International Journal of GEOMATE, Feb., 2017, Vol. 12, Issue 30, pp. 1 - 10
Special Issue on Science, Engineering & Environment, ISSN: 2186-2990, Japan
DOI: http://dx.doi.org/10.21660/2017.30.80102

THE APPLICATION OF THE ENVIRONMENTAL MANAGEMENT SYSTEM AT THE ALUMINUM INDUSTRY IN UAE

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ABSTRACT: Aluminum is the third most abundant element, after oxygen and silicon, and the most abundant metal in Earth's crust. It is widely used in buildings, construction, transport, packaging and general engineering due to its corrosion resistance, durability, insulation capability, structural strength and low-weight, making it the metal of the future. Aluminum is widely used in all UAE construction related projects; however, the sustainability and environmental performance of the aluminum production process is questionable. The production of this metal is associated with many environmental impacts which compromise the sustainable production of aluminum. Aluminum manufacturing is an energy intensive industry and a major contributor to Greenhouse Gases such as CO_2, CFC, and PFC. This industry generates huge amounts of waste such as the Bauxite Residue from the Alumina Refinery process and the Spent Pot-Lining (SPL) from the Smelting process. One of the sustainable solutions is to create a sustainable metal whilst also making a positive net impact on the environment over the life cycle of aluminum products. This solution suits UAE because the aluminum industry is on upstream production, with less emphasis on the use of recycling and secondary aluminum production. As an effective tool to control environmental impacts and improve the environmental performance of any production industry, Environment Management System (EMS) is further studied with regards to the aluminum production process. This research investigates the efficiency of the EMS at UAE aluminum production industry to determine its ability to control the industry's impact, and to attain sustainability standards. The aim of this research is to evaluate the efficiency of the existing EMS and to identify the factors affecting implementation of EMS in the UAE aluminum production. The implementation of EMS in the UAE aluminium industry is heavily affected by regulatory compliance and enforcement gap, transparent leadership, accountability, and human factors.

Keywords: Construction projects, Environmental performance, Aluminium Sustainability, Environment Management System

1. INTRODUCTION

1.1 Background on History and Development of Aluminium in Construction Industry

The first effective usage of aluminum as a construction material in buildings started in 1930s. The first aluminum specification code was established in 1932 [1]. The commercial production process of aluminum was developed in both U.S. and Europe around 1886, prior to which it was considered as a precious metal. Internationally, primary aluminum production has grown to more than 35 million tonnes per year since the 1940. Aluminum is the third most abundant element, after oxygen and silicon, and the most prevalent metal in the Earth's crust. Furthermore, it possesses unique characteristics such as light weight (density is one third compared to steel) and its ability to resist corrosion by forming a layer of aluminum oxide upon contact with air. It also offers a high strength/weight ratio, toughness and easy fabrication [1].

As such, there are many unique structural advantages of using aluminum alloys. In comparison to steel, both materials can provide efficient ductility that can resist mechanical challenges such as buckling, compression, tension and sheer yielding. This has lead engineers to employ aluminum in the design of complete structures such as beams and columns. For example, in 1933, the Smithfield Street Bridge in Pittsburgh, PA, was replaced by an aluminum deck [2]. Aside from the mechanical properties of aluminum, according to Sharp [3] the extrusion process is attractive for contractors and designers due to the relatively low extrusion cost when compared to other construction materials. It can also deliver a variety of different designed shapes. These distinctive features of aluminum, provide designers a freedom of selection and flexibility which grants them an effective metal placement on the construction site.

All of these unique characteristics of aluminum play a vital role in influencing the construction materials landscape. As such, many countries have adopted the use and production of aluminum to cover the materials demand of their construction projects. For example, China reported producing 2,272 metric tonne of aluminum in 2014 according to World Aluminum [4]. This has critically changed the economic growth of China for the last seven years where in each year the economic growth increased rapidly at a rate of 10%. This massive change in the construction engineering field has increased the demand for aluminum production raw materials. This in turn provides third world countries with these raw materials, such as Bauxite, a chance to utilize their resources and boost their economic status [5].

Developing countries such as Gulf Countries, which mainly depend on oil and gas revenues as the main income for their economic strength, has realized the importance of the aluminum industry and its benefits in the construction and economic fields. Such an industry can serve as a vital alternative income source that helps in attaining a sustainable development and a balanced, diversified economy. There are, however, many environmental issues that can be considered real challenges and threats for the aluminum production to become a sustainable industry. United Arab Emirates (UAE) is considered one of the fast growing nations among the developing countries in the Gulf region and its capital is Abu Dhabi. UAE has undergone a large-scale industrial development in the past 10 years. It has become a center for the growth of industrial projects in the region. Since the 1960s, the oil industry has been the main engine of UAE development, with Abu Dhabi being home to the sixth largest oil reserves in the world (about 98 billion barrels). Abu Dhabi also is the world's tenth largest oil producer, at around 2.5 million barrels per day (bpd) [6]. It is worth noting that UAE's economy is the second largest economy in the Arab world with a gross domestic product of $ 377 billion recorded in 2012 after Saudi Arabia. The international monetary fund expects UAE's GDP to increase from $403 billion in 2014 to $448 billion in 2017 [7]. It means that UAE's economy is constantly developing at a sharp rate and this growth is attributed to profits coming from many functioning sectors including the oil and gas sector.

1.2 Sustainability Issues of Aluminum in the Construction Industry

"The aluminum industry is committed to advancing the sustainability efforts of its customers through the use of aluminum," says Heidi Brock, president and CEO of the Aluminum Association [8]. Through this statement, both the aluminum industry and green building guidelines coincide to fulfill sustainable metal requirements for a green building. Radlbeck et. al, [9] agree with Sharp [3] view and confirm that aluminum plays a major role in the sustainability of new buildings and the renovation of existing ones due to its performance properties. Aluminum contributes to the sustainable design, safety and comfort of new buildings. It has a unique feature due to its versatility, malleability and molding that can be used in upgrading existing buildings and historic structures. It lowers energy cost and carbon emissions in construction applications and even can be used in the production of renewable energy from solar sources as aluminum alloys are used in solar panels and cells. Properly coated aluminum roofs can reflect up to 95 percent of sunlight, helping improve building energy efficiency [10]. At the end of its long lifespan, the high intrinsic value of aluminum acts as economic incentive for its recycling through a series of processes that make use of building scraps and cradle-to-cradle life cycle which achieve high environmental and economic benefits.

Other scholars, however, believe that there are many threats and challenges in the aluminum production process such as energy and environmental performances that can affect indirectly the sustainability of aluminum in construction industry. Lawson [11], for example, presents a comparison between several construction materials in the embodied energy levels in the operation and construction stages as shown in Fig. 1 and Fig. 2. Looking into the embodied energy levels of construction materials, it is clear that products with greater embodied energy have increased environmental impacts due to emissions and greenhouse gases arising from high energy consumption in the production process of these products. There is a difference between the embodied energy for construction materials and the embodied energy of materials when they are operational in buildings, as explained in Fig. 1 and Fig. 2. Aluminium has high embodied energy when it is extracted from Bauxite and processed as a metal through smelting as shown in Fig. 1; while it has low embodied energy when used at the operational buildings due to its durability, as explained in Fig. 2.

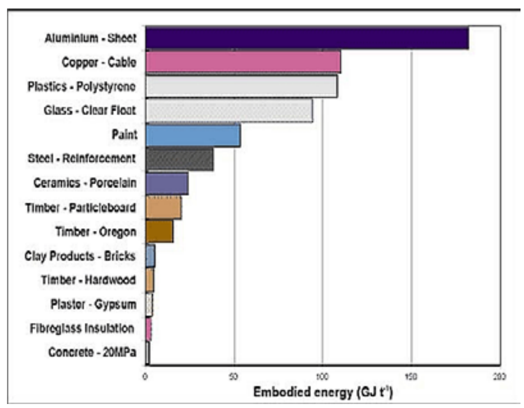

Fig. 1 Embodied Energy of Construction Materials [11]

According to Green [12], most of the proposed solutions and practices towards enhancing and overcoming sustainability obstacles in aluminum construction consist of two components. The first one is from a recycling perspective where many construction scholars believe material recycling for aluminum will save major energy and environmental costs. Frees [13], for instance, mentions that recycling one ton of aluminum as construction material can reduce 2 tons of construction waste and 9 tons of greenhouse gases emissions. Conversely, many construction professionals suggest implementing best practices in the aluminum life cycle can improve the sustainability for the whole aluminum in construction industry. Liu and Müller [14], in their critical review, indicate that to solve and mitigate the high embodied energy consumption and reduced environmental performance, addressing sustainability best practices of Alumnium production is the key. The authors believe that it can be achieved by various methods such as using new technologies that entails less energy consumption therefore leading to lower energy cost and production optimization in the operation process. In the end of the paper, both writers recommend employing EMS during the life cycle of aluminum to reduce environmental impacts associated with their upstream operations.

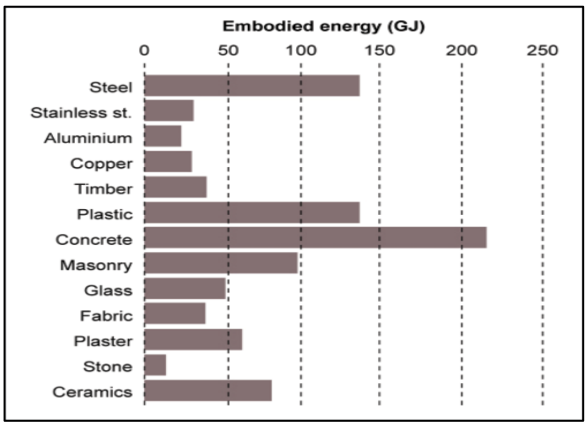

Fig. 2 Levels of embodied energy for materials in Buildings [11]

1.3 Aluminium Industry in the UAE

UAE is a world leader in aluminum manufacturing and its related construction industry, putting it on the global grid when it comes to sustainable environmental performance [15]. According to the Gulf Aluminum Council [16], there is a linear relationship between aluminum usage and the country's GDP. The wealthier the population, the more aluminum is being used in buildings, construction, transport, packaging and general engineering. There are still numerous environmental concerns in the aluminum Industry such as energy consumption, resource management, emissions, air pollutants, and above all sustainability. According to Ewers and Malecki [17], a closer inspect of the impacts of gulf mega-projects offers a great deal of understanding of the geographic and environmental implications of such projects. Given the vulnerability of the Gulf region to environmental stresses such as air pollutants, fragile marine and terrestrial ecosystem, water and electricity consumption, waste disposal etc, it is essential to further explore these environmental concerns in order to properly address the challenges and find suitable mitigation measures to address the associated environmental impact of the aluminum production.

There are many sectors that are expected to shape the economic diversification landscape of Abu Dhabi. Construction industry, construction related materials, construction supply chain and government services account for more than half of all employment. In addition, the metal production industry is the third most important sector driving the economic growth after the energy (oil and gas) and petrochemicals industry. Abu Dhabi produces iron, steel, aluminum and other basic metals. The metal sector is worth $1,470 billion a year and it is estimated that the investment in metal and mining sector will increase at 19% a year in the future. The metal related profits are calculated at 27% increase a year which is quite significant [6]. Lian et al., [18] said that developing economies likely to push on having key large-scale physical infrastructure projects in order to support employment, labor and capital costs, supply and demand in addition to offering economic diversification. This is exactly the case with the aluminum manufacturing and its related construction downstream sector in UAE. UAE is currently a home to two large-scale established aluminum smelters and an on-going alumina refinery project in the planning and feasibility stage that will soon be in the construction phase with operations expected to begin in 2017.

1.4 Environmental Management System (EMS)

The role of EMS in properly addressing the environmental concerns of the industry is becoming more vital every day. For the aluminum production, these concerns include air emissions such as greenhouse gases, carbon dioxide, particulate matter, and nitrogen and sulfur combustion related emissions, process waste generation, and high energy demand required to produce aluminum. EMS is a tool that can be used to control these environmental concerns. There is no concise and agreed definition of environmental management because of its broad scope, multi-disciplinary and inter-disciplinary nature [19]. According to the United States Environmental protection Agency US EPA [20], Environmental Management is a set of processes and practices that allow the facility to reduce its environmental impact and increase its processes efficiency. It is an attempt to control human activities on the environment in a way that protects and maintains natural resources. In the context of an EMS, the US EPA defines EMS as a framework that helps companies in achieving their environmental objectives by controlling their operations. The ISO 14001 EMS defines EMS to be "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" [21]. It is more of an administrative function that develops, applies and monitors the environmental commitments and policies of the organization. In simple terms, it is a set of practices that aim to control human activities and reduce pollution in order to preserve natural resources and, hence, the environment.

EMS became important because of the many critical environmental concerns that required immediate attention such as global warming, widespread pollution, de-forestation, loss of bio-diversity and impact on human health as Gonzalez et al., [22] explain in their research. For example, they mention that the scale and latitude of environmental issues are now greater than three decades ago. Many issues such as water scarcity, ozone depletion and increase of greenhouse gas emissions are pushing environmental concerns at the top of agendas in government agencies, companies and enterprises. Zutshi, and Sohal [23] agrees with Gonzalez et al., [22] view point and states that environmental management aims to manage the fast urban development in a way to guarantee human health and mitigate environmental impact. It focuses on the implementation, monitoring and auditing while coping with issues related to altering human impacts and damage to the environment. It should also work closely with environmental planning and must identify goals, determine if they are achievable, and then achieve them.

2. PROBLEM STATEMENT

When comparing aluminum with traditional construction materials such as iron and steel, aluminum may have higher embodied energy as shown in Fig.1. Its embodied energy is higher than steel due to the high energy consumption going into making primary aluminum in the production stage. However, the embodied energy for aluminum installed in buildings is less than steel because it contributes to lower operating energy, as explained in Fig. 2. There is also less maintenance cost mainly because aluminum is a corrosion resistant metal. However, many construction experts believe to reduce the embodied energy of alumnium as construction material, there is a need to evaluate the upstream production process of aluminum rather than looking into the downstream uses stage. Efthymiou et. al. (2010) describes aluminum as a "Green Metal" for being non-toxic, recyclable, light-weight and easily shaped, modern and durable. This has set the basis of sustainability formation for the aluminum as a metal used in construction field. However, it is still debatable whether aluminum is a green metal in spite of the high initial cost and the great amount of energy consumption during production. As have been explained previously, scholars propose mainly two methods to resolve energy and environmental performance obstacles by either recycling the aluminum construction waste or enhancing the manufacturing process through different tools such as sustainable energy sources technologies and (EMS). The second option could be more suitable for UAE since UAE aluminum industry is on upstream production and not on the downstream industries and uses such as recycling secondary aluminum.

This has brought the question of the ability of the EMS in effectively controlling the impact of aluminum production. With all of the benefits that the aluminum as a material can offer the construction sector, there is clear argument whether this metal can be called "Green" or "Sustainable" by looking into the adverse environmental impacts associated with its process of production. Aluminum manufacturing is an energy intensive industry and a major contributor to Greenhouse gases such as CO_2 and CFC, and PFC. Other air pollutants from this industry include HF and the typical combustion related gases such as NOx, SOx, PM..etc. Therefore, aluminum industrial complexes are usually coupled with power and desalination plants which utilize the waste heat and fulfill the concepts of industrial ecology and symbiosis. They are also set up in countries where the price of energy and fuel is considerably low, keeping in mind that in UAE the price of energy and fuel is heavily subsided by the government. This industry generates huge amounts of waste such as the Bauxite Residue from the Alumina Refinery process, the Spent Pot-Lining (SPL) from the Smelting process and the dross from the casting processes.

UAE being home to aluminum manufacturing and its construction related industry marks UAE's status as a major player in the global aluminum industry. Following China, Russia and Canada, UAE is the fourth largest aluminum producer, accounting for over 50% of the Arabian Gulf's aluminum production [4]. The aluminum production capacity was 2.4 million tonnes a year in 2014. About 300,000 tonnes are presently utilized in the country. According to a study by EC Harris [24], UAE is projected to spend $329 billion on major construction projects by 2030. Thus, growth and investment in aluminum industry will continue. Since the aluminum manufacturing and its construction related industry has global implications in UAE, the question for this research work is to investigate whether the EMS in such industry is up to the global environmental standard.

EMS tool aims at ensuring that the company complies with the environmental rules, guidelines, procedures and requirements of the regulatory and social context in which the company operates in [25]. There are many industrial plants in UAE claiming to have an EMS tool integrated within their operations. However, there is lack of research done about this topic in this part of the world. UAE is developing at a rapid pace which places a huge burden on the environment and the natural resources to accommodate these changes. The records prove that UAE aluminum manufacturing and its related construction industry holds a good EMS. A CEO of major aluminium manufacturer in the UAE mentioned that aluminum Industry in UAE is committed to attain the global environmental objectives set out in the sustainable development Initiative (SDI) and that sustainable reports for the company are written and published to comply with the global reporting initiative (GRI). This step allows the stakeholders to be more aware of the environmental performance of the company thus enabling them to make informed decisions about issues related to the business of the company [26].

The main problem lies in the implementation of the EMS and the related processes used in the aluminum production industry. The gaps are translated in the environmental management of air emissions, solid and liquid waste, and water and electricity consumption. According to the Global Environmental Management Initiative [27], common environmental performance indictors include quantities of chemicals emitted to air, discharged to water or disposed as hazardous waste, and energy usage. The process of producing primary aluminum consumes large amount of energy and generates air emissions, solid and liquid waste. An example of environmental performance with regards to emission data in the UAE based aluminium industry from the period of 2007 to 2009 is as follows. The volume of Sulfur Dioxide (SO_2) emissions increased 5% due to a 7.4% increase in production level. In contrast, Nitrogen Oxides (NOx) emissions decreased 27% due to introduction of low NOx burner and utilization of best available technologies or best available technologies not exceeding excessive cost (BAT and BATNEEC). As for the Chlorofluorocarbon (CFC), emissions were 0.11 mt in 2008 and 0.12 mt in 2009. In addition, Hydrogen Fluoride (HF) emissions increased from 0.55 kg/mt Al to 0.64 kg/mt Al in duration of four months. Greenhouse gas (GHG) emissions in 2008 and 2009 were totaled to 7 million metric tonnes and 8 million metric tonnes of CO_2 in 2008 and 2009 [15]. It seems that with increased production rate brings along increased pollution rate, unless there is a good mitigation measure or a technology to reduce this pollution. Moreover, the increased pollution rate is partially attributed to the power outage incidents in 2008 that caused a significant impact on operations, increase in waste generation, Per-fluorinated compounds (PFC) and particulate dust emissions. In comparison, UC RUSAL which is aluminum producing company located in Russia has reported in their sustainability report for 2009-2010 that investment in the development of environmental friendly technologies has reach USD 1 billion in order to reduce harmful emissions. For example, the total reduction in greenhouse-gas emissions at UC RUSAL was 130.8 thousand tonnes of CO_2 equivalent for 2008 and 749.3 thousand tonnes of CO_2 equivalent for 2008-2010. This was done while maintaining increased aluminum production level and increased sales

3. METHODOLOGY

3.1 Questionnaire

In order to integrate environment factors into the design of the management system, several steps must be taken in advance such as defining performance indicators, determining standards and collecting data. Regardless of what type of EMS is used at the industrial facility, whether ISO 14001, local EMS or a combination of both, these EMS share similar core requirements such as policy, planning, implementation, risk assessment, auditing and monitoring, continuous improvement and management commitment and review. Then, by determining the problem at hand, one can select correct problem solving technique and proper mitigation measure to minimize and reduce risk associated with the action/ problem. Following this, it is only a matter of implementing the results.

The investigation proposed in the questionnaire examines in depth factors that affect the assessment and improvement of environmental management requirements in aluminum production industry. This will be carried out via a designed survey. EMS factors can be ascertained through EMS performance evaluation and identifying areas of strength and weakness and performing gap analysis when required. Reactive and proactive methods for successful implementation of the EMS will be compared and discussed as well. Change management and factors affecting organizational structures may determine how sound the EMS is. Obtaining management commitment is a significant pillar that ensures successful implementation of the EMS. In general, there are three main factors affecting the environmental management in industrial projects. According to Taylor et al.,[28], they are: human factors such as skilled and trained labor, organizational factors such as management commitment and work environment and system factors such as used standards and management systems.

Human factors affecting the EMS include human failures, accident management, stress and fatigue management, labor environmental competence and skills, frequency of maintenance, inspections and testing, inefficiency and work demand management, and staff management at the industrial facility [29]. Additionally, organizational factors affecting environmental management include organizational changes and EMS work culture, lack of management commitment and awareness about EMS procedures, work patterns and types of resources available, communications in the organization, leadership and management styles. Finally, system factors affecting the EMS include the type of EMS procedures used at the facility, strengths and weaknesses of the EMS standard, reporting and communication techniques, control measures and the limitation of the physical environment. Each of those factors will be undergo in-depth analysis using different assessment and evaluation techniques.

3.2 Questionnaire Structures

The key aim of this questionnaire is to evaluate the implementation of EMS in UAE aluminum production. There are two major smelter plants focusing on the upstream aluminum industry, located in UAE. The population of the questionnaires is comprised of two categories: firstly, top management which includes directors, managers and senior engineers, and secondly, operational laborers. Due to the limited education of the operational labors, there was a need to conduct targeted workshops that explain the purpose, structure, and the mechanism of the research questionnaire.

The questionnaire contains four major questions that come with a Likert Scale. According to Leedy and Ormord [30], the Likert scale method is highly effective in measuring the implementation of any system because it presents the individual attitude and behavior towards the scheme. The general statements contain elementary information about the EMS that all employees should be aware of in the smelter plants and understand their mechanisms in the operational processes. For instance, the general statements section focuses on the level of the EMS awareness inside the facility and among the employees by highlighting the accessibility factors considered vital elements for EMS implementation. Then, the questions examine the organizational control of EMS inside the facility that can be applied by proper documentation of policies, objectives, and procedures. Moreover, this section covers the management commitment towards providing the required competencies for their employee through training courses, workshops, and seminars in order to facilitate their understanding of the importance of EMS and why it should be applied in the aluminum upstream industry. To do so, all responsibilities should be clearly defined for all the employees, which the EMS section of the questionnaire aims to check. By achieving this, the communication channels internally between the departments or externally with federal government bodies will be visible thus allowing the employee to monitor and implement EMS effectively.

3.3 Statistical Significance

Data was verified by applying Pearson Chi-Square Goodness of Fit Test. Chi Square Goodness of Fit test was chosen due to many factors. First, it provides a 5 x 5 (or less) category analysis that allows us to examine all the 5 variables in the received responses, which are strongly agree, agree, disagree, strongly disagree and do not know. Second, chi square test allows for analysis of statistical significance for categorical data and provides a robust evaluation of data fit within assumptions and distribution properties [31]. This correlation method was chosen due to its accuracy in capturing all data categories in details and providing a mechanism for projecting significance and independence for each category under study. Sharpe [32] has explained that many applied researchers have used chi square test for more than one hundred years where categories must be logical, reliable and defensible, as the case used for this type of survey and data collection work. Categories were defined prior to conducting the survey work where there are two main categories; managers and senior engineers under one category and operations staff and labor under the other category. The significance of factors was tested based on Likert scale categories where it provides a robust method to understand staff positions with regards to the factor.

The statistical assumptions are:

- $\alpha = 0.05$
- Asymptotic Significant values is the Probability-value (P-value) “2-sided”

Cases and conditions for statistical analysis:

A. If P-value < 0.05 then the factor is “Statistically Significant”, which means respondents’ status is Dependent on (or Not Independent of) this particular factor.

B. If P-value > 0.05 then the factor is “Statistically Insignificant”, which means Respondents’ status is Independent of (or Not Dependent on) this particular factor.

The main chi-square test equation used to interpret the data in a (5 x 2 table) is the following:

$$\chi^2 = \sum_i \sum_j \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

Equation.1 Pearson’s Chi Square Goodness of Fit

Where:
O = Observed frequency
E = Expected frequency
$\sum$ = Summation
X2 = Chi Square value

The statistical package for the social sciences (SPSS) is also used for data analysis. The following is a description of the questions along with the obtained results.

4. RESULT AND DISCUSSIONS

The first question was about the environmental policy awareness where it plays a vital role in communicating the company's environment vision. In addition, it should be clearly communicated in a language understood by the staff and written for all workers at the facility.

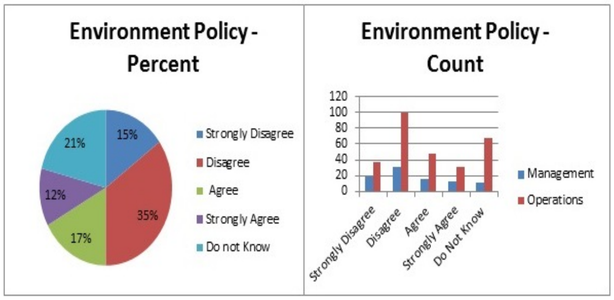

Fig.3 The environmental policy visibility

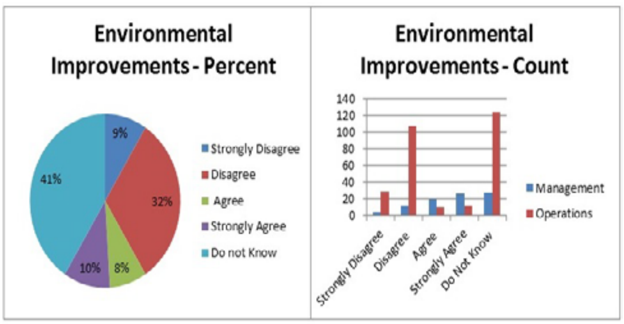

Fig.4 Drive for improvements and reduced environmental risks after implementing the EMS.

As displayed in Fig. 3, a fair percentage of (35% + 15% = 50%) of staff members believe that the environmental policy is not visible, accessible or communicated. This percentage indicates a huge gap in EMS, environmental policy communication and implementation. According to Shen et al. [33], a clear environment policy is the key to an improved EMS implementation. Through the organization networking, the environment policy provides the main legal background for all the required communication in order to implement the EMS in the operation process. In addition, the authors believe that the environment policy in the operation stage helps the construction organization to have a legal cover in the case of environmental accidents occurring at the operation or construction stages. With regards to the statistical analysis for the significance of Environment Policy questions, both management and operations staff have indicated a gap in the communication of effective environment policy at the facility where their results were mostly shown around “disagree” and “ Do Not Know”. By applying the Chi Square Test to the set of responses from management and operations staff, we note that the chi-square statistic is 7.9627. The p-value is .092954 which means that result is not significant at $p < .05$. This indicates that there is no difference between management and operations staff when it comes to agreeing that the environment policy is not visible, accessible or well communicated at the facility.

The second question tries to explore the environmental improvement and risk reduction after the implementation EMS inside the organization operations.

Figure 4 indicates that around 41% of the respondents do not know whether there is a real drive for environmental improvements and reduced environmental risks after implementing the EMS. An operational employee would not be able to assess the level or reduced risks and environmental improvements related to EMS performance. This responsibility lies on the shoulders of those environmental specialized personnel working at the environment department as they are the subject matter experts. In addition, collectively 41% of the respondents (32% disagree and 9% strongly disagree) disagree that there are environmental improvements and reduced risks after implementing the EMS. Such two extremes exemplify how the facility is perhaps not harvesting the benefits of existence of the EMS considering how EMS’ main function is to reduce and continuously improve the environmental impacts relevant to the main activities. The EMS is far from just an image enhancer and extends to real-time improvements of business and processes related to the facility operations [34].

The statistical significance of this question and comparison between the set of responses obtained from management and operations staff reveals that the two latter groups are different in relevance to believing that there is real environmental improvements after the implementation of EMS. The chi-square statistic is 92.7519. The p-value is < 0.00001 which means that the result is significant at $p < .05$. Most operations staff disagrees or are not sure whether there is real environmental improvements at the facility after implementing the EMS while most management staff agree that there is.

In the third question, the efficiency of the environmental leadership in EMS implementation is examined.

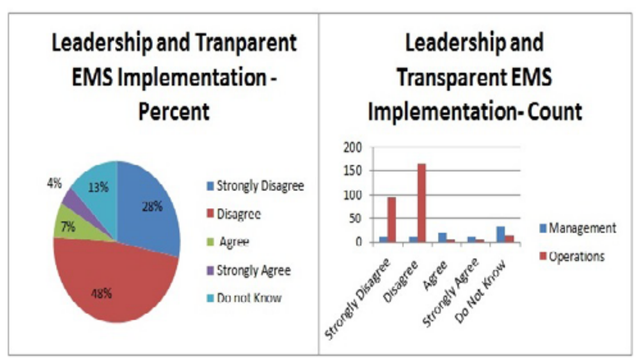

Fig.5 Leadership and management is committed to transparency in EMS implementation

Alaati et al. [35] expounds that nowadays leaders must be able to handle complexity and changes within organizations as well as maintaining performance at a high standard. This illustrates the strong relationship between leadership behavior and environmental performance. In fact, the status of EMS implementation is mainly dependent on leadership behavior. Top management commitment towards EMS implementation can be seen not only through written statements but also activities, communication messages, and employee involvement. This ensures that these companies' sustainability and environmental reports are not just visually appealing reports [36]. The case study of Robinson and Clegg [37] reveals that environmental leadership can provide competitive advantage for the product through EMS standard using process cost savings in terms of energy and materials and reduction of waste in addition to catering the demand of market for environmentally friendly products. This certainly proves that leadership plays a significant role in tailoring the implementation of EMS. Fig. 5 indicates that around 76% of the respondents disagree with the statement that leadership is transparent in implementing the EMS (48% disagree + 28% strongly disagree). This massive percentage reveals a definite shortcoming in the leadership's style and approach towards EMS implementation.

The statistical analysis of significance between the two set of responses obtained from management and operational staff vary greatly as explained in Fig.5. Most operational staff disagree that leadership is transparent in implementation of EMS while management responses are distributed in random pattern. Many management respondents have escaped answering this question by choosing "do not know" option while other indicated their "agree" or "disagree" on the statement. The chi-square statistic is 163.0632. The p-value is < 0.00001 which means that the result is significant at $p < .05$ further emphasizing that the management and operational staff responses are different.

Annandale et al. [38] explain how EMS implementation cannot be applied without a visible leadership from the senior management and how it is crucial that the leadership maintain a transparent EMS implementation process for reporting, awareness and respect for their employees. The authors hold that visible leadership makes the individual employees keener to understand direct environmental and health hazards related to their daily tasks and operations. Kolk and Mauser [39] support this idea, believing that the environmental management performance can be enhanced for a group of workers by targeting senior individual labors that hold experience as they can sense the management environmental leadership and commitment.

For the last question, the questionnaire attempts to know the level of organizational support towards EMS in the operation facilities.

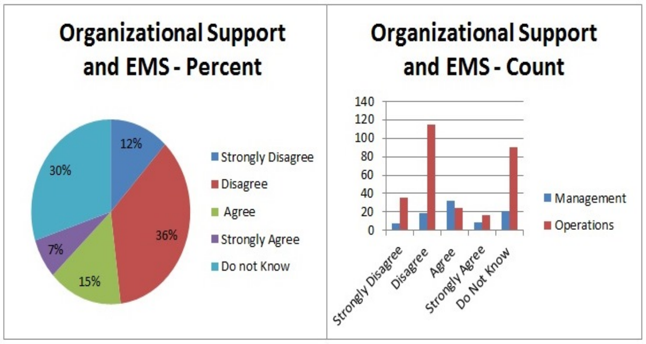

Fig.6 There is strong organizational support towards EMS in your facility

Daily and Huang, [40] believe that human resource factors such as top management support, environmental training, employee empowerment, teamwork, and rewards systems as key elements of the implementation process of an EMS. Organizational support serves as a one of those top elements for a successful EMS implementation. Fig.6 represents respondents' opinion regarding the statement that there is strong organizational support towards EMS at the facility. Around 36% disagree and 12% strongly disagree that there is strong organizational support at the facility. As such, 48% indicates the weakness of the organizational support system including top management support and employee empowerment. Around 30% of staff indicates that they don't know whether there is a strong organizational support at the facility or not. This percentage is attributed, again, to the lack of awareness and involvement of staff. Fig.6 further illustrate the responses obtained from management and operational staff, where most operational staff either "do not know" or "disagree" with the statement of strong organizational support towards EMS. The majority of management staff agree on the existence of strong organizational support towards EMS, while a fair amount of management staff do not know or disagree with this statement. By applying the Chi square test, the chi-square statistic is 44.8177. The p-value is < 0.00001 which means that the result is significant at $p < .05$. This indicates a significant difference between management and operational staff with regards to EMS organizational support.

5. CONCLUSION

The questionnaire sheds organizational defects and challenges in implementing the EMS, as illustrated by Fig. 6. The absence of transparent leadership is also a major barrier to implementation of the EMS, as shown in Fig. 5. Furthermore, as shown in Fig. 4, the EMS implementation process has remained stagnant with no continuous improvement. All of these major challenges are revealed and prove that employees working on site will need to get a better understanding of the internal and external factors affecting the implementation of EMS. Moreover, in order to understand how the EMS operates and what we can do to improve the implementation of the EMS, there is a need to conduct a specific UAE aluminium Iindustry case study to validate the questionnaire responses. This paper presented questions and associated results for a selected number of factors within the survey. Other factors have been fully examined in details and only the results of the analysis is discussed in this paper. The case study followed by a proposed framework for implementation of EMS will be discussed in a follow up research.

With regards to statistical significance, many questions in the Likert scale indicate a significant difference between management and operations staff. For example, 41% of the respondents mostly from the end-users reflect that they do not know the environmental improvement needs in their facility. This demonstrates a clear gap of communication between management and end-users. In addition, this stresses that fact that these two populations are essentially different. However, few questions have shown that management and operations staff are not different on the following statements:

- The environmental policy is visible, accessible to all staff and well communicated – majority of management and operations staff disagree which means that the environmental policy is evidently not as described above.
- There is lack of accountability in fulfilling the set objectives and targets – majority of management and operations staff agree that there is lack of accountability in fulfilling the set objectives and targets.
- Your facility benefits from the marketing and branding in adopting the EMS by increasing the number of clients and expanding business – majority of management and operations staff agree on the above statement.
- Your facility have set targets and objectives for all the significant environmental aspects including air, water, solid waste, hazardous waste and noise – majority of management and operations staff disagrees on the above statement.

These statements are considered true as the responses indicate because the management and operations populations agree on them. The above mentioned statements are clearly linked to the gaps in terms of environmental training and awareness. Looking at root cause analysis, the EMS questionnaire offers no direct suggestions; therefore, the results obtained from the EMS questionnaire require more in-depth analysis to identify the EMS gaps and their root causes at the UAE aluminium Industry. Further investigation approach is suggested to reinforce the EMS study results and reconfirm the gaps identified through the questionnaire. A proposed case study and a framework for EMS implementation will follow to further investigate and improve the status of EMS in UAE aluminium industry.

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