high pressure of oil, they nevertheless are required to be replaced after a period of time generally determined by the manufacturer (Parker Hannifin Ltd 2008, pp. Aa-1). Regarding Comilog a maintenance schedule does exist it is shown in Figure 4 below:

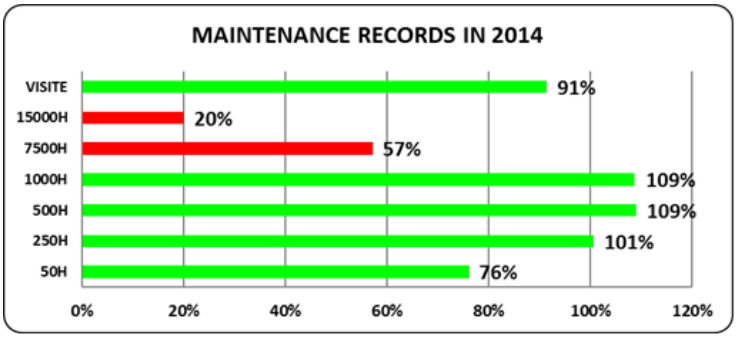

Figure. 4 Camilog Hydraulic Hose Maintenance Records

The green lines on the figure above showed that objectives had been reached and red ones had failed in this regard. Even though five out of seven objectives seemed to have been achieved, it is important to understand that the 15000H and 7500H are the major maintenance cases; with only one overall maintenance. This maintenance included even a new engine in which the machinery had a replacement of all hydraulic hoses. Other type of maintenance also considered hydraulic changes or checks but not as thoroughly as the major ones. The problems with 7500H and 15000H were caused mostly by the fact that the production side did not release machinery for maintenance on time. As a result the environment considerations would be always at risk as well as compromising the productivity of the maintenance department.

6.4 Impact on main warehouse

The other department covered by the study was purchasing, as the main warehouse had to go through several changes in order to be ISO 14001 compliant. In fact with the intention to get their EMS certified to ISO 14001 the warehouse had to deal with anarchic storage of dangerous material; potential chemical reactions of dangerous products mixing together; dangerous products exposed to rainwater and any ambient temperatures; soil, air and water pollution. For this reason the following actions were taken from the year 2010: identifying all chemical products available at hand, grouping chemicals with identical pictograms, construction of appropriate storage facilities for chemicals and storing chemicals on retention trays. Therefore these actions impacted both the environment and the productivity positively. Hazardous products are now stored accordingly as adequate storage facilities were built for this purpose. There is a clearer visual categorization of products as shown in Figure 5 below.

Figure. 5 New Warehouse Material Categorization Order (right)

The clearer vision and organisation of material makes it easier now for new employees' to adapt. The figure below displays the layout of the warehouse. From 2010 to 2015 the green and grey section were built. Grey sections are just roof covered and open on the sides while the grey ones are completely closed and air conditioned for goods requiring such features.

Figure.6 Warehouse Space Reorganized

7. Recommendations

It appears from the above data that the environmental concern has had impacts that are both good and bad depending on the departmental activities being carried out. From around year 2000 to the ISO 14001 certification in 2012, impacts in terms of production are positive. This is explained by the process of recycling manganese fines and sand that used to be considered as waste. As a result of that recycling, new product were added to the range of the company. However the maintenance work backlog of the maintenance department is now subjected to take longer than before due to environmental concern. The best recommendation has to always have all equipment ready in order not to waste much time when a repair is needed. Regarding the oil pollution due to hydraulic hoses breaks, the solution lies between a better understanding between both production and maintenance department. Indeed if the maintenance program is properly followed they would be less chance to have these hoses break. This also shows that despite the desire to be environmentally friendly, production always remains the number one priority of a company especially when there was no EMS from the beginning of operations. The warehouse has seen great improvement of its productivity and environment performance as well. From an archaic storage to a complete reshaping of it facilities, it now enjoys good work performance and less product.

8. Conclusion

The idea that EMS with or without certification can enhance a company's performance has been assessed in a Gabonese mining company. The results show that some departments have improved on their productivity and some did not. Because this research was done in the mining industry only and in some departments that seem to be relevant to the research, results cannot be generalised. However one important aspect of such a research is to show

the importance of conducting such a study in a qualitative approach. It was found that in industries such as the mining one, recycling is the key to productivity improvement. As it is known globally through Lavoisier, nothing is new but everything get transformed. Hence further study may need to be undertaken to see whether service industries can benefit from EMS in the same manner.EMS ISO 14001 was recommended as an "enabler of good business" as seen in the warehouse of Comilog. When activities are performed in a stipulated correct standard way, departments such as warehouse can only gain from it. A formal EMS tends also to be an upset for businesses that have long existed without environmental concern before. When production is the only main focus, EMS can find hard to be properly implemented or followed. In any company going for formal EMS must really be the centre of its operation and strategy especially in the execution of business' objectives.

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Biography

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