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CONTACT US

QualGreens Publishing
929 Greenbriar Avenue
Ottawa, Canada K2C 0J8
support@qualgreens.ca
Phone: +1-613-228-4019

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AIMS

The primary aim of this journal is to bridge the gap between scholarly research and societal benefit by presentation of applications of research and innovation for the community; preferably in active collaboration with the beneficiaries wherever feasible. This may be demonstrated, for example, by a group of co-authors from the academia having joint co-authorship with members of the user community, or other innovative models that may evolve. To further illustrate, co-authors may constitute technology: academic-industry; management: academic-corporate; social science: academic-NGO or a community stake holder, corporate-NGO; educationist: academician-learner; health care: professional-patient or patient groups; agricultural: academic- farmer or farming community; geo-scientific: academic-exploration and mining stake holders including industry as well as concerned communities, and numerous other combinations of diverse fields, actors and entities whose interests overlap or intersect. We understand that this task is easier said than done and is immensely challenging as it is a paradigm shift from what has substantially been the aim of traditional scholarly academic publishing. However, societal benefit is an important criteria still at early stages (Bornmann, L. "Measuring the social impact of research", EMBO reports, vol. 3, no. 8, pp 673-676, 2012) and the aim of this journal is to advance towards steps to be able to measure and recognise such impacts. Further, we fully understand the importance of traditional scholarly publication and thus intend to complement the same avoiding competition or duplication as the aims are different.

SCOPE

The scope of the journal is diverse, and trans-disciplinary intended to touch across a broad spectrum of beneficiaries internationally. Within science and technology, we know that most products and services are outcomes of teams comprising of different disciplines and sub-disciplines. Moreover, a successful product or service cannot reach an end-user without application of appropriate management acumen and consideration of legal and regulatory frameworks nationally or even globally. The products and services may also have social impact such as emotional, cultural, financial, environmental, sustainability and other repercussions, creating the framework for interesting multi-disciplinary avenues of research.

Several aspects of humanities and social sciences are deeply entrenched in the technological framework in which the society lives. Explosion of the mobile and internet technologies and their affordable penetration in the society is just one such example. A niche area that the journal wishes to cover is to provide a platform for publication of potentially patentable utility or design embodiments or processes where the innovators are not interested to exploit commercially securing monopolistic intellectual property rights for whatever reasons. Such disclosures through publications would serve an important cause for the benefit of the society by making the potential innovation open for public use freely and perpetually for non-commercial as well as commercial purposes by individuals, small firms and start-up entrepreneurs without any barriers for entry, thus providing valuable freedom of operation. Fuzzy areas such as business methods that are often at the cross roads of technology, management and law with patentability under a question mark in most countries, yet examples of corporate success to secure monopoly further manifests a need for such publications to pre-empt unfair exploitations.

FREQUENCY

The frequency of publication of this journal is thrice yearly: Spring, Summer, and Winter issues; generally released around April, August, and December.

EDITORIAL

Since we entered the new millennium, there were several targets set called sustainable development goals (SDGs). Concerns for ecology, debates on climate change, questions on traditional methods of measuring human development and legitimacy of what we have been perceiving as "progress" have been some of the new paradigm shifts of our times. While there has been no shortage of platforms for purely scholarly academic publishing on one hand, and industrial trade publications updating on latest products and services on the other hand, there is still a need for bridging the gaps between research and innovation applications that have impacted or made a difference in the lives of the habitats of societies in geographies all over the world.

While career academicians from natural, physical, medical, social sciences and their numerous derivatives or hybrids know very well the importance of Journal Impact Factors, H-index, I-index and other evolving parameters for evaluation of peer reviewed scholarly publications; technologists and business managers are generally conversant about the importance of securing intellectual property rights through patenting preferably before any scholarly publications or concurrent to the same where the one year grace period is available. It is well known that a considerable number of Journal publications as well as patent publications probably fail to directly impact an end-user in the society. While citation is a well-established measure of scholarly impact, voices such as the San Francisco Declaration on Research Assessment (DORA) have begun to question its absolute hegemony. On the patenting front, it is important to consider that the process has now become so complex and expensive in most countries that an ordinary innovator may not be able to afford the same due to lack of resources. Moreover, if an innovator is not interested to seek monopoly of rights but wants to share an invention for larger societal good without royalties, there is lack of adequate platforms for enablement of dissemination of such knowledge and recognition for the same.

The origin and mission of this Journal is an honest attempt to address some of the issues stated above. While we do value the traditional feedback on articles published in this Journal and will seek for the Journal Impact Factor and Indexing in well-known journal databases as per norms as we move forward, we hope that it will additionally catalyze constructive and open discussions towards answering the question: what are the alternative approaches, if any, to assess research and innovation output by scholars and technocrats? For example, can a social science research article be measured by a criteria that includes implementation in a number of community clusters? Should we consider the impact as higher if it was adopted in several countries? Can a new business method that is highly customized for application in a country facing the so called "last mile" problem in pharmaceutical supply chain management benefit from a technological solution using non-smart or low-end smart mobile phones ubiquitously affordable in those communities?

We are keeping the doors for all disciplines open for this journal as we believe that any research or innovation that may have direct and preferably immediate impact on an end-user community is generally a trans-disciplinary team effort necessary to address the niche target of societal benefit at the grass-root levels.

Jyoti Prakash Naidu

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Implementing modern maintenance management at KivuWatt-Rwanda: Part-1

Gracious Banda

EMaintE Consulting CC, P.O. Box 11200, Ceturion, South Africa 0046
Email: gracious@emainteconsulting.co.za

The KivuWatt Power Plant, an integrated offshore-onshore facility at lake Kivu, that generates electricity into the Rwandan national grid utilising the lean-burn internal combustion processes in the Wärtsilä 20V34SG gas engines is probably one of its kind in design and technological innovation on planet earth. Its uniqueness therefore ultimately requires sophisticated but technologically simplified modern maintenance management tools to ensure an optimum upkeep of assets' healthcare. This paper introduces the salient aspects of the maintenance management approach implemented at site bringing out the perceived and observed benefits. The approach reported in the paper is expected to have broad applications in the growing field of energy production management in which sustainability is an essential requirement for success of a business venture.

Keywords: KivuWatt, Wärtsilä, technological innovation, assets' healthcare, maintenance management, power generation, sustainability, lean-burn IC process

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1. INTRODUCTION

1.1. General

Modern scientific technology and tools combined with research result in advancement in Plant Engineering, a field which is key to sustainable development. Plant Engineers and managers typically need modern scientific technology and tools to run their plants smarter, safer, faster, and better for the sustenance of both social and economic benefits.

1.2. Background

The existence of Lake Kivu, dangers posed by huge amount of biogas reserves trapped and highly pressurized in the resource zone, 260 to around 480 meters below water surface under a layer of heavy water containing minerals washed out of the nearby volcanos made it known as the "killer lake" (Wärtsilä, 2016). According to research records prior to the innovation and inception of KivuWatt project, it has been scientifically proved and reported that when the gas concentration gets too high, or the lake is hit by one of the regular earthquakes in the region, the gas can be released, posing a threat to lives of the people living in the vicinity.

By tapping these gas resources, ContourGlobal is making Lake Kivu a safer place, while at the same time utilizing the trapped methane gas for much needed electric power generation (ContourGlobal, 2017).

In addition to gas extraction and power generation business activities, to show corporate social responsibility (CSR) as part of the global corporate citizenry, Contour-Global-KivuWatt is also engaging with the local communities, training and developing local workers and funding charitable projects such as providing libraries and computers at Kibuye schools in the district of Karongi.

The 2009 twenty-five (25) year Power Purchase Agreement (PPA) and Concession agreement (CA) signing between ContourGlobal and Rwandan government for a 100MW power generation project gave way for construction of the KivuWatt biogas power plant under the build-own-operate-transfer (BOOT) model. The innovative ground-breaking technology project development took seven years, from concept in 2008 to completion of first phase, a 25 MW project portion, in November 2015. First phase plant entered commercial operation on 31 December 2015 to sell the power to the National Utility and commenced fullscale operation after official launch thenceforth in January 2016.

Successful completion of the first phase gave second phase of the project which will produce 75 MW and transfer to the national grid.

2. AIMS AND OBJECTIVES

The project aimed at providing an engineering solution for maximization of application of modern

technology in managing operations and maintenance of systems and processes ensuring their reliability without compromising the per design required output and service delivery in a sustainable as well as economically benefiting manner.

The objectives of the project have been as follows:

- Work together with ContourGlobal-KivuWatt Engineering Management team to investigate the business as usual regime in Operations and Maintenance Management of the systems at the Power Plant and identify gaps for improvement
- Conduct a Requirement Survey and analyse work process flow (WPF) in order that problems associated with the systems are investigated
- Perform master data coding for key enterprise process assets
- Perform data collection, compilation and quality manage primary asset data listing
- Analyse existing checklists and schedules for preventive maintenance (PM) as well as reorganise collected and compiled data in readiness for deployment into a central database
- Perform program Installation, test and commission the integration process
- Perform Implementation Training
- Evaluate the results of the project (challenges and benefit)
- Identify appropriate and applicable measures and standards for mitigation of potential adverse effects and then promote responsible and professional practice for economic benefit but in respect of life, law and public good.

3. FACILITY DESCRIPTION

A representative block diagram of the integrated Offshore Barge-Link-Onshore Plant facilities listing different sections of the constituent facilities has is shown in Figure 1 and subsequently briefly explained in sections 3.1 through to 3.8.

3.1. The offshore gas extraction facility (GEF)

The Gas Extraction Facility (GEF), a special 3000-tonne barge, located 13km from the shore and tethered to the bottom of the lake, extracts gas by bringing gas-laden waters (water is drawn from 350 metres below the surface) from 35 bars to 2 bars of pressure via a gas separator where gas bubbles are extracted from the water. Raw gas is then washed in four wash towers, ultimately producing clean methane gas. The raw gas composition is about 70% carbon dioxide (CO2) and 30% methane (CH4). The GEF is designed to remove the CO2 and provide 9,500 m3/hr of dry gas with 90% CH4. To the knowledge of the author, KivuWatt GEF is the only one of its kind in the world.

3.2. The link and the moorings

The methane extracted gas is transported to the power plant through a HDPE pipelines, technically called Export Lines which link the GEF (offshore) and the PP (onshore) gas reservoir from which the power generating engines are fed. Export lines run for 13 km, are balanced and supported from the lake base as well as with moorings on sides for the length between the two integrated facilities.

3.3. The onshore power plant (PP)

The PP constitutes Electricity generating engine hall and the aggregate of Wärtsilä intelligent power engines, ancillary equipment, and the human-machine-interface (HMI) control system. At the power plant (PP), combustion engines generate electricity to be supplied to the Rwanda energy grid.

3.4. Marine landing site (MLS)

By operational activities carried out at the MLS, it briefly could be described as a constructed site for the landing, holding of utility boats, boat fuel filling as well as refueling and storage of boat accessories, and marine rescue and life-saving equipment.

3.5. The boats and the utility vehicles

The on-water and on-land transport modalities are considered as key peripheral assets for mobility of the personnel and goods within, around and between the integrated facilities that form KivuWatt Power plant and systems.

3.6. Administrative block

The mezzanine block adjacent to the Power Engines Hall is for KivuWatt management staff and power plant operations staff which includes offices, executive boardroom, server-room, plant control room, kitchen, changerooms and ablution rooms below which lies the main store on the ground floor.

3.7. Conference centre and canteen block

This is a stand-alone block comprising conference hall, training centre/open plan offices for Maintenance planning engineers, technicians, Safety, Health, Environmental, Risk & Quality (SHERQ) staff, operations staff, canteen and ablution rooms and the canteen.

3.8. Perimeter fence and security gate-office

This include outbound facility safety and security physical structure for security personnel.

The primary focus of this modern Asset Management project has been to provide an efficient, on demand and

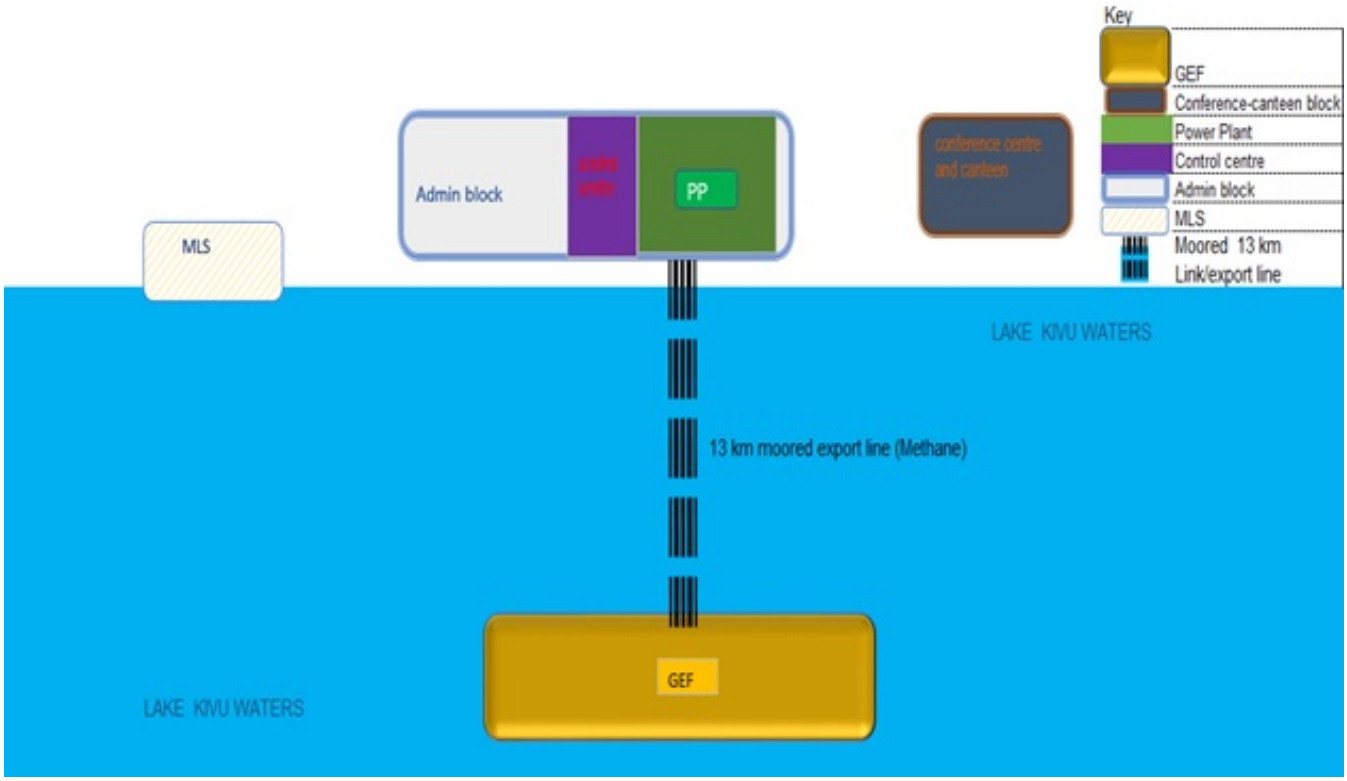

FIGURE 1. Block layout diagram of KivuWatt Electricity Power Plant

systematic solution to problems in systems' operation and maintenance management activities at the newly inaugurated (in 2016) ground-breaking innovation of KivuWatt bio-gas power plant to meet demand for asset reliability, economic and sustainability issues that affect the livelihood and development of the African continent, more specifically applicable to Rwanda.

4. REVIEW OF RELEVANT LITERATURE

Relevant literature searched in respect of implementation of this project focused on areas of sustainability in Rwanda, Methane gas power plants and Methane gas/fuel flow, Wärtsilä technology, engineering management solutions, Operations and Maintenance (O&M) management, and systems integration as follows.

4.1. Sustainability

United Nations Industrial Development (UNIDO) on Inclusive Sustainable Industrial Development (ISID) in its 2014 ISID brochure no. 12-03.0 (UNIDO-ISID, 2014, pp. 6-12), states that,

> *Any progress on poverty eradication will be short-lived if we do not succeed in achieving the necessary economic growth within an environmentally sustainable framework. Also states that, successfully implementing ISID in our current era of globalization requires new approaches that harness globally available knowledge, technology and innovation. Knowledge exchange and technology transfer will therefore significantly contribute to realizing ISID.*

According to Environmental Sustainability in Rwanda's Economic Development and Poverty Eradication Strategies (EDPRS): Towards Mainstreaming Environment, it is stated that,

> *Poverty in Rwanda is intimately related to a series of interlocking issues, in particular land, demography, environmental degradation, as well as low and limited sources for growth. It is evidently clear that for progress in poverty reduction to be made, the issues of land, demography and environmental degradation must be immediately dealt with failing which, deteriorating environmental situation and tardy and prone to disruptions inclusive sustainable industrial development will be prevalent...*

To further understand sustainability from a perspective of micro-macro-economics, an approach model has been devised which shows the link between the determinant factors against the impacts and the outcome indicators shown in the Figure 2, a PESTLE based sustainability indicators approach (PESTLE, 2015).

4.2. Methane gas power plants

The common sources of methane gas are from landfills and bio-digester tanks for which the extraction

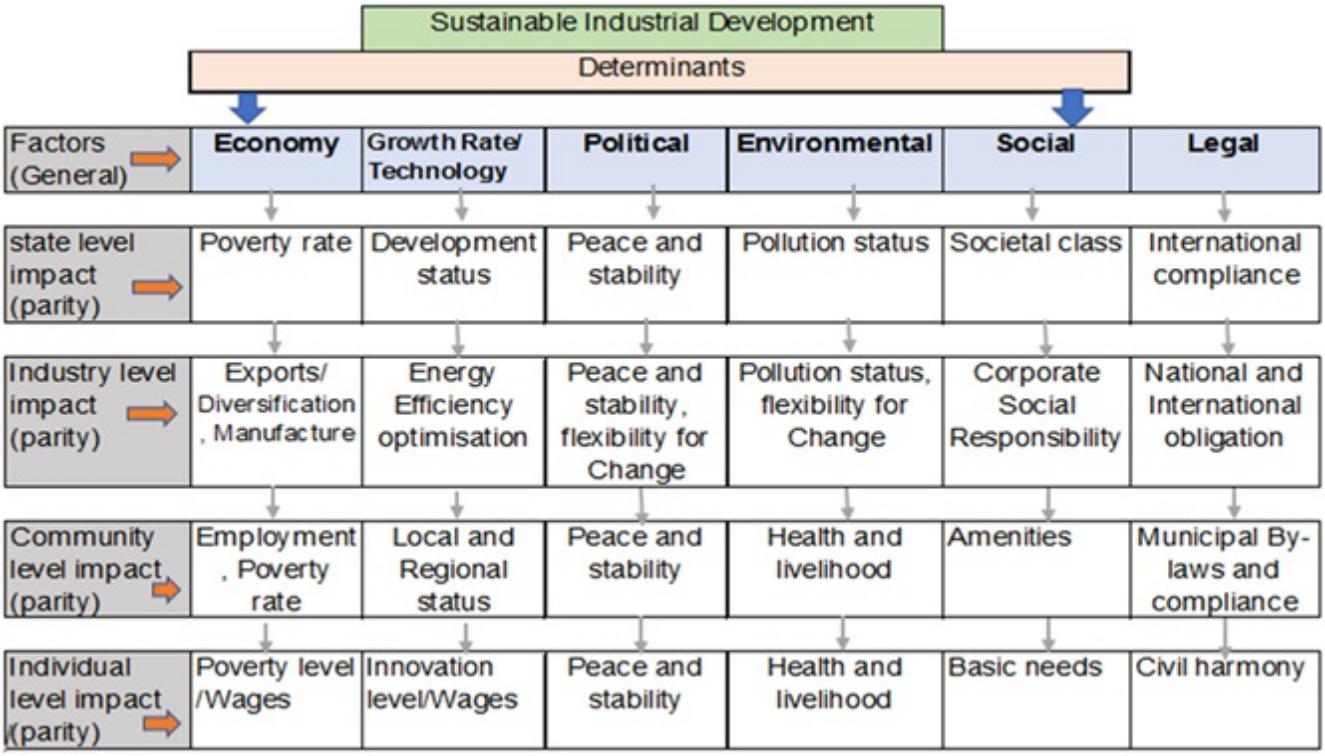

FIGURE 2. Relationship of indicators for assessment of industrial sustainability

technology and design is not complex. In contrast, the gas extraction technology and design which was introduced by the innovative KivuWatt barge Gas Extraction Facility (GEF) was a product of deep engineering research and innovation which took seven years to be concluded.

The methane powered power plants (heavy duty 20-cylinder by Wärtsilä coded 20V34SG engine) are the type installed at KivuWatt power generation facility. Wärtsilä's quality and environmental management systems fulfil and are certified according to ISO 9001 and ISO 14000.

4.3. Wärtsilä Technology

According to Wärtsilä OEM technical guide (Wärtsilä Corporation, 2015), Wärtsilä started the development of lean-burn, spark-ignited Otto gas engines in 1992. The first WÄRTSILÄ 34SG engine was released in 1995 and now the product range of lean-burn gas engines has been expanded by introducing the new Wärtsilä 34SG.

These engines take the power output of the Wärtsilä 34SG series up to 9 MW. The Wärtsilä 34SG is a four-stroke, spark-ignited gas engine that works according to the Otto process and the lean-burn principle. The engine has ported gas admission and a pre-chamber with a spark plug for ignition. The engine runs at 720 or 750 rpm for 60 or 50 Hz applications and produces 8700kW and 9000 kW of mechanical power, respectively. The efficiency of the Wärtsilä 34SG is the highest of any spark-ignited gas engines today. The natural gas fuelled, lean-burn, medium-speed engine is a reliable, high-efficiency and low-pollution power source for baseload, intermediate peaking and cogeneration plants.

A typical composition of Methane in natural gas is presented in Table 1 (Demirbas, 2010).

The stoichiometric combustion of methane is typically

$$CH4 + 2O2 + 2(3.76)N2 \rightarrow CO2 + 2H2O + 7.52N2$$

With lean-burn, i.e. oxidisation with excess air of around 5%, the lean combustion becomes

$$CH4 + 2.1O2 + 7.9N2 \rightarrow CO2 + 2H2O + 7.9N2 + 0.1O2$$

The excess air in the combustion products denotes complete combustion. This is the basis for considering the Wärtsilä 34SG series biogas lean-burn power engines as exceptionally designed for sustainability of the environment as there is almost insignificant or trace emission factor from the combustion process, making this technology fall within the band of green renewable energies.

4.4. Methane flow in pipes & reactivity properties

The KivuWatt methane flow includes in the risers to the barge that run 0.3 km deep as well as linear to the power plant, 13 km away. Piping in use is high density polyethylene (HDPE) material which according

Component	Typical % Volume Analysis	% Volume Range
Methane	94.9	87.0 to 96.0
Ethane	2.5	1.8 to 5.1
Propane	0.2	0.1 to 1.5
Isobutane	0.03	0.01 to 0.3
η-Butane	0.03	0.01 to 0.3
Isopentane	0.01	Trace to 0.14
η-Pentane	0.01	Trace to 0.14
Hexane	0.01	Trace to 0.06
Nitrogen	1.6	1.3 to 5.6
Carbon dioxide	0.7	0.1 to 1.0
Oxygen	0.02	0.01 to 0.1
Hydrogen	Trace	Trace to 0.02

TABLE 1. Natural Gas composition – courtesy of (Demirbas, 2010)

to Plastic Piping Institute (Plastic Piping Institute, 2012), has properties of: long-term service life, highly-resistant to corrosion, abrasion and chemicals, strong, durable, flexible, ductile and lightweight, longer-length pipe capability with leak-proof joints, lower labour requirements for installations and Significant overall cost savings.

4.5. Engineering Management solutions

Migration from the prior management system of Excel only processing of maintenance activities (because of the time consuming and intensity of workload that it posed), to a database programmed modern technology maintenance management system (MTMMS) was the best option to simplifying maintenance management activities.

4.6. Description of O&M Management

According to DOE-US (Sullivan et al., 2013), best practice in industry, Operations and Maintenance (O&M) management integration program is a critical component of the overall industrial processes. The management function should bind the distinct parts of the program into a cohesive entity. Based on experience, the overall program should contain five very distinct functions making up the organization: Operations, Maintenance, Engineering, Training, and Administration—OMETA. Beyond establishing and facilitating the OMETA links, O&M managers have the responsibility of interfacing with other departmental managers and making their case for ever-shrinking budgets. Their roles also include project implementation functions as well as the need to maintain persistence of the program and its goals.

4.7. Systems Integration

Just as Integration is, in calculus, used in the calculation of complex areas and volumes of irregular shapes and solids, so is the solution to complexity in engineering systems management if the systems are linked or networked to have any entered data be centrally configured but updated from any of the link points normally referred to as workstations.

According to 4C Systems and EMaintE Consulting (EMaintE Consulting, 2012), systems integration is done based on a variety of platforms including local area network (LAN), wide area network (WAN) and a hosted service termed software as a service (SaaS). Different platforms are suited for different data analytics.

5. PROJECT FEASIBILITY CONSIDERATIONS

The project feasibility was assessed based on compliance with ethical issues and professional code of conduct followed by project feasibility analysis based on TELOS Model (Hall, 2011).

5.1. Ethical and Professional Code of Conduct

The project feasibility study checked potential for compliance with the codes of conduct of two relevant societies in the U.K. Society of Operations Engineers-IPlantE (Society of Operations Engineers, 2016), states that,

> *All members of the Society of Operations Engineers shall, by their conduct, uphold the reputation of the profession in applying the specialist discipline of operations engineering in the specification, evaluation, acquisition, commissioning, operation, management, inspection, testing, maintenance, repair, refurbishment, development and disposal of vehicles and fixed, mobile and removable machinery, plant, equipment and systems and all activities related or incidental to any of them.*

Engineering Council and Royal Academy of Engineering Statement of Ethical Principles, (Engineering Council UK, 2018) states that,

> *Engineers invent the future and their work affects the lives of millions of people, for better or worse. That raises enormous ethical issues in every branch of engineering, from computing through biotechnology and energy to civil and aeronautical.*

The academy also lists the statement's underpinning principles as: (i) Honesty and integrity (ii) Respect for life, law, the environment and public good (iii) Accuracy and rigour (iv) Leadership and communication.

Affiliated to both these cited organisations, the consultant ensured compliance with the obligation that at all times professional practice can be followed, adhering to their codes of conduct. Implementation of modern maintenance management at the KivuWatt plant was assessed as feasible to be executed in

conformance with the requirements as agreed in the due diligence documents which were generated based on prescripts of Ethics and Professional Code of Conduct.

5.2. Project Feasibility Approach

Hall (Hall, 2011) first wrote the acronym "TELOS" in respect of cost-benefit-analysis by considering attainability, coordination, effective operability and organisation of a proposed system to produce profitable economic benefits. The TELOS Model was utilised in analysis of the feasibility of this project. The structure of the model is as per Figure 3.

FIGURE 3. TELOS Feasibility model (Hall, 2011)

The TELOS Feasibility model was applied to the KivuWatt Modernised Maintenance Management project as explained in Table 2.

The evaluation of the effectiveness of the existing O&M management paradigm for the operability of the plant, including considering the aspects of risk, safety and life cycle was approached using asset reliability and management standard.

Modern Facilities Management requires that owners and managers of Assets understand the applications of the concepts of total life cycle cost (TLCC) of assets and optimisation of the assets and facilities so that their assets are always economically profitable, sustainable, compliant with legislation and environmentally friendly.

ISO 55000:2014 explains the approach by a model framework that links and integrates operational excellence in Asset Management. This fits well with the Facilities Management standard, ISO 41011:2017 stipulating that Facilities Management is an Organisational function which integrates people, places and processes within the built environment with the purpose of improving the quality of life of people and the productivity of the core business.

The ISO 55000 model framework as depicted in Figure 4 was followed during feasibility assessment.

TELOS Parameter	How it was applied to KivuWatt Project
Technological	Most modern scientific technology of database programming was used to develop the implemented product
Economic	A fit-for-purpose LAN CMMS with lowest initial and running costs was negotiated for implementation by project sponsor Ethane
Legal	The project implementation ensured meeting requirements for applicable legislation
Organisational	The project implementation has resulted in effective coordination, operability and management of activities at the establishment
Scheduling	Once off schedule for automated planned preventive maintenance (PM) activities has eradicated the time intensive and tiresome manual preparation and processing of PM Work Orders

TABLE 2. Description of TELOS application

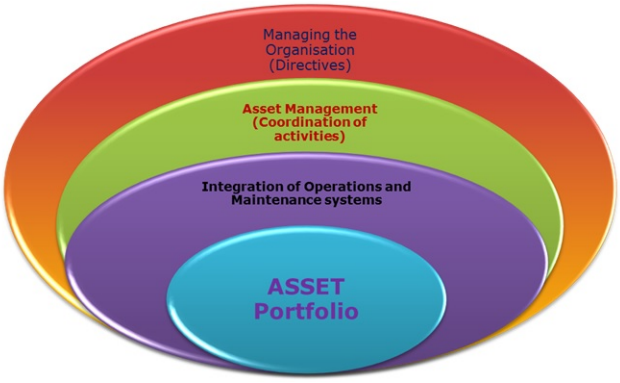

FIGURE 4. Asset Management Model based on ISO 55001:2014 and PAS 55 IBM, 2009

6. METHODOLOGY AND APPROACH

The overreaching objective of this project implementation was to ensure that simplification in complexity of achieving maximum uptime of all assets and operating in a healthy state gets maintained with the aid of an easy to use, developed for purpose computerized Maintenance Management system (CMMS).

A dual prong model framework (design model framework and implementation model framework) for the system approach was employed as follows.

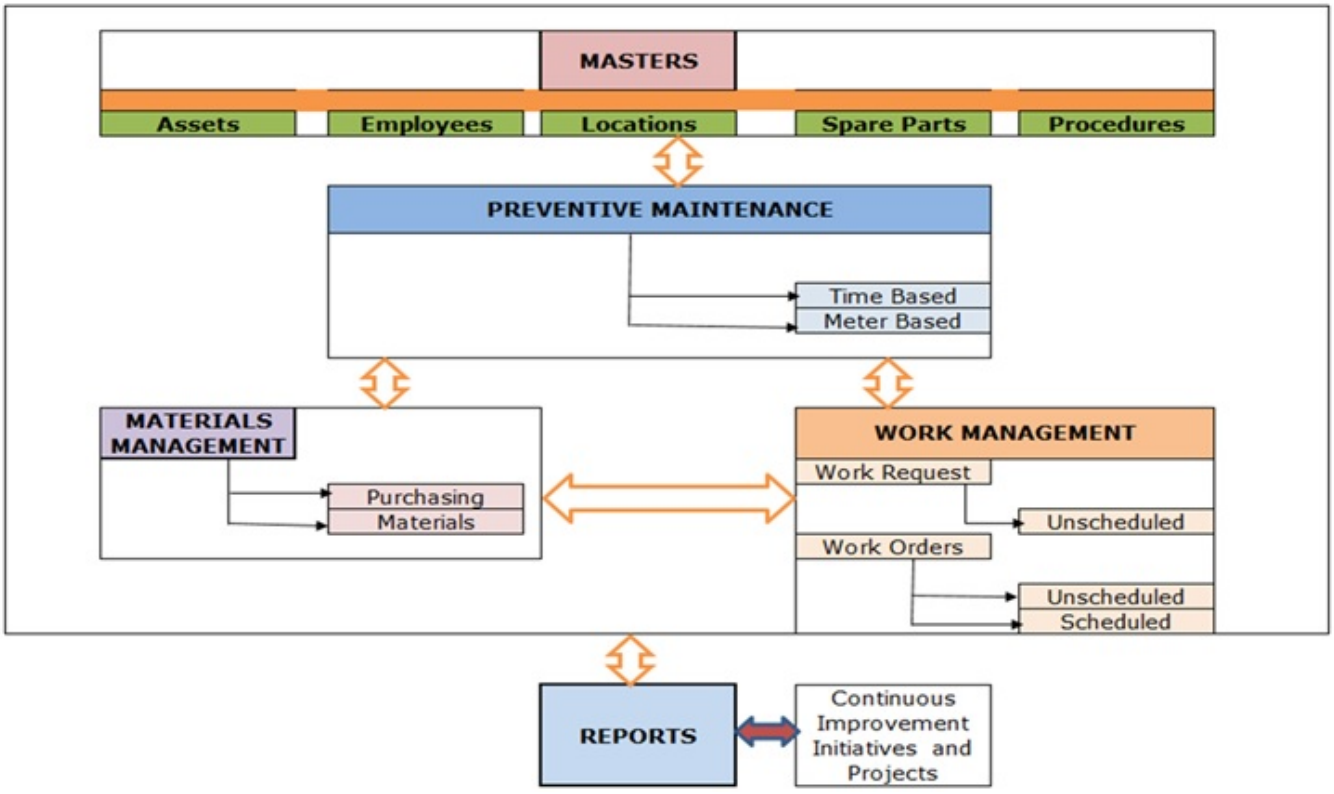

FIGURE 5. CMMS Design Model Framework (courtesy of EMaintE Consulting and 4C Systems)

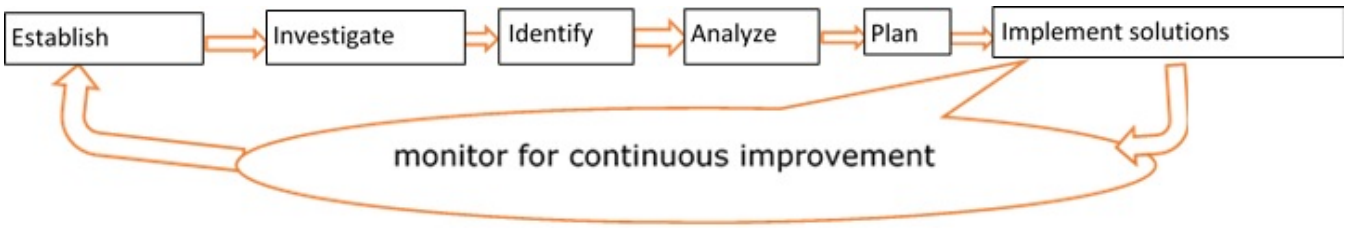

FIGURE 6. Engineering management optimisation (EMO) model

6.1. The design model framework

The design and development of a model framework for a computerised maintenance management database is what determines the hierarchy in structure of the fields for recording various parameters of the enterprise process assets (EPAs), resources and their associated activities in order that there is simplification of the patterns via which the various processes flow.

Five levels of main data tables are used in the design model framework for the CMMS that is used at the KivuWatt facilities and are Masters, Preventive Maintenance, Materials Management, Work Management, Reports, as shown in the Figure 5.

A tabulated functional description of main data tables is depicted in Table 3.

6.2. The implementation model framework

The United Nations Industrial Organisation (2012) based iterative systems engineering management optimisation (EMO) model shown in Figure 6 was significantly utilised in this project.

6.3. Project execution plan

Planning entailed pre-site visit and onsite visit activities as follows.

6.3.1. Pre-site visit plans

The core areas of preparations prior to consultant's arrival at the ContourGlobal-KivuWatt site were generally split into due diligence activities and software training material where:

(i) Due diligence activities included exchange of communication and agreements on the ContourGlobal standing policies on; Supplier code of conduct, Vendor card and registration, anticorruption policy, anticorruption compliance, service providers tax compliance, banking details as well as confirmation of partial prepayment for consultancy service as

Database Parameter	Key Function
Masters	Provides for the main structure for Primary data entry on which different tasks, activities and processes depend
Preventive Maintenance	Provides for scheduling of predetermined automatic trigger of Time-based or Meter-based maintenance tasks
Materials Management	Provides for inventory and procurement management
Work Management	Provides for both planned and unplanned work process and management
Reports	Provides for pre-set standard reports for instant on-demand generation

TABLE 3. Implemented CMMS Main Levels of data management

an indication of commitment to conditions on approved quotation and subsequent purchase agreement.

(ii) Software training material included preparation of: software and training workshop data, design CD labels, write and label CDs, design and prepare certificates as well as communication with KivuWatt plant and facilities management on the prerequisite platform software and hardware required by the program and a list of prospective workshop attendees to enhance offsite generation of certificates.

(iii) Pre-site visit confirmation of project take-off entailed communication and proposing of initial schedule of activities.

6.3.2. Onsite planning of project activities

In line with the pre-site visit schedule of activities, the onsite plan entailed discussing all the scheduled implementation activities during the project kick-off meeting held in the Plant Manager's office. These included discussion of the systems' approach, the requirement survey to identify of all existing gaps and shortfalls in the existing methods of operations and maintenance (O&M) management, identify the facilities setup using the P&ID (process and instrumentation diagrams/layout design drawings), identify, organise and allocate time and resources for all the activities in sequence of: Plant walkthrough, physical verification of all parent and child assets listed on the facility register, installation, integration and setting auto-backup of the CMMS program, review collected data, perform master data coding, capture primary data into the program, review and reorganise all data required for planned maintenance including Preventive Maintenance (PM) task lists, PM Schedules, quality checking data, import data into the database, perform program test, training workshop according to scheduled groups and hand-over certificates of participation, launch the program, close-out workshop and handover project, monitor operation by visiting all workstations using the program or its add-ons, site visit and project implementation report (an offsite activity).

7. CONCLUSIONS

This paper elucidated some of the salient aspects of an important offshore-onshore facility at Lake Kivu that generates electricity and transmits the same into the Rwandan national grid utilising the lean-burn internal combustion processes. As Part-1 of the two part paper, the areas covered were background of the project, aims, objectives, facility description, review of relevant literature, project feasibility considerations, methodology and approach. The second part will highlight more detailed description of scope of works, implementation steps, setting up of the modern O&M management system, Data Quality Control issues, Training considerations, implementation challenges, and benefits along with proposed future work. The project management presented in this paper is a case study that can help other projects in the African as well as other regions across the globe to improve planning, and execution of large magnitude projects in general, energy oriented projects in particular integrating several mainstream as well as consequential issues that affect the society and environmental sustainability.

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ABOUT AUTHOR

Gracious Banda is currently associated with EMaintE Consulting, Centurion, South Africa. He is a corporate member of the Institution of Plant Engineers with the Society of Operations Engineers (SOE-IPlantE), a Professional Engineer EC-IEng, EC-CEng and Cenv candidate, Licentiate in Professional Plant Engineering, UNIDO Industrial Energy Efficiency expert, Sustainability and Reliability Engineering consultant.

Global youth unemployment - Is early identification of entrepreneurs the solution for reducing unemployment and the burden on the welfare state?

Stephen Robert Pearson

CEO, Remvox Global Communications Group, Technology House, Hurstwood Court, Lancashire Business Park, Leyland – PR25 3UQ UK
Email: steve@remvox.co

Youth unemployment is a global phenomenon that is on the increase. It is a problem that isn't going to be solved overnight, but one which needs to be addressed immediately to prevent an exponential expansion that has the potential to become irreversible. This paper seeks to examine the issue and asks the question could early identification of entrepreneurs go some way towards providing a solution, and if so, how can this be achieved? In conclusion the paper highlights the implications for further study in both theory and practice, the outcome of which may not be a panacea to the global problem, but may help to reduce the dilemma.

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1. INTRODUCTION

This paper begins by explaining that in order to become entrepreneurial a person must first understand the value of money or material things, which makes it hard for children to exhibit entrepreneurial traits until they have reached this level of cognitive awareness. Examples of this can be seen with children at school or when socialising with their peer groups wherein they are happy to swap items of significant value for items that have little intrinsic value purely because they want them or their friends have one and they want one too. An example of this was recently observed with a child of around 5 years old who had agreed to swap his toy car for a 'Pokemon' type card merely because he didn't have that one in his collection. This would seem like a ludicrous transaction to make, but it could be argued that he perceived his collection would be more valuable to have this missing card as part of it, which may be true if it was an adult undertaking the transaction who would be fully understanding of the implications of their actions and reasons for doing so, however the reality in this case was that the child had no concept of value of either item, but merely desired having the 'Pokemon' card. This lack of awareness of value however does not preclude the child from being innovative, but merely prohibits them from being entrepreneurial. Cultures around the world have operated throughout time on moneyless trading of objects, but have invariably exhibited a raised level of awareness as to the worth of objects/goods/services which enable them to be traded on a percentage value type system i.e. object 'A' is worth two of object 'B' and five of object 'C' etc. This awareness does in fact allow for entrepreneurism, whereby an individual or group of people could take it upon themselves to trade to acquire all the object 'A's in their community thereby making that commodity less readily available. This if required could serve to increase its intrinsic value, which when introducing it back to the market could be worth several times its original trade value showing the individual holding them to be entrepreneurial. Having availed of the opportunity of monopolising a situation which they were able to exploit and 'cash-in' so to say, enables entrepreneurs increasing their material wealth.

There are tales often reported in local and regional news of children taking the opportunity to make additional money from others at school by going and buying bulk packs of sweets/chocolates, which we shall call their initial stock, splitting the packs and selling the items individually for far more than their initial stock value, thus making a substantial profit on their initial investment, which further allowed them to invest in even more stock, which they then sell on at a profit. Other similar schemes stating that the pupil identified was entrepreneurial have been reported, often to supplement the news and are in most instances not particularly newsworthy.

The likelihood in those scenarios is that the children

didn't come up with the original idea themselves but that it was possibly suggested to them by a parent or other adult. It can be argued in this case that the child wasn't being entrepreneurial but merely following a set of instructions on how to make a profit from the purchase and vending of goods or similar objects. After all, isn't that what a shopkeeper does?

So how can a child exhibit entrepreneurial characteristics and traits? It can be a difficult and complex question to answer, one that is subjective and open to different interpretations and views, so the starting point has to be, asking the question 'what is an entrepreneur and what do they look like?' By this it is not meant literally in terms of are they tall or short, or they have blue eyes and brown hair. It is the belief of this author that they look like a compilation of characteristics and traits that serve to define them, therefore in order to answer the question as to what an entrepreneur looks like, it is necessary to identify the characteristics and traits that are common to most entrepreneurs, which could provide valuable information for entrepreneur identification.

Geneticists have proven that life is made up of combinations of genes and that it is a persons genetic make-up that makes us look the way we do. Genes control hair colour, eye colour, skin colour etc. They also control predispositions to disease and other ailments, but can also be susceptible to external factors influencing them. It is therefore proposed that we seek to examine whether characteristics and traits, in a similar way to genetics can serve to show a persons propensity towards being entrepreneurial.

The 'Entreprenetics', as it is referred to (see, for example, Damir Perge, 2012) will seek to categorise specific trait/characteristic groups and then further sub-divide these primary groups into more refined groups of characteristics that could further categorise the type of entrepreneur a person is, rather than simply being labelled as an 'entrepreneur'. The characteristics of entrepreneurs have been identified by several researchers and entrepreneurs themselves too and range from 10 to 35 (Berry, 2018). However to make the list more comprehensive, from a list of 638 identifiable characteristics and traits, 57 have been short-listed based on personal experiences by the author as specific for entrepreneurs and are shown in Table 1.

Traditionally, research focused on a small number of traits such as innovativeness, locus of control, risk taking and the need for achievement as being the key traits to identification of entrepreneurs, however this does not cover a broad enough spectrum of traits to have significant differentiation between entrepreneurs and non-entrepreneurs therefore for such frameworks to be of practical use the identifiable traits list needs to be expanded to identify specific differentials between the two groups. Gartner (Gartner, 1989) suggested that research on entrepreneurs personality should be the first priority and the most important perspective in psychological research, however previous studies merely generalise a number of traits and attributes that are common to several groups of people i.e. sportsmen/women, business owners, and even academics, who would not be classed as being entrepreneurs but still exhibit the small sub-set of traits cited in most of the previous studies undertaken. Entrepreneurs are fundamentally different in their thought processes than counterparts in all walks of life and fall into three identifiable categories.

The three broad categories currently cited are 'innovators' – people who generate new ideas; 'entrepreneurs' – people who take ideas (novel or not) to market; and 'innovative entrepreneurs' – people who have new ideas which they take to market. These could be further sub-categorised in their respective markets i.e. Scientific entrepreneurs, technical entrepreneurs, artistic entrepreneurs etc.

When looking at the 'entreprenetic' make up of different age groups, it is yet to be proven, but may be found that only certain specific traits exist at identifiable levels of age/mental development i.e in the age group 1-4, no traits exist. In the age group 5-10 no more than 10% of potential traits can be found to exist and in the age group 18+ 100% of the traits can be found, but in different levels.

As of now this is only a supposition, and shall form the basis of further research to be carried out, but is believed to be crucial in terms of value in identifying potential entrepreneurs of the future. The endeavour would enable further research to comprehensively determine whether or not an 'entreprenetic' profile can accurately determine a persons propensity to become entrepreneurial.

The question of how this information could be used can be best answered by looking at why we require the information in the first place.

The population of the world is expanding at an exponential rate and the jobs market is shrinking. With the potential introduction of robotic replacements for the labour workforce and the ever-increasing supply of those completing their education entering the jobs market supply is outstripping demand. The resultant outcome being that youth unemployment is increasing. It has been found that many countries are exhibiting unprecedented levels of youth unemployment and according to research from Price Waterhouse Cooper (PwC), UK figures for 2016 show that high youth unemployment is costing the British economy £43bn per year, as well as blighting the careers of workers who miss out on a job in their teens and twenties (Cooper, 2017). This is not isolated to UK, it is a worldwide issue and one that is being experienced by most European countries supported by the graph shown in Figure 1 (Statista, 2018; Eurostat, 2018).This is a problem that isn't going to go away, therefore something must be done to try and slow down and restrict its growth. Unemployment exists because jobs don't, therefore one

Entrepreneur- Traits & Characteristics		
1. Adaptable	21. Efficient	40. Personable
2. Amiable	22. Enthusiastic	41. Positive
3. Articulate	23. Farsighted	42. Practical
4. Aspiring	24. Focused	43. Precise
5. Attention to detail	25. Hardworking	44. Rational
6. Balanced	26. Imaginative	45. Realistic
7. Challenging	27. Innovative	46. Reflective
8. Clever	28. Insightful	47. Relaxed
9. Confident	29. Intelligent	48. Reliable
10. Courageous	30. Intuitive	49. Resourceful
11. Competitive	31. Logical	50. Risk taker
12. Competitive	32. Multi-levelled	51. Self-critical
13. Continual improvement	33. Networker	52. Self-aware
14. Creative	34. Objective	53. Skilful
15. Decisive	35. Observant	54. Spontaneous
16. Dedicated	36. Optimistic	55. Systematic
17. Desire to give back	37. Passionate	56. Venturesome
18. Dedicated	38. Perceptive	57. Ambitious
19. Dynamic	39. Perfectionist	58. Determined

TABLE 1. Entrepreneur- Traits & Characteristics

way to act to reduce it is to create jobs. It isn't the governments remit to create jobs, particularly not in the private sector therefore this responsibility is falling more and more on entrepreneurs. They can be the lifeblood of an economy, creating wealth and job security from little more than an idea.

So, where are these entrepreneurs, it can be asked? They are already out there, in society, possibly unemployed or employed as a member of a workforce. They are in colleges and universities, they are in schools and they are yet to be born. The problem is that many of them don't know that they're entrepreneurs. They either aren't aware that they are potential entrepreneurs or they haven't been identified as potential entrepreneurs because they're still in the education system and haven't been put into a position of having an opportunity to be entrepreneurial. It's this latter group, those potential entrepreneurs still in education that this paper will discuss.

The potential entrepreneurs can be categorised into three broad age groups:

1. Primary – i.e. Junior School pupils.
2. Secondary - i.e. High School students.
3. Tertiary – i.e. College students

It is category 3 that should be the focus of future study as a primary course of action, as that age group is more likely to produce the budding entrepreneurs for the next generation.

2. WHAT IS AN ENTREPRENEUR?

Statements like 'Entrepreneurs are made not born' have been given and are in part true, but not wholly accurate. Maths geniuses aren't made, nor are top scientists otherwise anyone could be taken and made into a top mathematician or scientist. The same can be

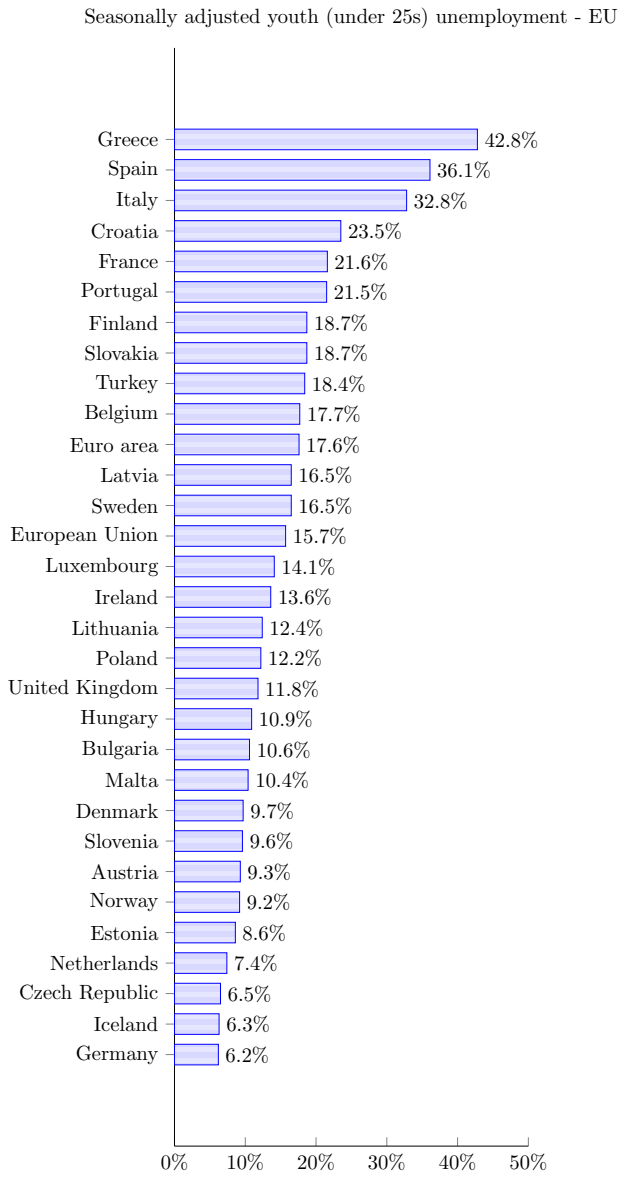

FIGURE 1. Graph of Seasonally adjusted youth (under 25s) unemployment in the EU, January 2018 (Eurostat, 2018). The statistic shows the seasonally adjusted youth unemployment rate in EU member states as of January 2018. The source defines youth unemployment as unemployment of those younger than 25 years.

said for entrepreneurs, successful ones that is. Whilst it's true that the knowledge required to be acquired by the potential entrepreneurs is imparted from those who have gone before them, the requisite level of intelligence and ability to assimilate information and formulate new ideas and concepts is believed to some degree to be innate and genetically inherited.

It is therefore important to identify this innate genetic ability at an early stage and begin the nurturing process towards becoming successful entrepreneurs. A genetically gifted athlete who isn't given the opportunity to train and be coached in the right techniques to make them the best that they can be, would probably never realise the potential that exists within them: a) because it hasn't been identified and b) because they haven't been coached how to make the most of their abilities. Top athletes don't just appear on the world stage without training, they spend many hours, weeks and months refining their skills and even then, they may not make it to the top level. The same is true of entrepreneurs, they don't become an immediate success overnight, they learn their trade, hone their skills and surround themselves with the right people and resources.

To understand how to identify an entrepreneur we need to establish what an entrepreneur is. The word has its derivation from the French 'Entreprendre' meaning (undertake) and English 'Enterprise' meaning (business) giving the meaning to 'undertake business'. An Entrepreneur is stated in the Cambridge English Dictionary as 'a person who sets up a business or businesses taking on financial risks in the hope of profit'. (Anon, 2018)

The belief of this author is that the key ingredients to becoming a successful entrepreneur are:

$$entrepreneur + business\ idea + financial\ backing + effective\ marketing + strategic\ sales = business + profit$$

It is the combination of all these elements that make for a successful entrepreneur. Without effective marketing and strategic sales the entrepreneur simply has an expensive hobby. Without financial backing the venture may be doomed for a protracted failure during which time a similar idea with financial backing may take the market share of sales. An idea without an entrepreneur whose vision and passion can drive it forward to a successful completion may simply drift along achieving sales but never the success it could have the potential to reach. It is the combination of those ingredients that make an entrepreneur a successful one and without them they may simply be innovators and visionaries often with good ideas, but never the ability to realise their full potential.

Accurate identification of a potential entrepreneur can be a complex process and is one of the most difficult challenges facing researchers in the field. The journey outlined in Figure 2 suggests potential elements to be examined which individually may not serve to provide any answers but collectively could provide valuable information and indicate an individuals potential to be entrepreneurial. This provides a starting point from which to commence the research, with each element developed specifically with entrepreneurial identification in mind.

3. CONCLUSIONS

It is fundamentally important to identify at an early stage those individuals who have the innate ability to

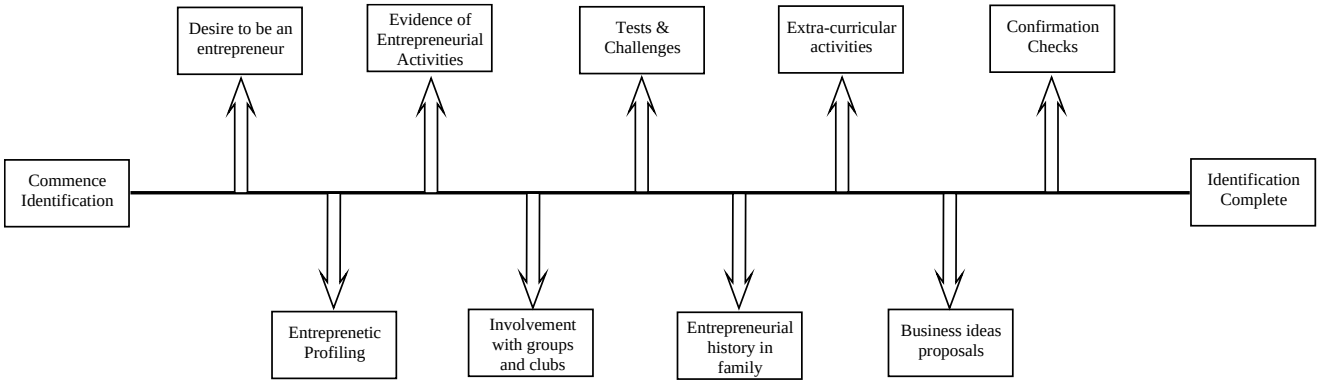

FIGURE 2. The entrepreneurial identification journey

be entrepreneurs. This early stage identification in conjunction with specific skills training could be the catalyst to reversing the current downward spiral of unemployment.

Innovation alone does not make an entrepreneur and therefore the application of training modules in the requisite disciplines to become an entrepreneur once identified are essential. Young entrepreneurs need the assistance of business incubators to enable them to reach their potential for growth and success, therefore one suggestion would be that colleges should set up business incubators specifically for students to create their own businesses, hone their skills using a series of online tutorials for each business discipline and have access to successful entrepreneurs in the community to assist with advice and suggestions. This perspective may have some radical implications for the way colleges operate in the future, especially with the assertion that candidates for entrepreneurial training should be selective and that only those positively identified as having the potential to become entrepreneurs should be eligible to undertake the training programs.

A comprehensive training program should be created covering all aspects required of an entrepreneur. This should be aimed to educate the young entrepreneur as to what is required of them to be successful as entrepreneurs, rather than cover each aspect as a training course as these currently exist in different forms for older adult entrepreneurs.

Finally, Young entrepreneurs need the self-discipline to want to make it. They need to want to learn and develop their confidence and self-efficacy, and this desire needs to be introduced to them at an early stage in their formative years. Parents and relatives may not possess the experience or knowledge to provide this stimulus therefore it is down to the educators/teachers as role models to initiate and enhance the potential that may lie dormant within children.

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ABOUT AUTHOR

Steve Pearson is currently Director of Remvox Ltd., Lancashire, U.K. He is a multi-award winning former Sandhurst Army Officer in the Royal Electrical and Mechanical Engineers. He left the forces in 1994 and started his first business which won business of the year awards in 1995 and 1996. His second company was a CCTV company which subsequently went on to install CCTV systems on housing estates throughout the country and also most of the CCTV cameras in Blackpool Town Centre. He has provided security consultancy services in the Middle East working on projects that include royal palaces in the UAE. In 2012 he published a book entitled 'Success Breeds Success' which is a guide for businesses on how to be successful and also in 2012 he invented and was successfully granted two patents on 'Wireless Mobile Telephony Public Address System' Patent numbers GB2499695B and GB2511703B and has developed a whole range of products/systems that are extremely innovative. He currently has several other patent applications pending for innovative technologies. He was awarded Entrepreneur of the Year award for Lancashire in 2014 and writes articles for national and international security magazines while being a keynote speaker at various security conferences and exhibitions in relation to audio intervention.

Investigation on the negative impacts and risks associated with fleet operation & maintenance activities in the city of Abu Dhabi

Sunil Jayantha Hettiarachchi

Al Naboodah National Plant and Equipment LLC, PO Box 33900, Al Awir 800, Dubai - Hatta road, E44, Dubai 00000 - United Arab Emirates (UAE).
Email: s.hettiarachchi1@unimail.derby.ac.uk

This study discusses the impacts and risks associated with fleet operation and maintenance activities and remedial actions in the city of Abu Dhabi as the corporate social responsibility of a professional engineer. Emissions with air pollutants, risk of fuel, lubricant and toxic material spillages, hazardous waste produced, and depletion of natural resources by operating numerous internal combustion engine driven machineries and risks and impacts associated with human life by utilizing, operating or maintaining above fleet were the main concerns identified.
Ongoing practices, waste management, mitigating and preventive activities with regards to risks, impacts and aspects associated with health, safety and environment were reviewed. Available company literature on Safety, Health, Environment and Quality (SHEQ) policy, code of conduct, sustainability policy, risks and impacts assessment, and corrective action plans were assessed. Internal and external audit reports were appraised for recommendations and set of proposals were made, while observing local statutory obligations with the guidance of ISO 14001:2004 and OHSAS 18001:2007 management systems, for the senior management's consideration as an environmental and ethical responsibility of a professional/ chartered engineer.

Keywords: fleet-maintenance, risks, pollutants, hazardous waste, environment

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1. INTRODUCTION

Al Naboodah National Plant & Equipment (NP) is a classified plant hire and maintenance company owning little over 3,000 units of equipment, within the Al Naboodah Construction Group (ANCG), based in Dubai, United Arab Emirates (UAE). The group undertakes all type of civil constructions in Middle East, North Africa and South Asia, thus NP is to provide machinery back up for aforesaid ANCG activities utilizing its own fleet, which consists of all types of construction plant, machinery, equipment and vehicles, light and heavy, which are powered by diesel or petrol driven internal combustion engines (ICEs).

Aligned with above scope, NP has established several branches in key regions to support its operation and maintenance activities and NP Abu Dhabi is one of them, a branch situated 160 kilometers southwest of Dubai, the capital city of UAE.

Emissions added to the atmosphere with a number of pollutants in addition to the carbon footprint appended by operating more than 3,000 units powered by ICEs and waste produced (both hazardous and nonhazardous) within their workshops and sites' activities while maintaining above fleet to meet clients' targets are the foremost environmental concerns. NP needs to address these concerns considering the risks and impacts associated with their operations to the wider society. Consequently, the aim of this project is to investigate on the impact and the risks encompassed with the fleet operation and maintenance practices and to implement best possible procedures to eliminate those in ethical manner with following objectives:

- Observe the environmental impacts associated with fleet maintenance and operation practices and the best possible solutions to remove or reduce those;
- Investigate the risks involved with operational and workshop practices and set up a mechanism for risk mitigation planning, implementation and a progress monitoring system;

- Identify ethical responsibilities associated with the above work environment and workout a system to avoid negative social effects from the organization.

Remainder of the paper is structured as follows: Section 2 – contains a literature review associated with legislative requirements; Section 3 – defines the methodology utilized in this study; Section 4 – comprises the results and observations; Section 5 – explores the ongoing Health Safety and Environmental practices; Section 6 – for the waste management; Section 7 – explains the identified environmental and ethical responsibilities within the activities and section 8 – discusses the risks, hazards and impacts associated with fleet maintenance and operation activities with suggestions to mitigate or improve outcomes for the betterment for the society, followed by section 9 – for the references used in this evaluation.

2. LEGISLATIVE REQUIREMENTS

Guidelines from subsequent Integrated Management Systems (IMS) and from regional legislative establishments were followed in this investigation, such as:

- Integrated Management Systems (IMS); EMS 14001:2004 & OHSAS 18001:2007
- Environment Agency - Abu Dhabi (EAD)
- Centre of Waste Management – Abu Dhabi (CWM)
- Department of Municipal Affairs – Abu Dhabi (DMA)
- Dubai Municipality – Government of Dubai (DM)

The fourth chapter of the above IMS manuals: EMS (Environmental Management System) 14001: 2004 and OHSAS (Occupational Health and Safety Management System) 18001:2007, elaborates the requirements with guidance for use with following subsections: General requirement, Environmental or OHS policy, Planning, Implementation and preparation, Checking, and Management review

Detailed correspondence between both management systems, ISO 14001:2004 and OHSAS 18001:2007 is given in the Table 2.

In general, the organization should establish, document, implement, maintain and continuously improve an environmental and occupational health & safety management system in accordance with the above international standards while adhering to regional legislative obligations.

Moreover, following federal and local directives were referred as Guidelines to have best possible occupational health & safety and environmental protection practice within above endeavors:

- Federal law no. (24) of 1999 for the protection and development of the environment (Environment Agency – Abu Dhabi (EAD), 2016)
- Federal law no. (21) of 2005 for the waste management in the emirates of Abu Dhabi (EAD, 2016)
- Technical guidance document for storage of hazardous materials, EAD – EQ – PCE – TG – 16 (EAD, 2014)
- Cabinet decree no. (12) of 2006 regarding the regulation concerning the protection of air from pollution (EAD, 2016)

Complying with the above, the organization's Safety, Health, Environmental and Quality (SHEQ) policy, Code of Conduct and sustainability policy were established and latest revisions could be browsed through at the company website: www.alnaboodah.com.

3. METHODOLOGY

In this investigation, below mentioned methodology had been followed to achieve the objectives mentioned above.

1. Identified and documented all ongoing fleet operation and maintenance activities, the risks involved with those events and both hazardous and nonhazardous waste produced in workshop practice, thus possible impact to the environment.
2. Reviewed legislative requirements by local authorities for above maintenance and operation activities and for hazardous waste produced in workshop practice. In addition, guidelines of, ISO 14001:2004; environmental management system for safe handling of above waste produced, and guidelines of OHSAS 18001:2007; occupational health and safety management system were appraised and followed for a better solution.
3. Scrutinized ongoing health, safety and environmental protection practices to safeguard all employees involved with workshop practice, fleet operation and the environment as far as reasonably practicable, from potential hazards in the performance of their duties and a waste management and reduction plan to handle the disposables to minimize, mitigate and eliminate environmental impacts created by producing hazardous waste in workshop practice.
4. Acknowledged all possible ethical responsibilities associated with above operations and prepared a feasible action plan to implement including employee welfare.

CLAUSE	EMS 14001: 2004	CLAUSE	OHSAS 18001: 2007
4	Environmental management system requirements	4	Occupational Health and Safety management system requirements
4.1	General requirements	4.1	General requirements
4.2	Environmental policy	4.2	OH & S Policy
4.3	Planning	4.3	Planning
4.3.1	Environmental aspects	4.3.1	Hazard identification, risk assessment and determining controls
4.3.2	Legal and other requirements	4.3.2	Legal and other requirements
4.3.3	Objectives, targets and programms	4.3.3	Objectives, targets and programms
4.4	Implementation and presentation	4.4	Implementation and presentation
4.4.1	Resources, roles, responsibility and authority	4.4.1	Resources, roles, responsibility, accountability and authority
4.4.2	Competence, training and awareness	4.4.2	Competence, training and awareness
4.4.3	Communication	4.4.3	Communication
4.4.4	Documentation	4.4.4	Documentation
4.4.5	Control of documents	4.4.5	Control of documents
4.4.6	Operational control	4.4.6	Operational control
4.4.7	Emergency preparedness and response	4.4.7	Emergency preparedness and response
4.5	Checking	4.5	Checking
4.5.1	Monitoring and measurement	4.5.1	Performance measurement and monitoring
4.5.2	Evaluation of compliance	4.5.2	Evaluation of compliance
4.5.3	Nonconformity, corrective and preventive actions	4.5.3	Incident investigation, nonconformity, corrective and preventive actions
4.5.4	Control of records	4.5.4	Control of records
4.5.5	Internal audits	4.5.5	Internal audits
4.6	Management review	4.6	Management review

TABLE 1. EMS 14001: 2004 – Environmental management system & OHSAS 18001: 2007 – Occupational health and safety management system - requirements with guidance for use

5. Formulated a set of recommendations with regards to environmental and ethical responsibilities involved with above mentioned activities and presented to the senior management to consider as a part of the NP's corporate social responsibility.

4. RESULTS AND OBSERVATIONS

The observations of this appraisal is segregated into 4 subsections, i.e. 4.1) Operation and maintenance activities associated with NP Abu Dhabi; 4.2) waste produced, both hazardous and nonhazardous during above activities; 4.3) risks and hazards identified within above actions and 4.4) significant environmental aspects identified with the ongoing practices and elaborated below for enhanced interpretation.

4.1. Operation and maintenance activities of NP Abu Dhabi

I Maintenance activities related to plant equipment and vehicles.

- i Periodical preventive maintenance activities
- ii Day to day running repairs
- iii Major overhauls
- iv Site maintenance activities, daily checkups, routine maintenance
- v Lifting and working at height operations involved with above activities

II Paint booth and associated activities

III Wash bay and associated activities

IV Fabrication and associated activities

V Bulk diesel fuel storage and handling activities

VI Diesel fuel dispensing to machinery, equipment and vehicles at site

VII Material handling and transportation

VIII Other transport activities and plant and machinery operations at sites

IX Managing waste created by above activities.

X Office and stores, communication, documentation and material handling activities

FIGURE 1. Hazardous waste collection at NP workshop, Abu Dhabi

4.2. Hazardous and non-hazardous waste produced during above activities

I Waste crankcase oil, lubricants and fluids

II Used batteries/ battery acid

III Used tires

IV Contaminated rags

V Used/ contaminated filters

VI Waste sludge, contaminated soil

VII Waste/ contaminated water

VIII Paint material waste, tins/ cans

IX Food waste

X General waste/ road sweeping

XI Paper and office waste

XII Metal scrap

XIII Used plastics

XIV Paper cartons

Figure 1 illustrates the storage of hazardous waste collection; used crank case oil, contaminated rags and filters, paint wastes, and likes within a bund wall at NP workshop, Abu Dhabi.

4.3. Risks/ hazards identified with above activities

Risks and hazards associated with above activities were identified and documented in Table 2.

5. SIGNIFICANT ENVIRONMENTAL ASPECTS IDENTIFIED WITH ONGOING PRACTICES

- Combustion of fuels during transportation and offloading materials and maintenance of equipment
- Chemical spillage releases to land and water (abnormal operation)
- Consumption of fresh water (excessive use)
- Contaminated washout/ waste water during washing and maintenance of plantequipment in undesignated areas. (abnormal operation)
- Depletion of natural resources during operation of plant, equipment and vehicles, fabrication processes and all other related activities
- Diesel spillage while filling or dispensing from bulk tanks, dispensing at sites or leakage or spillage from bulk storage or mobile tanks
- Dust accumulation during moving and passing of mobile equipment or operation of plant & equipment
- Emission of fumes or gases during painting activities, fire, maintenance of equipment, transport and offloading, fabrication processes, use of defective equipment, using of vehicles and equipment
- Excessive noise emissions
- Excessive use of paper
- Fire at diesel/ oil storage areas, work environment
- Generation of contaminated washout/ waste water

ACTIVITY	RISK/ HAZARD
Workshop activities	Machine guards/ screen covering rotating parts not on equipment Contacts with moving and mechanical parts Machinery left unattended and running Inadequate ventilation No safety signs Obstructed emergency shut - off switches Chemical substances in unmarked containers Trailing wires, cables No barriers on inspection pits Top heavy shelving Missing, damaged or misused machinery guards Fire and explosion Contact with hot machinery parts Excessive noise Manual handling Chemical hazards Slips, trips and falling hazards Unsafe person and practices Electric shocks Use of improvised tools and improper use of tools Gas cylinders not chained on trolley or wall Flickering lights Missing or inadequate covers on inspection pits Tire changing
Welding and cutting	Gas cylinders not fitted with flash-back arrestors Free standing high pressure gas cylinders Not fitted with protection cap Buildup of combustible material Personnel without correct personal protective equipment (PPE)
Painting works	Inhalation of fumes Poor visibility Contamination of environment Skin contacts with hazardous substances Fire hazard
Vehicle, plant & equipment high pressure washing	Electric shock hazard due to malfunctioning of electric power plant, short circuited wires, etc. Falling from heights Manually handling, spraying, cleaning degreaser Heat stress Poor visibility Congested washing area High pressure washing hazard, skin contacts Wash bay blind corners Slippery floor Hit injuries due to improper body posture
Driving related	Speeding, impact with other vehicles, stationary objects Poor visibility Unauthorized driving

TABLE 2. Risks and hazards identified within fleet maintenance and operations activities of NP Abu Dhabi

- Hazardous chemicals/ waste, generation, storage and disposal
- Inefficient use of electrical equipment
- Leaks; from delivery trucks, treatment plant facility (abnormal)
- Solid waste, mixed (paper, plastic, bottles, food waste, aluminum cans, etc.)
- Release of substances from accidental puncturing and damage of buried services, releases to land and water (abnormal operation)
- Sludge waste generation
- Storage and handling of diesel fuel and oils/ lubricants, hazardous chemicals
- Ultra violet light emissions
- Workers exposure to chemicals at diesel filling area, at maintenance of equipment, during painting activities

6. ONGOING HSE PRACTICES IN THE NP BASE WORKSHOP, MAFRAQ, ABU DHABI

The base workshop of NP Abu Dhabi was inaugurated in March 2011. During early stages, in 3rd quarter of 2012, following facilities were designed and established as requested by the NP general manager, while obtaining and adhering to all necessary regional legislative requirements:

- Service inspection pits and vehicle lifts to service and maintain vehicles and plant & machinery in all categories.
- Bulk oil (lubricant) storage tanks with dispensing mechanism including air compressors, dispensing pumps, guns, associated plumbing, electrical works, etc.
- Bulk diesel fuel storage facility for around 172,000 liters (38,000 IGL) capacity.
- Vehicle and machinery wash bay.
- Paint booth for painting and preparation activities for all vehicles and equipment.
- Other necessary installations, security cabin, waste management arrangements, traffic control, operators/ drivers rest area, car park and similar other facilities.

From above tasks, item numbers 1, 2 and 6 were freely established since there were no additional legal compliances required by authorities to install within a premises approved by the Abu Dhabi municipality for the said purposes. Albeit rest; item no.3, 4 and 5 required serious consideration, followed by the approval from Abu Dhabi Civil Defense, prior installation and subsequent commissioning of the facilities.

6.1. Bulk Diesel fuel storage for 38,000 Imperial Gallons (IGL) capacity

This facility consists of 3 tanks: two of them with 14,000 IGL and one with 10,000 IGL capacities. The requirements of Abu Dhabi Civil Defense for bulk diesel storage are as follows:

- Bund wall around the tanks to contain more than 110% of the storage capacity of the containers within the confined area, in case of emergency.
- No electrical cables or connections inside the encircled area except earth rods or cables.
- No building, erection or structure with fire hazard within 6 meters distance.
- All tanks/ containers should be painted white with red colour strap in middle, clearly indicating the storage capacity with all recommended safety and permit stickers.
- All pipes carrying diesel fuel should be painted yellow and connections or joints with black to identify leaks and with arrow mark to indicate the fluid flow direction.
- Adequate drip trays, spill kits and fire extinguishers to prevent possible diesel leaks and sudden fire and manual siren for emergency.

Figures 2 and Figure 3 below indicate arrangements of bulk diesel storage at NP workshop, Abu Dhabi.

6.2. Vehicle and machinery wash bay

The legislative requirement for a wash bay is to dispose waste water in accordance with the requirements of the Centre of Waste Management, Abu Dhabi.

The wash bay was designed with 24 x 8 meter washing area with washed water to drain naturally into a tank with a capacity of 15,000 IGL, which consists of 3 stage sedimentation process: 1st tank with sloped bed thus all remains will deposit in the bottom and when the tank is full with washed water above 2/3rd of capacity, water will spill into 2nd tank. Second tank is connected to the third through goose neck, 1/3rd above the bottom level of 2nd and 2/3rd above in between 2nd and 3rd tanks to spill when 2nd tank is filled up to the 2/3rd of its capacity. This allows the oil films, emulsions, sludge etc., to float on 2nd tank surface and could be removed by an oil skimmer or manually. When the 3rd tank is full, the content will go through a 3 stage filtering process before it pumps into reusable storage tank with the capacity of 5,000 IGL. The filtering process consists of stages as follows

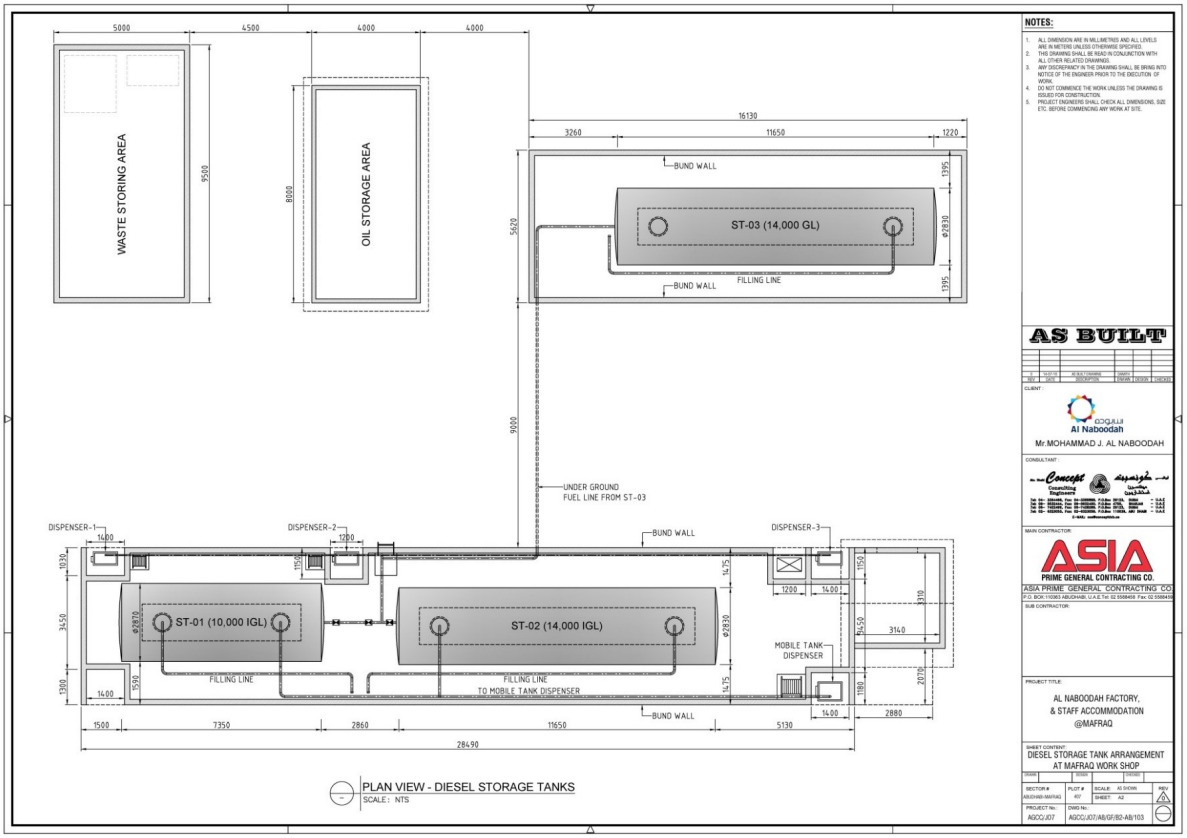

FIGURE 2. Diesel bulk storage tank arrangement at NP workshop, Mafraq, Abu Dhabi

FIGURE 3. Bulk diesel fuel storage at NP workshop, Abu Dhabi

1. Filtering through gravel sand filter
2. Through gravel coal filter
3. Through paper filter

Figures 4 and 5 illustrate the detailed wash-bay arrangements.

6.3. Monitoring and disposal of waste water

- A filtered water sample is analyzed monthly bya competent third party, authorized by the Center of Waste Management (CWM) in Abu Dhabi.
- Authorized hazardous waste transporter is called and disposed through the city hazardous liquid disposal facility when the test report indicates that the allowed limits were exceeded.

From the past analysis it was observed that the filtering system effects to reuse the used water for a period of six months before it exceeds allowed limits and it is observed that the total dissolved solids (TDS) is the parameter, which exceeds the allowed limit always. Hence disposing in every six months is the procedure followed at present, after producing current lab report and obtaining permission to dispose. Figure 6, below unveils the general operational view of the wash bay at NP Abu Dhabi.

6.4. Paint booth for vehicle and machinery painting and preparation activities

This facility was constructed by partitioning last bay of the main workshop using corrugated fire rated sandwich panels creating a room with the dimensions of 24mx6mx7m as length, breadth, and height respectively. This was done considering the size of the heavy earthmoving machinery, which need to be accommodated for above activities. Main features of the paint booth are the fumes extraction filter installed at the end of the room with the filtering area of 19.24 M2, and suction filters created on front door with 3.25 M2 area (Figure 7). The extraction filters are backed with two suction fans, powered by 22 HP electric motors. In addition, essential lighting, heating and air supply arrangements were done as necessary. Finally, before commencing, the inspection and certification was done by a competent third part organization authorized by the regional and federal authorities, adhering to USEPA EMC Method 2. The results indicated that they were exceeding the required minimum levels.

7. WASTE MANAGEMENT AND REDUCTION PLAN

Waste management and reduction plan was made with overall objective of minimizing the waste produced with reference to the section 4.2, by using the sequence of avoid, reduce, reuse, recycle and dispose as per the directives of the CWM and DMA of Abu Dhabi with the guidance of aforesaid IMS procedures.

The general manager, plant manager, SHEQ manager and regional manager are the personnel acknowledged with key responsibilities to implement the program.

The risks involved with waste generation, handling, segregation, recycling, storage, transportation and disposal were identified and documented with counter measures in the "Environmental aspects and impacts evaluation form" prepared by the SHEQ department.

Current waste generation sectors were identified as; i) by manpower (office/ workshop), ii) workshop practice, iii) site maintenance activities; and quantified for minimizing efforts.

Authorized waste transporters were identified as illustrated in the Table 7.

At present the stated services are being used to handle the waste generated to meet the objectives mentioned and also to meet the targets set in the "Waste Management Duty of Care Checklist" as illustrated in the Figure 8.

Minimizing printing, printing both sides of papers, using LED lighting as much as possible instead of CFL, florescent or element type lightings, switching off unnecessary appliances, switching off engines rather than idling, avoiding surplus orders, order in bulk, paper works through network were some measures implemented and are in continuous action to minimize the waste. Progress will be monitored and submitted to senior management annually with measures to control further as much applicable and practical as possible.

8. ENVIRONMENTAL AND ETHICAL RESPONSIBILITIES

With this study following environmental and ethical responsibilities were acknowledged throughout aforesaid fleet maintenance and operation activities:

- Mitigate and control the emissions created while operating numerous ICE driven equipment by annual inspections of emission levels through annual registration renewal procedure.
- Manage the waste generated by above activities as per the 3R waste hierarchy by reducing, reusing and recycling as practical as possible to minimize the effects on the sustainability of the environment.
- Planting necessary green plants around the boundary of workshop and other probable areas as applicable to compensate as much as possible the contribution of carbon footprint to the environment due to operating of many ICE driven machinery & equipment and vehicles by the company.
- Providing safe working environment for the workforce by maintaining good housekeeping, clearing unwanted material around, providing

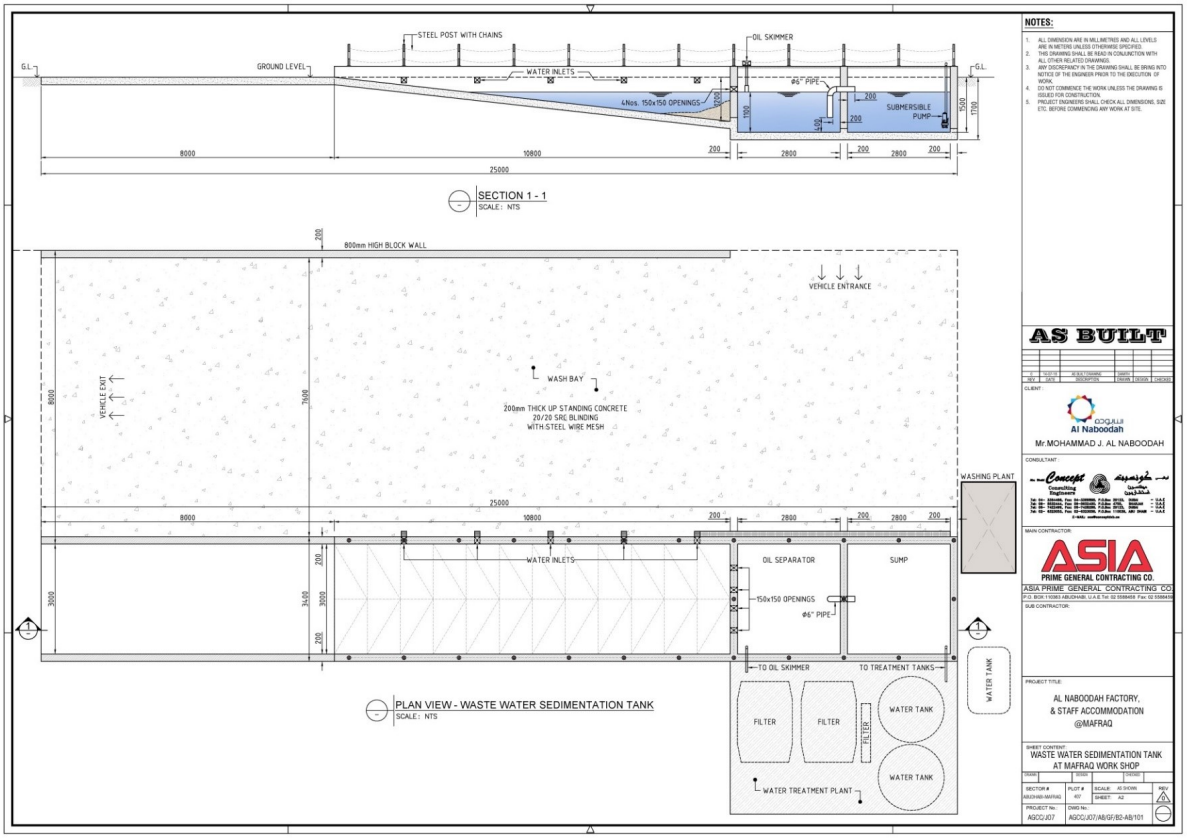

FIGURE 4. Wash bay, layout plan with details of waste water sedimentation tanks at NP workshop Abu Dhabi

Service provider	Service type	Permit Number
Veolia Environmental Services	Recyclables, papers, cardboard, plastic	PMT - 13 - 15982
Veolia Environmental Services	General & nonhazardous waste	PMT - 13 - 15982
Oasis Environmental Solutions	Hazardous waste	PMT - 15 - 16118
Aafaq Bela Hudood Used Lubricants	Waste/ Used oil	PMT - 13 - 16196
Green Mountains Environment & Transport Services	Waste water	PMT - 16 - 15677
Mazoon Used Spare Parts	Metal scrap	PMT - 13 - 16164
Mazoon Used Spare Parts	Used batteries	PMT - 13 - 16164

TABLE 3. Waste contractors/ transporters

proper tools and risk-free space with appropriate PPE for the workforce to perform in a secured manner.

- Providing safe to work plant, equipment, machinery and vehicles at all times by inspecting, testing or load testing and certifying all above periodically, including lifting equipment annually and all lifting gears semi-annually. This is in addition to daily, routine and periodical inspections and preventive maintenance activities by maintenance staffs.
- Improving employee skills by educating and providing required training where necessary to meet aforesaid management standards established by the organization.
- Providing a glass of milk daily for the personnel involved with painting activities.
- Adhere to midday summer break law and prohibit working during the banned hours and avoid working under direct sunlight as much as possible.
- Provide adequate drinking water, energy drinks and temporary shelters in case of necessary emergency site activities especially during summer season.
- Promoting safety by conducting safety suggestion competition and awarding winners with cash prize,

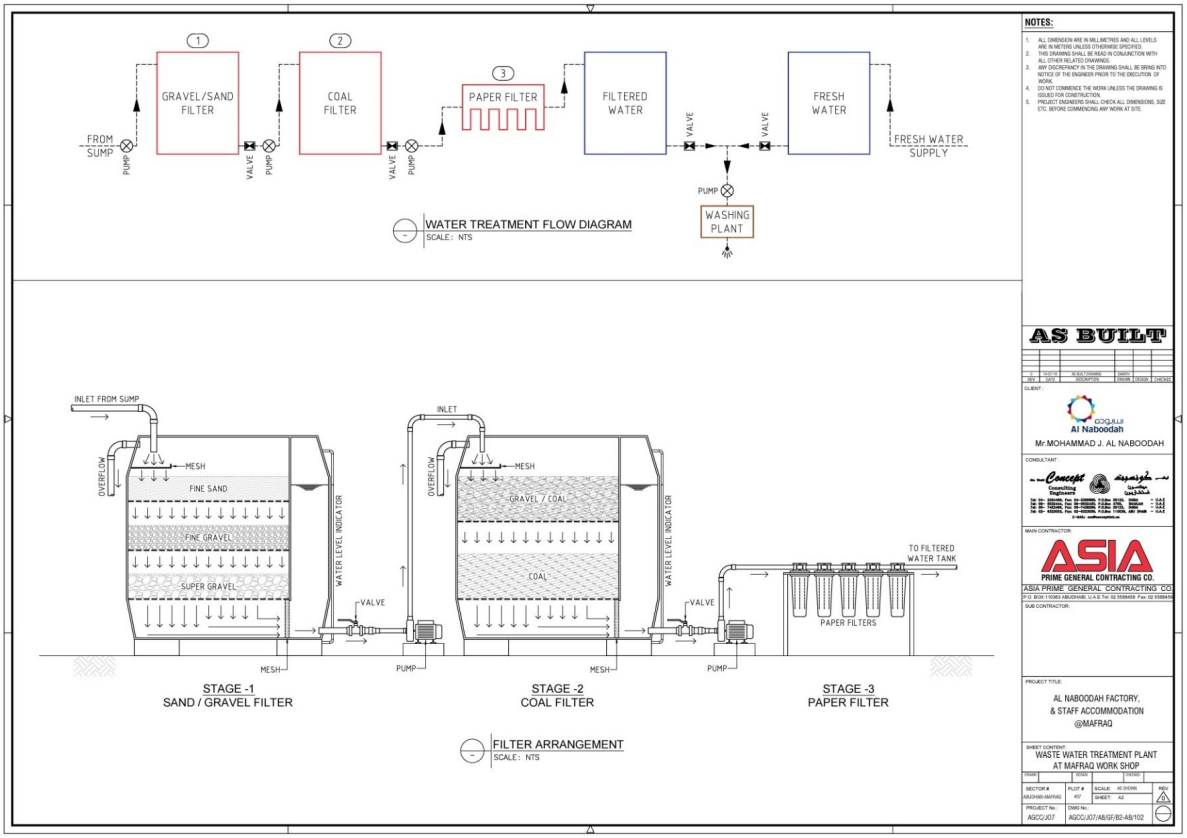

FIGURE 5. Waste water treatment process at NP workshop, Abu Dhabi

FIGURE 6. Wash bay at NP workshop, Mafraq, Abu Dhabi

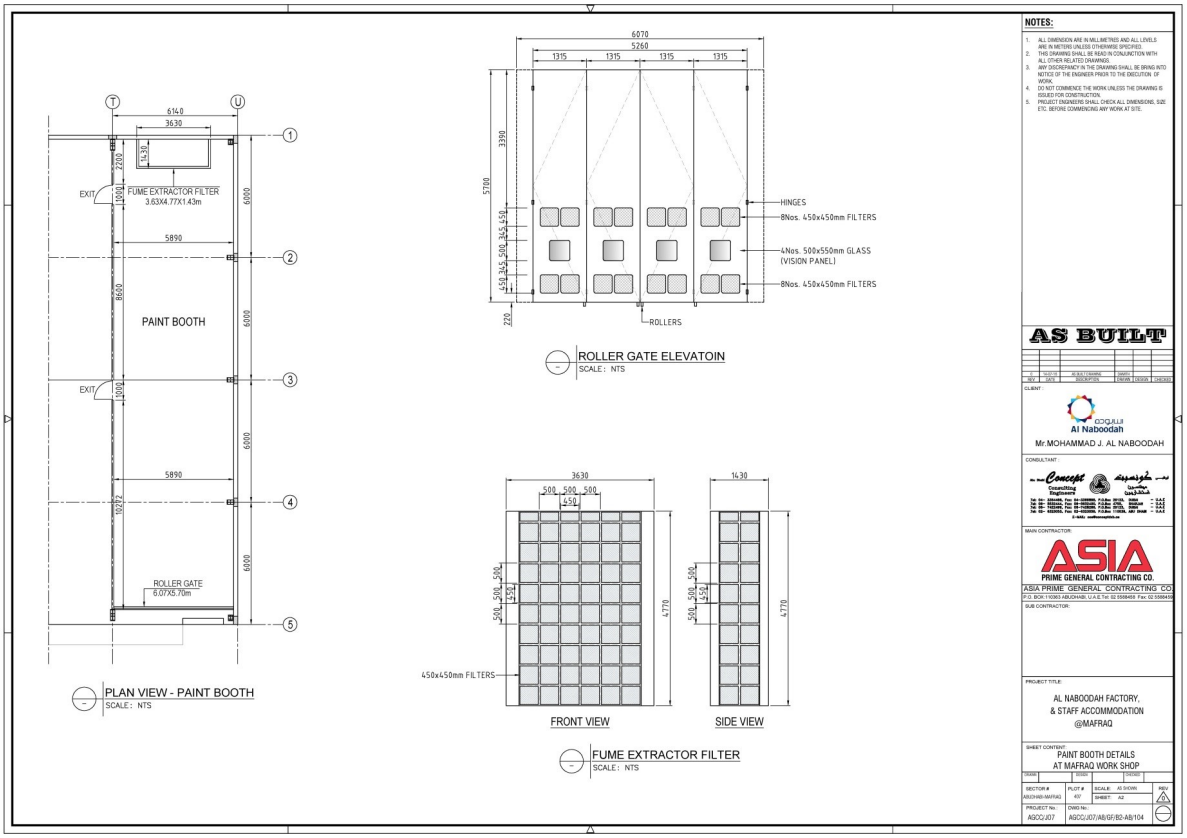

FIGURE 7. Paint booth filter arrangements at NP workshop, Mafraq. Abu Dhabi

bump cap and a certificate.

9. DISCUSSION AND CONCLUSION

This research has investigated the risks, hazards and impacts associated within fleet maintenance and operation activities towards the environment and human life. Emissions with many pollutants, risks of diesel fuel, lubricants or chemical spillages and contamination with soil or water, hazardous and nonhazardous waste produced with workshop practices, depletion of natural resources by operating numerous equipment and vehicles powered by an ICE and risks associated with various maintenance endeavors were the main issues identified.

Aligned with the above, control measures or corrective actions with risk and significance ratings (SR) were documented as:

- Environmental aspects and impacts evaluation form
- Significant environmental aspects, action list
- Waste management, duty of care check list (Table 4), etc.

This investigation is within the spirit of "National Plant workshops and associated plant yards HSE plan" and implementations are in action for prevention or mitigation as practical as possible to protect the environment for the future generation.

The HSE plan is a live document, prepared according to the group SHEQ policy with the guidance of OHSAS 18001: 2007, ISO 14001:2004 and ISO 9001:2008, while adhering to regional and federal legislative requirements.

With ongoing practices in wash bay, purifying waste water through gravel, sand, coal and paper filtering process is used instead of bioreactor method, This has reduced the use of chemicals during maintenance of bioreactors, power consumption and initial installation cost to save natural resources in addition to reuse of same water for the washing.

Bulk diesel storage tanks with bund wall above the specified capacity, static plants with inbuilt drip trays, service trucks and mobile fuel tankers with spill kits and dip trays are some ongoing measures to prevent environmental contaminations.

Hand and finger injuries, mostly because of the use of power hand tools, metal partials' prick in hands and legs while hammering due to use of improper (mushroom headed) tools and hammers were the most regular

Al Naboodah Construction Group LL

Al Naboodah Building and Civil Engineering Group

Waste Management
Duty of Care Checklist

Document Reference	
ABCG-HSE-FRM-018	
Rev. No.	Rev. Date
01	12/13
Page	
1 of 1	

Contract/CC: MAFRAQ WORKSHOP

Completed By: Print Name: Melwyn Loy Rodrigues Signature:

Location Management Agreement: Print Name: Hettiarachchi Signature:

Item	Waste Type	Expected Quantities		Disposal Option	Waste Carrier	Carriers Registration		Waste Disposal Site	Notes
		Tonnage	Time Span			Checked	Expiry Date		
1	Office Waste	20 kg	1 month	Disposal	VEOLIA	YES	16.08.2016	Abu Dhabi	
2	Food Waste	25 kg	1 month	Disposal	VEOLIA	YES	16.08.2016	Abu Dhabi	
3	Waste Oil	5 ton	1 month	Recycling	AFAQ BELA HUDOOD	YES	07.01.2016	Abu Dhabi	
4	Used Batteries	500 kg	1 month	Recycling	MAZOON	YES	08.12.2015	N/A	
5	Old Tires	3 ton	1 month	Recycling	AL FARWANIA	YES	08.09.2016	N/A	
6	Waste Sludge/ Contaminated Soil	1 ton	3 months	Disposal	AL ZELAL	YES	16.12.2015	Abu Dhabi	
7	Paper Cartons	1 ton	3 months	Recycling	VEOLIA	YES	16.08.2016	Abu Dhabi	
8	Plastics	5 kg	1 month	Recycling	VEOLIA	YES	16.08.2016	Abu Dhabi	
9	Tin Cans / Paint cans	150 kg	1 month	Recycling	VEOLIA	YES	16.08.2016	Abu Dhabi	
10	Contaminated Rags	300 kg	1 month	disposal	AL ZELAL	YES	16.12.2015	Abu Dhabi	
11	Metal Scarp	1000kg	3 months	Recycling	EXPEDIA SCRAP	YES	13.06.2016	Abu Dhabi	
12	Waste Water	5000 gals	3 months	Recycling	GREEN MOUNTAINS	YES	15.02.2016	Abu Dhabi	

FIGURE 8. Waste management duty of care checklist

injuries witnessed, thus dealer training for safe handling of power hand tools, tool box talks for appropriate tool use were conducted.

Carrying out testing, inspection and certification periodically on all plant machinery & equipment, vehicles and special tools by competent and ratified third parties will ensure that the fleet is safe to operate with minimum emission levels as sanctioned.

Personnel were given outside training for basic and advance first aid, firefighting or banksman/ lifting applications besides the ongoing in-house education by day to day work based instructions and toolbox talks.

With this study the practitioner has demonstrated an engineer's ability to protect human life and the nature within his professional deeds with the guidance of IMS, while observing regional and federal decrees, with reference to the required chartered engineer's competency category E3 as stated in UK Standard for Professional Engineering Competence (UK – SPEC, 2014).

Moreover, ethical principles cited in the Statement of Ethical principles (SEP) (raeng.org.uk, 2011) were met with reference to UK – SPEC, E5 competence and continuing within this work based engineering built environment, such as:

- Accuracy and rigor – by investigating and troubleshooting machinery defects accurately, minimizing down time and spare parts/ repair costs.
- Honesty and integrity – Public, the employer or the professional body of the individual should comment on his ethical behavior to recommend on this virtue.
- Respect for life and the public good – by providing safe to work machinery or vehicles to work and providing safe work environment to the workforce.
- Responsible leadership: listening and informing - by directing this multinational workforce to the achievements demonstrated in this analysis.

Some organizations may use not only ISO certification but also Corporate Social Responsibility (CSR) and sustainability events for green washing as noted by Robinson (Robinson, M., 2007) as a propaganda media to keep their banners high and as well as to be on top of the competitive market. However, the organizations who maintain those international standards are under obligation to continue, thus, the organization and the responsible personnel will be under scrutiny until the organization holds the certification by conducting

weekly safety tours, tool box talks, quarterly internal and annually external audits in additions to various inspections and tests to come by in-between. The audit findings or recommendations; nonconformities, observations or opportunities for improvements will create ample openings for advancements for really competitive organizations to be in the market. Therefore, practicing ISO standards will certainly enhance an engineer's efforts towards fulfilling his/ her responsibilities for the sustainability of the environment in an ethical manner.

ABOUT AUTHOR

Sunil Jayantha Hettiarachchi is a Sri Lankan mechanical engineer working as a maintenance manager attached to Al Naboodah National Plant & Equipment in Dubai, United Arab Emirates (UAE); a classified plant hire and maintenance company having more than 3,000 equipment to cater construction projects undertaken by the Al Naboodah Construction Group. After the college studies since 1964 to 1977, he joined the University of Moratuwa, Sri Lanka from June 1977 to Jan 1981 for higher studies, Jan 2007 to Oct 2007 with City and Guilds, UK for PGD, May 2015 to Jan 2018 with University of Derby for MSc and presently with London South bank University for doctoral research. Sunil's first employment was in February 1981 as an engineering assistant with the River Valleys Development Board of Sri Lanka, left the board on September 1987 to join with Al Mawarid Services in Riyadh, Kingdom of Saudi Arabia (KSA) and left KSA as an assistant workshop manager in March 1999 to take up present occupation on May 1999 where he is continuing to date. In 2002, he attained first professional affiliation through the Institution of Incorporated Engineers, Sri Lanka (IIESL) with abbreviations MIIESL, IEng, followed by fellowship FIIESL in 2012 and MIET in Mar 2018. Sunil is engaged with many CSR and CPD developments through activities associated with IIESL – UAE branch as an elected committee member, secretary and at present as the serving branch chairman since 2012.

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Women in Drug Abuse – Potential Pathway to Release: Part 1

Anupama Sanjeev

Assistant Dean - Student Affairs and Counselling, Presidency University, Bengaluru, Karnataka, India 560097
Email: anupamasanjeev@presidencyuniversity.in

This paper examines and discusses the reasons for drug addiction, consequent repercussions and subsequent coping techniques for young women based on case study experiences of the author in the socio-cultural context of South Asia. The experience indicates towards applicability of Cognitive Behavior Therapy (CBT) developed by Dr. Aaron Beck as a path to enhance self-efficacy as a self-regulatory agency in order to empower the affected women with adequate coping skills.

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1. INTRODUCTION

Understanding substance abuse or addiction is no simple task. It has existed for millions of years and while the APA (Price, 2008) reports that: (a) about half of a person's susceptibility to addiction can be linked to genes, and (b) there are many different types of genes all working together that can influence whether someone starts using, likes to use, continues to use or feels a few consequences due to use of addictive substances like drugs; we must remember that humans are a social species and easily influenced by the people around them. Also, environmental risk factors or characteristics in a person's surroundings can increase their likelihood of becoming dependent on drugs.

In one sense, all human beings have a genetic predisposition for addiction as when we find something in our environment that creates pleasure (such as food, relationships, drugs or alcohol, and so on), we learn to prioritize these substances or interactions because they bring temporary feelings of comfort or security. The brain and the nervous system work together to strategize and obtain experiences that reduce physical discomfort, emotional distress, and mental obsessions and addiction then can be viewed as an overactive survival strategy (Verweij et al., 2010).

2. WOMEN AND DRUG ABUSE – A LITERATURE REVIEW

Drug abuse and the havoc it creates has been a source of great concern for many years now across the world. Much of it centered on men initially, particularly in South Asian socio-cultural context, but for at least a decade now the number of female victims has become significant. Moreover a murkier connection with social ills which provoke a woman to resort to drugs as a means of coping has also emerged in the course of research.

Women may not intend to develop an addiction, but their genes might spark the pleasure or comfort in addiction. Their environment might make an addiction easier to sustain than it might be where there is a different nurturing environment around that person. More specifically, while it has been established in many ways that nature and nurture have a very close relationship, what if nurture corrupts nature? (Kreek et al., 2012)

Baumrind's (Baumrind, 1966) research indicates that children who are raised by parents adopting the authoritative model (praising children for accomplishments, while providing guidelines and encouragement to improve on successes) of parenting tend to be more successful than their peers, when measured for self-image, academic success, or substance abuse (or lack thereof). The findings from Baumrind (1966) also indicate that the key reason why the authoritative style is so effective is because children who grow up in that structure learn important approaches to problem-solving, and how to regulate and express their emotions, to where they can develop skills and strategies against the harmful thought patterns that often come before substance abuse.

Many addicted women in treatment report that they began using drugs regularly after a specific traumatic event in their lives (Doshan et al., 1982; Kane-Cavaiol et al., 1991; Reed, 1985). Incest and rape are commonly cited precipitating events for drug use among women (Volpe et al., 1982–1983), and rates of sexual and physical abuse reported by women in treatment run as high as 75 percent (Forth-Finegan, 1992; Root, 1989; Roshenow, Corbett, & Devine, 1988).

Women may face unique issues when it comes to drug abuse, influenced by sex differences based on

biology and gender differences based on culturally defined roles for men and women. Scientists who study substance abuse have discovered special issues related to hormones, menstrual cycle, fertility, pregnancy, breastfeeding, and menopause that can impact women's struggles with drug abuse. In addition, women themselves describe unique reasons for using drugs, including controlling weight, fighting exhaustion, coping with pain, and self-treating mental health problems (National Institute on Drug Abuse, 2015).

Hien et. al., (2005) have shown that women who are on drug abuse are likely to experience ongoing traumatization, associated with severe problems in self-regulatory behavior: regulation of affective impulses (e.g., difficulty modulating anger), cognitive processes (e.g., disruptions in attention, memory and consciousness), and relationship with others (e.g., problems with intimacy and trust). All these problems may in turn reinforce the difficulties in the social environment of the woman in drug abuse.

Substance-abusing women in particular also experience higher levels of guilt, shame, depression, and anxiety about their addiction than men (Reed, 1985; Underhill, 1986; Volpe et al., 1982–1983; Winokur et al., 1967). In addition, like women in general, women who are chemically dependent report more negative feelings about their bodies than their male counterparts; they are also at higher risk for eating disorders (Marsh et al., 1986).

In spite of the above, women often have difficulty acknowledging their problems with substance-use disorders, and professionals are reluctant to ask women about drug or alcohol use (Hecksher et al., 2009). Since the turn of the century, scientists have found that, while half of a person's susceptibility to addiction can be linked to genetic factors, the other half is the result of poor coping skills (Prescott et al., 1999).

3. CASE STUDIES

Resorting to drugs in the pre-teens, using a wide variety to almost complete dependence, women too have experienced it all. This article is based on the experience of the author as a therapist and counsellor while dealing with two individuals who have moved into doing drugs as a coping mechanism because of extremely disturbing experiences. The individuals who are currently in therapy are hesitant with sharing details in a public space such as this article in a journal due to fear of social stigma as can be expected in these cases. Hence the broad similarity in these cases has been taken as the context to present the scenario in a sequence of social/family setting, circumstances and actions which have led to drug abuse. In one case the individual has a single parent (mother) who is running a business, while the family comes from a wealthy lineage and in the other case the individual is from a middle class nuclear family set up with a homemaker mother and employed father. In both cases, though the family structure is nuclear, there is very regular interaction with the extended family and relatives who also play a significant role in decision making with respect to the lives of the individuals in question. Both individuals are from a peri-urban set up from South Asia. Being first born is also an attribute shared by both the individuals.

Since the individuals had consented to embark on intervention therapy with the author – the path, and the rationale behind it, as based on existing therapy techniques is also presented in detail. Personal details are kept anonymous in compliance with the applicable research ethics and privacy policies.

Young women between the ages of 18 to 23 attempt to escape from a past that stifles them. They have been unable to talk about it till recently and at the time of starting the therapy were using coping mechanisms that pushed them further into a circle of abuse and social isolation.

What started as a visit completely out of curiosity have now become regular sessions with the therapist where the women are now able to speak of the various ugly events of the past that has made them fear trusting people and stay away from deep relationships, and sometimes shun people completely. The past which includes molestation by a trusted family member or even a trusted friend has left several negative impressions on them, especially on what they think about their bodies and as individuals.

Drugs had become a coping mechanism to get through the day. Work or academic performance had dropped drastically and sleep became rare and drug induced. A craving for sugar, chocolate and anything that gave a temporary feeling of well-being or a "sugar high" as described by them had become a large part of the regular diet which would definitely lead to issues that result from too much refined sugar in the diet.

Pronounced circles under eyes, cold hands, and severe shaking of the body in panic are some of the physical manifestations of the mental turmoil that the two women have had to deal with. They discovered that it helps when two similarly suffering people are able to share their experiences and support each other, and did arrive at the understanding that their coping mechanism was only pulling them down further.

Research has shown that poor coping skills often result in an underdevelopment of emotional regulation and social skills, for example: becoming easily upset, blaming others, having difficulty taking praise or criticism, social isolation, relationship enmeshment, and social anxiety. Without a healthy set of coping skills, addicts often find themselves stuck in the repetitive cycle of drug use, which is the habitual strategy that they have developed to cope with the stress of daily living. A potent factor that influences women's help-seeking behavior is stigma associated with being a woman and an addict. Together, these are elements that affect women's inclination or willingness to seek

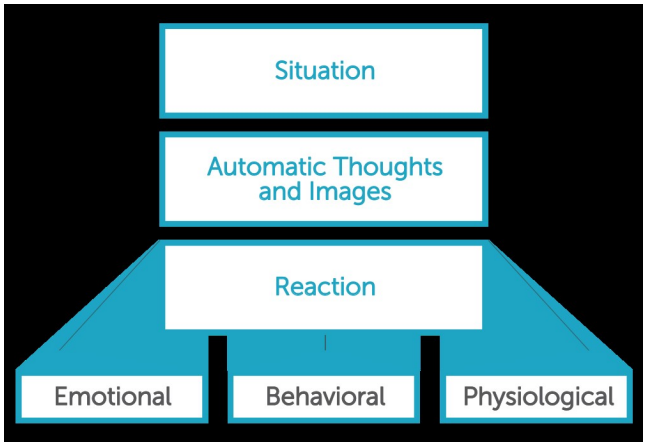

FIGURE 1. CBT Model (Beck, 1967)

help and by that initiate change of behavior.

The first few sessions were all about getting the pent up feelings out. They cried more than they spoke. They lamented at not being able to do anything about the experiences or the ugly hold it has on them, as the memories hurt them harder every day due to which they sank deeper into the whirlpool.

4. DISCUSSION

Bandura (Bandura, 1999) says perceived self-efficacy is the foundation of human agency. Unless people believe they can produce desired effects by their actions, they have little incentive to act. Self-efficacy beliefs promote desired changes through cognitive, motivational, affective, and choice processes. Perceived self-efficacy exerts its effects on every phase of personal change—the initiation of efforts to overcome substance abuse, achievement of desired changes, recovery from relapses, and long-term maintenance of a drug-free life.

Cognitive Behavior Therapy (CBT) developed by Dr. Aaron Beck (Beck, 1987) is offered as a path to heighten self-efficacy as a self-regulatory agency in order to enhance coping skills in people. The way an individual feels and behaves is influenced by the way s/he structures her/his experiences. When applied in the context of overcoming drug abuse, the therapy focusses on the experiences that have generated- what can be termed dysfunctional thinking or feeling – about themselves and the environment.

Figure 1 shows the General Cognitive Model that describes the cognitive process in three simple steps – of how a situation leads to certain thoughts which then result in reactions that could be emotional, physical and/or psychological.

The cognitive process when seen in the context of Beck's cognitive triad (Figure 2) involves "automatic, spontaneous and seemingly uncontrollable negative thoughts about: the self, world or environment and the future" (Beck, 1967).

Thinking for the individual primarily focusses on

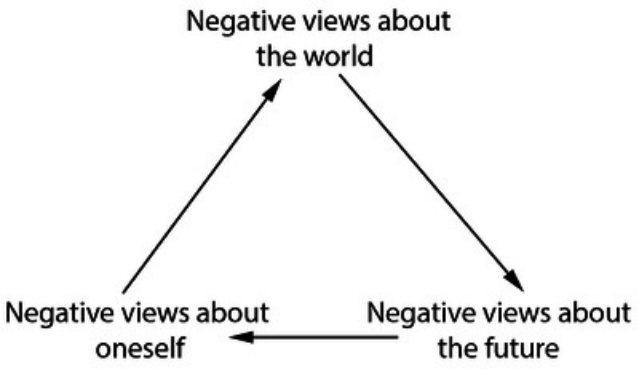

FIGURE 2. Beck's Cognitive Triad (Beck, 1967)

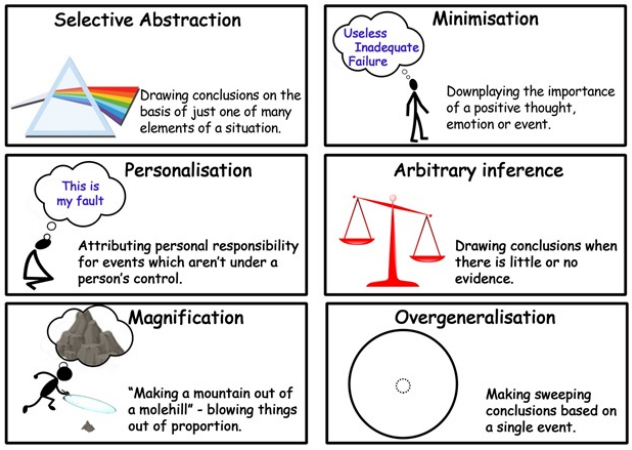

FIGURE 3. Unhelpful Thinking Styles / Cognitive Distortions. (Based on: https://psychologytools.com/unhelpful-thinking-styles.html)

negative aspects and includes thought patterns that define the self as "I'm worthless and ugly" or "I wish I was different", the world view as "No one values me" or "people ignore me all the time" or the future as "I'm hopeless because things will never change" or "things can only get worse!" This leads to certain identified biases (Gross, 2015) which clients are taught how to identify and alter as a part of therapy.

CBT, Process and Techniques - The process involves identifying and changing maladaptive thoughts through recognition of biases in thinking or cognitive distortions. The therapist introduces the notion of negative cognition (Beck's triad) in the first couple of sessions followed by the biases that can occur in thinking (3). The therapist and the client are "fellow scientists in therapy" who jointly identify less threatening alternatives that can replace the current biases in thinking, solidify gains and focus on prevention of recurrence.

Potential techniques include a self-monitoring record (Jaffe et al., 1988) to record the craving for drugs as given in Table 1.

Statements with words like "everyone", "never", and

Trigger (What sets me up to use?)	Thoughts and Feelings (What was I thinking? What was I feeling?)	Behavior (What did I do then?)	Positive Consequences	Negative Consequences

TABLE 1. Self-Monitoring Record proposed by Jaffe et. al.

"always" are pointed out in the course of interaction as exaggerations and the client is facilitated to re-attribute or distribute responsibility for an event like an argument which could involve negative connotations. "What if?" scenarios are designed by the therapist to explore actual events and de-catastrophize them. Scaling or putting an event on a continuum for example rating oneself between 'Most disturbed' (10) to 'Not disturbed' at all (0) for a particular event is used as a means to move away from dichotomous thinking. Positive mental rehearsals of future events are also encouraged to build confidence in the client.

5. CONCLUSIONS

Women often use chemicals to cope with what appear to be unsurmountable stressors.

Chemical use may actually succeed as a coping mechanism for a period of time. At some point, however, the negative effects of drug use outweigh its benefits (Woody, 1989). Having realized that this method of coping is no longer reliable or effective, the chemically dependent woman is often at a loss for productive alternatives. When viewed from this standpoint, it is clear why drugs become an integral part of some women's lives. Life can be perceived as successive experiences which overpower the individual, or a journey of discovery wherein experiences can be used as means to strengthen one-self. And for the latter to happen, one has to be able to first cope with the experience. Models understanding drug use as a coping mechanism are central to understanding the root cause of drug use for women (Mason, 1991).

The coping technique that one uses depends not only on the individual but also the life skills one imbibes from one's parents (Baumrind, 1966). Given this scenario, as an adult the appropriate coping technique may not be used and combined with the scarring effect of negative experiences, one's belief in oneself to take corrective action decimates and the downward spiral begins. However, the lessons learnt from the two case studies indicate that Cognitive Behavior Therapy or CBT as given by Dr. Aaron Beck (Beck, 1987) is an option in such a situation and works on the premise of the client playing an active part to walk the road to freedom from abuse.

Techniques that move away from the traditional ones reflect a philosophy that focuses on the strengths of each individual and uses her experiences, both past and present, as learning tools rather than as sources of grief and shame (Walker et al., 1992). Women identify components of their own mental make-up and the environment that are unhealthy and oppressive and that trigger the use of drugs. Having identified these sources of struggle and stress, women can then be helped to develop and use effective, safe, and nondestructive alternative coping strategies (Anglin et al., 1987; Woodhouse, 1990).

For women who choose to take this path, it could be a long journey ahead but the difference here is that they will be active decision makers with their therapist. This gives a sense of power to them, on the lines of Bandura (Bandura, 1999) who emphasizes human capacity rather than human failings and dysfunction. The line of therapy that was followed in the reported case study is based on Bandura's explanation of how self-efficacy can be influenced and developed, and how it positively affects all facets of human experience.

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ABOUT AUTHOR

Anupama Sanjeev is the Assistant Dean, Student Affairs and Counseling at Presidency University and is currently engaged in conceptualizing, organizing, and executing - (a) psychological and behavioral counselling and (b) all non-academic student related activities on a campus with 4000 students pursuing both undergraduate and graduate courses and (c)Design and execution of psychometric survey tools for student feedback. She has more than 9 years of experience in counseling, psychometrics, training, and content writing, apart from teaching and research. Her recent projects include created and providing a framework and content for a mobile app related to counselling, conceptualization and creation of an assessment battery for assessing the influencing patterns on children between the ages of 11 to 18 years, to be administered to school children across India, and successful alleviation of chronic psychosomatic severe, function impairing headache in a 17-year-old female, through a blend of non-directive counselling – both the patient and family, with lifestyle and dietary habits. Anupama is currently working with several young people in the areas of managing emotions, career path setting and successful relationships. Anupama holds a Ph.D. in Psychology, Organisational Behaviour (2013), M.Sc. in Human Resources (2006), Diploma in Counseling (2006), and B.Sc. in Math, Statistics, Computer Science (1993).

Opinion

Social Cost of Digital Revolution: Challenges ahead

Manjunath Shastri

Senior Product Development Engineer; Fisher & Paykel Appliances Ltd, New Zealand
Address: 791, Highcliff Road, RD2, Dunedin 9077, New Zealand
Email: shastri_kulkarni@yahoo.co.nz

There has been a significant absorption of digital technologies in our communities over the last decade. The side effect(s) of these technologies as a direct measure of systemic failures such as data breaches, security threats are being addressed by the regulating agencies around the world. The secondary effects of digital revolution which is responsible for creating undesirable social and behavioural issues in the communities are harder to comprehend. There is a lack of accountability among governing agencies and corporates to take ownership for these outcomes. Our track record as a community to introduce new technologies into the society and manage their long-term effects has been less than desirable. This review recommends that the technology promoters and regulators actively look at ways to introduce robust regulation measures for better accountability on the social impact of ongoing digital revolution.

Keywords: Digital revolution, Accountability, Social media, Regulations

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The Digital revolution is here and is happening irrespective of the speed at which the society or an individual is accepting these developments in their lives. Funded and driven by global corporations, lean and smart start-up groups, collaborations among hardware, software and infrastructure sectors, the pace of development of these technologies and speed of implementation has been remarkable. The digital revolution has been a blessing for the society by addressing some of the perennial problems across communication, commerce, healthcare and governance through innovative solutions to support an exploding population and user base.

The unusual added bonus here is the unprecedented adaptation of these new technologies in the market place. Technologies such as solar power, electric cars and medical alarms have taken decades to breakthrough barriers of the market place and for communities to appreciate and adopt them. In stark contrast, digital technologies are on a different platform. According to 'Statista' (Statista, 2018) the number of mobile applications available to download in March 2018 was at 3,600,000; an exponential rise from a meagre 30,000 in March 2010. These products/services can locate your missing phone, teach programming to students, monitor your health, allow online banking, video calling and the range of applications are limited only by one's imagination. We now have a situation where business growth and economy driven technologies are barging into the society with their offerings at a phenomenal rate, while the associated risks and long term effects are being uncovered by the communities' at a much slower rate.

This decade has seen a phenomenal growth of products and services developed by start-up companies with limited resources rushing their innovations to the global markets. Their efforts have been greatly supported by easy access to global open market platforms for rapid product launch into the society through internet and mobile networks.

Like every other technology in the world, these developments have created new dilemmas in our society. At the primary level, there is a direct association between a product or service and its effect on society. Recent incidences of data privacy breach by big multinationals, identity thefts, data breach of biometric information, security threats to the governments through wiki leaks, ongoing hacks of banking systems and ATMs fall into this category. Here we can co-relate the system failure with a company or product. In most situations, as a community we have gone too deeply into the technology adoption process to turn off or turn back from these developments. Our only hope and option is to make them more robust and address the new issues as they arise. Most of the corporations and governing agencies are working

towards bringing in new versions of software updates, bug fixing patches, regulations and so on. Looking back, how did we decide that these technologies are ready for the market?. If we had not rushed to adopt these technologies so quickly as a society, we might have given time for better understanding, testing and building more reliable systems in the first place. We could have developed robust regulatory systems to reduce risks within the banking sector, e-commerce and issues of national, public and private security concerns.

The risks at a secondary level with these technologies are even harder to comprehend and address. It is about how people use these products or technologies in a way that affects others and communities at large. It is about, how individuals/groups can use or manipulate these products for selfish gains. Typical outcomes could include, misuse of social media for cyber bullying, spreading religious hatred, creating mass hysteria on a racial abuse or road rage incident, political and lobby groups to progress their vested interests, etc. These activities fly around the boundaries of legality depending on the country and its current setup. From the global perspective, in most cases they are deemed as unethical or immoral.

At another level, there is an ever increasing body of evidence in the public domain to link the use of digital technologies behind many of the terrorist attacks in the recent years. They are used for planning, communications, co-ordination among teams, triggering explosive devices, engaging GPS guidance to track the targets and so on. At a slightly lower level of crime, we have digital technologies aiding drug distribution, robberies, kidnapping, counterfeiting and money laundering activities and so on. Our law enforcement agencies across the world are struggling to cope with speed and agility of technology adoption by criminal minded groups in our society. We created this situation in our communities with a tunnel vision thinking about the benefits of digital revolution and its economic windfalls.

When it comes to a physical product like a toaster, it needs to meet international/national safety standards before it can be launched into the market. It could be electrical safety, temperature hazards, warnings on conditions of use/abuse, user education needs and so on. What measures do we have in place to check the effects of new mobile applications or services that are being launched into the market place every day?. How do we ensure that these new technologies provide adequate safety to our communities covering various age groups, skill levels, and literacy levels of the users to understand the terms and conditions of legal agreements which service providers are routinely asking users to 'accept'?

Our current practices of introducing digital technologies/services into the society calls for a closer examination on how we assess the risks associated with them and how do we dispense system level controls for long term sustainability. There is a growing concern among medical professionals about the risks of these un-regulated health check apps on mobile devices available to the public and calls for improved accountability and regulations (Boulos et al., 2014). The rate of new technology introduction through digital platform is so rapid that even the people and agencies responsible for managing these systems have not had time or resources to understand their long-term implications. These technologies have a global reach and operate beyond the conventional boundaries of regional or national governance. While, there are reasonably well laid out regulations to protect people from physical injuries caused by machinery and equipment's, work or sports related activities, the damages from technologies leading to social or psychological issues are in their infancy.

In this era of digital revolution, data is in abundance. We are still evolving as a society to define the boundaries of 'Public' and 'Private' data. As a community these are grey areas, with evolving zones of acceptable limits for public and private information. We need to address issues around who owns our personal data and how we can manage and trust the service providers not to compromise the access to that information. As a society, we are in a state of transition across these issues. One segment of the society is concerned about their lack of digital connectivity with the rest of the world, while the other with full range of data connectivity is worried about data breach and privacy. The role of internet in our education system is a classic example of this dilemma. As a community, we want to embrace the digital revolution into the classrooms to enhance the quality of learning. At the same time, we are uncomfortable with the way it brings access to adult/inappropriate content for young minds or dealing with behavioural issues due to social media influence around the classrooms.

As a society, our track record for managing the impact of technology on our communities has been quite inadequate over the last century. While national governments and international agencies use GDP, quarterly exports, and foreign reserves as a measure of economy or nation's health, they do not take into account the cost we have to pay as a society to address the new emerging failure modes. How do we quantify the cost of healthcare support needed for our communities due to the smog we have created by allowing uncontrolled industrialisation in the mega cities?. How do we account for the cost of shutting down nuclear reactors we have built up over the years in a safe way for future generations? Based on a recent review (Furuya et. al., 2018), 'Asbestos' exposure causes an estimated 255,000 deaths annually in our world and according to the European Commission, it costs about 4 million EUR per cancer death as a measure of 'Value of Statistical Life'. This doesn't take into account the human sufferings and loss to the families from such incidents. As a society, how did we fail to see the effects of pollution from automobiles

globally? While our accountability and responsibilities were shifted and moved among various groups, the damage to the environment, the cost associated with healthcare and traffic management etc. were put down as a side effect of this evolution. As a society, we forgive and forget the role of past administrators and regulatory agencies for their inaction and passed on the burden of dealing with these mishaps to the next generation.

While, we expect the governments and regulatory agencies to manage the implications of new technology on our communities, with the digital revolution, new failure modes are appearing at a pace much faster than governments or public institutions can cope with. It is not uncommon for governments and regulating agencies to expect the industries to self-manage/develop a standard which is ethical and sustainable. Many a times this could be driven by their lack of understanding of the technologies or resources. The end result of this approach at the community level has been quite evident. Our current generation is coping by wearing masks for breathing air while children are playing in smog filled playgrounds. We are paying the price of pesticides in our food supply. The benefits of these technologies have become dubious over the decades. When we look at the way we introduced nuclear power into our society, the risks posed by these technologies on our communities were foreseeable. We collectively failed to introduce / regulate their adoption in a safe manner for long term sustainability. We lacked the vision to create a cohesive strategic plan to manage the implications of these technologies on our society.

As a society, we are constantly working towards building systems and processes across the globe for better quality of life. Human rights, Economic equality, Equal employment opportunity, Gender equality, Political equality, Access to healthcare, Education and so on. At a holistic level, we believe all the programs and developments on which we are currently working on are meant to make this planet a better place for everybody. The issue here is not to undermine the benefits these technologies have brought to our community. It is more about our ability to understand and look at the systems we have in place to control their growth

Challenges ahead are clear, 'How do we introduce new technologies into our communities in a sustainable and inclusive way'. If we choose to ignore and leave these issues to the corporates to address them, we will be responsible for creating the next crisis after global warming. Collectively, as a community we need to take a hard look at the way we introduce new products and technologies into society. We need to establish mechanisms for assessing medium to long term effects of these technologies at the global levels beyond economic, regional and national interests. We need to define the boundaries of 'unacceptability' that a product/service could breach in our societies. We cannot expect businesses to self-regulate the implications of their inventions and by its nature it will introduce the issues around conflict of interest of profit driven growth models. We need proactive and forward thinking civic minded technical/social agencies at the global helm to be accountable for our communities' long-term interests and be inclusive in their approach to the distribution of benefits to the wider society.

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ABOUT AUTHOR

Manjunath Shastri is currently working as Senior Design Engineer at Fisher & Paykel appliances Ltd, New Zealand. He is engaged in design and development of professional kitchen appliances and consumer electronic products for global markets for over 25 years. Professional interests include sustainable technologies, manufacturing technologies, Thermal analysis, Technology feasibility studies, Product and consumer safety issues, FMEA, Ergonomics and disabilities associated with impaired vision. His past work experience includes as Lecturer, Product Development Technology, Massey University, New Zealand; and as Manager Industrial Design, BPL Ltd, India. Manjunath is Professional member of the 'Royal Society of New Zealand', Professional member of 'Engineers without Borders New Zealand (EWBNZ)', and Volunteer Member - Blind Foundation New Zealand.

Nurturing Sustainability at the Roots- During Conceptual Design

C. R. Jyoti Prakash Naidu

TechnoDevelop Corporation, Ottawa, Canada
Email: dr.naidu@technodevelop.com

Having worked as a hands-on design engineer for decades along with academic research on Design Theory and Methodology, the author was inspired to look into the possibility of applying some of the concepts from the field to contribute to improved sustainable development. This article is a result of that endeavour. There are better chances that sustainability is achieved if the relevant factors are imbibed in the initial stages of the design process itself just as the laws of physics, aesthetics, functional requirements and many such aspects are considered compulsorily as an inherent part of the design methodology. The article proposes an integrated approach to include identification of sustainability parameters and their consideration in the multi-phase design mapping process. Further, consideration of entropy as a common measure across different fields pertaining to technology as well as pillars of sustainability namely environmental, economic, and social appears to be promising. Finally, as an example, the article looks into factors pertaining to sustainability considering outsourcing business model where teleoperation and telepresence technologies are expected to play enhanced roles.

Keywords: Sustainability, Entropy, Design Theory and Methodology, Conceptual Design, Business Methods, Outsourcing, Teleoperation, Telepresence

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1. INTRODUCTION

While UN's Millennium Development Goals transit to Sustainable Development goals (Hsu et al., 2014) with stress on integrated approach (Secretary-General's High-level Panel on Global Sustainability, 2012) considering the well-recognised three pillars of sustainability (Hasna, 2007)- environmental, economic, and social (under debate to include political and cultural aspects); the question has remained: what can be the technological tools or methodologies that may be employed to ensure the same? It has been rightly highlighted (Smith, 2012) that the thinly stretched scientific community may not be able to support a new assessment process and further questioned whether that is what policy makers really need from research? Kareiva (Kareiva, 2014, Ehrlich et al., 2012) has expressed that as one of the 21st century's wicked problems, need for sustainability may have some solutions in the perceived magic of science or beyond but no university, NGO or government agency can have the practical answers alone without solving them at the incubation stage bringing resources and people together shedding their biases. While sustainability index and indicators (Bell et al., 2008, Scerri et al., 2010) are efforts to measure the level of sustainability when a system or process is already in practice, it is often too late or too costly to go back to the origins to improve the resultant performance. Here, the author proposes that there is a means to integrate the basic tenets pertaining to sustainability at its origins- where it all starts: during the earliest conceptualization stages of a product or process design, minimizing influences of subjective or biased decisions. The paper is organised as follows. Section 2 presents the proposed approach as an extension of the state-of-the-art in Design Theory and Methodology considering entropy and sustainability. Section 3 discusses application of the proposed approach considering Teleoperation and Telepresence as examples.

2. PROPOSED APPROACH

Ever since about last 50 years of research in the relatively new field of Design Theory and Methodology (which has its origin sometime between the first conference on Design Methods at Imperial College London in 1962 and consequent founding of Design Research Society in 1966), the effort of scientists and engineers has been to make the process of design as objective and systematic as possible (Pahl et al., 1988; Hubka et al., 1988; Suh, 2010; Naidu et al., 1997; Blessing et al., 2014). The role of design process in achieving sustainability is emerging only recently (Walker, 2006). Based on Shannon's mathematical theory of communication (Shannon, 1948), while the metric of entropy is not new to design theory (Suh,

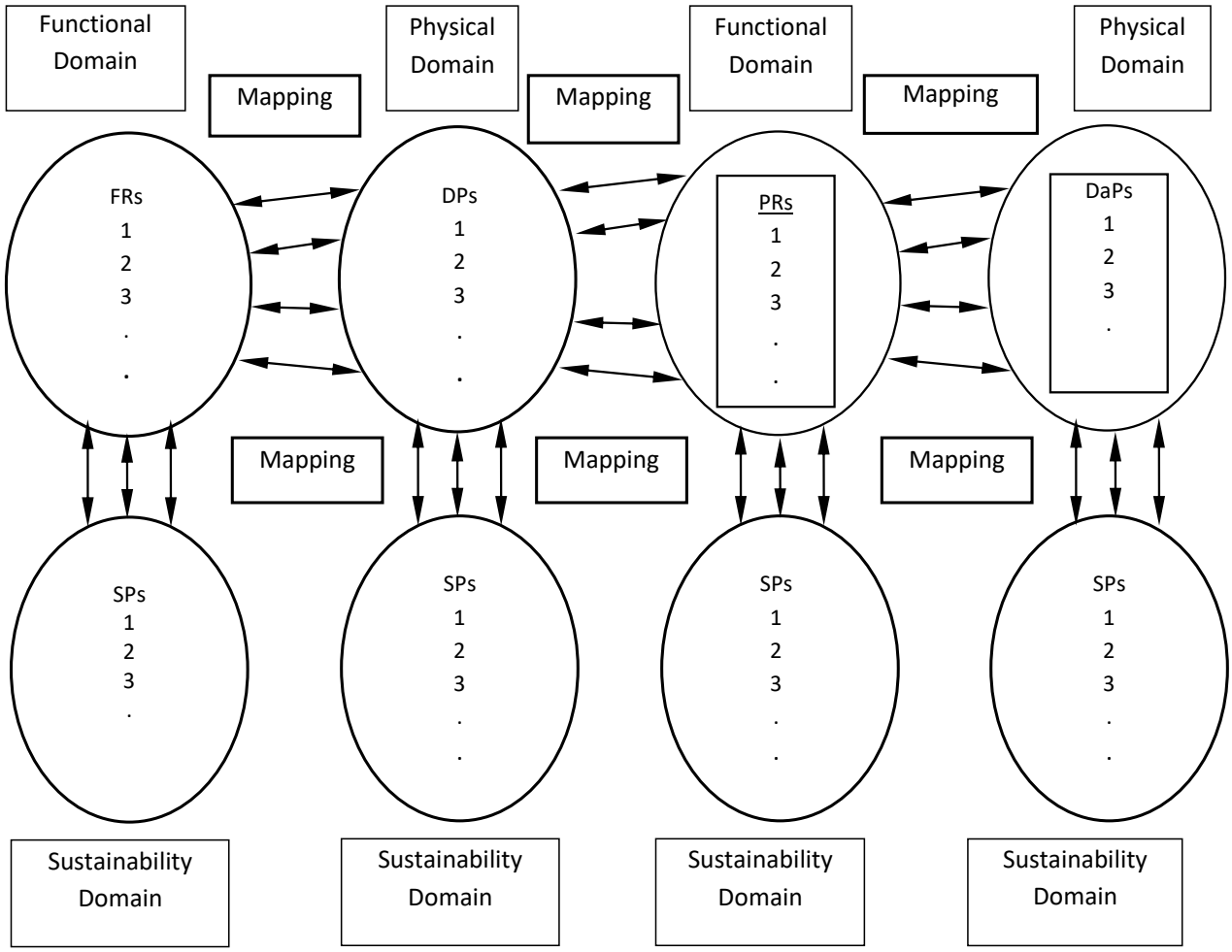

FIGURE 1. Conceptual design mapping including sustainability domain. [Legend; FR: Functional Requirement, DP: Design Parameter, PR: Process Requirement, DaP: Design Automation Parameter, SP: Sustainability Parameter]

2010; Naidu et al., 1997) and sustainability (Pascale, 2012; GoBling, 2001; Krysiak, 2006; Penner, 2007) researchers in isolation from each other, the author proposes its deployment as an integrated step during early conceptualization for sustainability. The power of this approach derives from the fact that entropy can be a measure for several parameters having diverse origins including but not limited to environmental, economic, social and technological. Entropy is broadly a measure of disorderliness that is considered as always increasing for a closed system based on the well laid down physical laws of thermodynamics (Bailey, 2010). Entropy has also been associated with complexity theory (Menhorn et al., 2011) giving hope that it can probably have a solution for some of the difficult problems confronting us, sustainability being one of them, particularly as it spans across different disciplines as diverse as basic science, engineering, business, social sciences and humanities. Shannon entropy of a finite sample x1, x2, x3,. . . , xi ,. . . , xn of a random variable X is expressed as,

$$E[I(X)] = E[-log(P(X))] = \sum_{i=1}^{n} p(x_i) log(p(x_i))$$

wherein, measure of Entropy (E) associated with information (I) of the variable (X) is the negative of the logarithm of the probability mass function. The implication of this is the more certain an event, the less information its occurrence adds to our understanding of the underlying process.

3. APPLICATION EXAMPLES

Let us consider teleoperation (Kim et al., 2004) and telepresence (Kammerl and Steinbach, 2010) systems as examples. While teleoperation is conducting a task at one location through control of the actions from a different location, telepresence is a virtual proximity through audio communication, 2D graphic

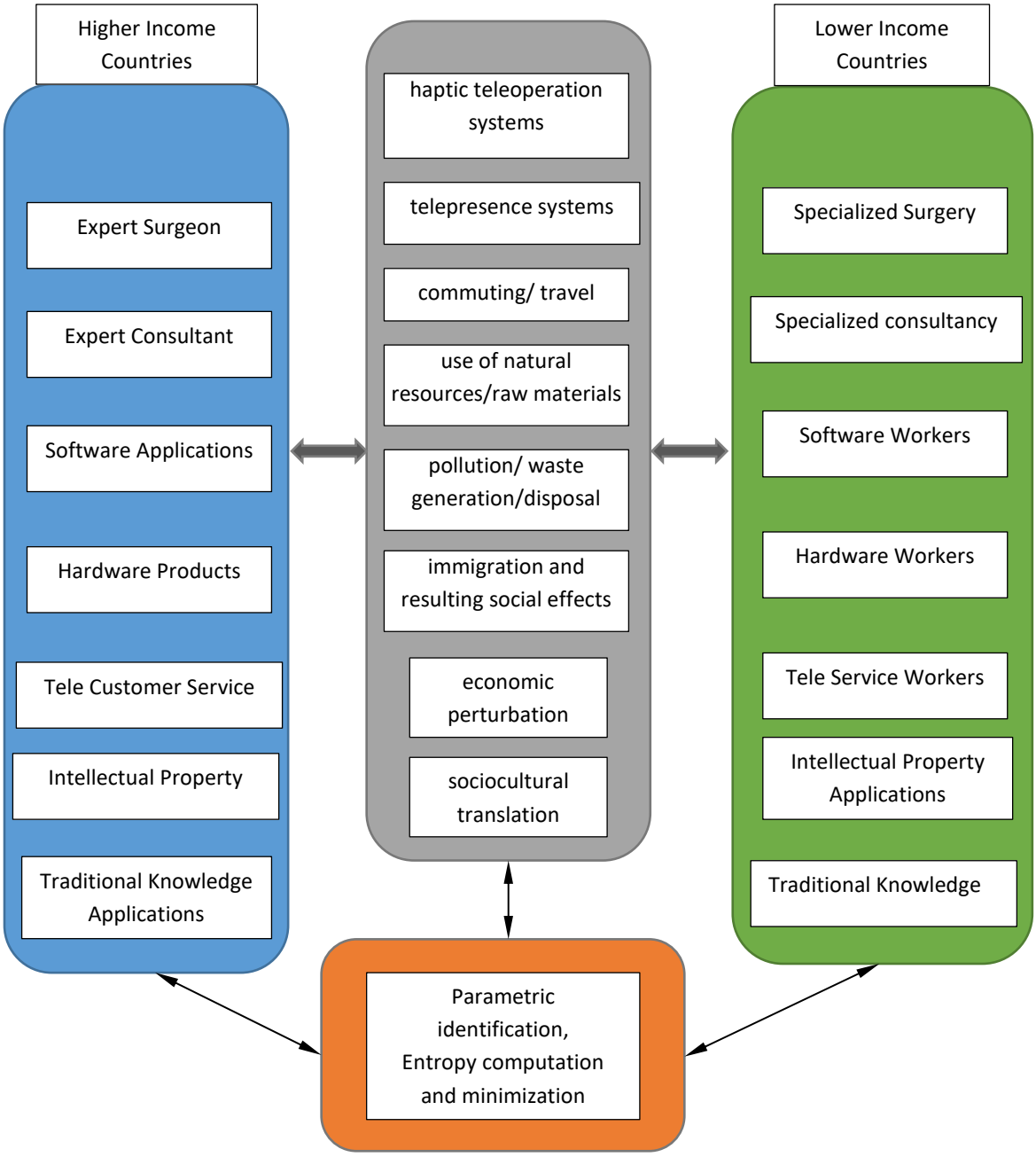

FIGURE 2. Example illustrating sustainability influencing factors in outsourcing business model

or 3D holographic representation of a person physically present at a different location. Both the technologies have seen growth in the recent years which is expected to continue, although the full potential of teleoperation applications is yet to be realized due mainly to very high capital equipment cost associated with safety considerations and complexity of some of the areas such as space exploration, remote surgery and hazardous material handling which have been early adopters of the technology because of pressing and inevitable need coupled with high investment of funds in some of these fields. Telepresence, through the fairly matured and well established telecommunication technology enhanced by recent enablement of free or low cost video conferencing means is perhaps the most widespread application that has become possible by advancement in internet as well as mobile phone networks' capacity and affordability. An important element of some of the more advanced teleoperation systems is a haptic (Kim et al., 2004) device which enables a controller master to sense the forces effected at the slave side. Although haptic devices have recently become quite low cost by developed countries' affordability standards, they are still substantial (£2500 and above) but may

inevitably come down with new applications driven by both market pull and technology push as has happened in the case of many other gadgets. As teleoperation and telepresence systems are expected to permeate further into daily lives, with ubiquitous haptics (Sekiguchi et al., 2005; Cheng, 2014) and newly emerging field called haptography (Elgan, 2014; Kuchenbecker, 2014) probably becoming a widespread reality in future, it is imperative that their implementation is evaluated at the conceptual design stages of products, processes and business methods with appropriate considerations of overall sustainable development (Figure 1).

After the design mapping stages are completed following the considerations of coupled, decoupled or uncoupled designs (Suh, 2010; Naidu et al., 1997), the competing concepts need to be evaluated for minimum information or entropy content. With the inclusion of sustainability parameters related to environmental, economic, and social factors, it is possible to ascertain which conceptual design option would be more favourable to sustainable development. It is significant to note that the entropy minimization of the elements of a teleoperation system such as haptic device through method of entropy coding (Kammerl, 2012) is only a small part of the total entropy of a sustainable system design. The author calls this segment as device entropy, as entropy coding is a technique in which haptic data reduction is achieved by deploying Weber's law of Just Noticeable Differences (JND) and other sampling and quantization techniques to compress haptic data signals or reduce or even eliminate non-essential data. However, there are other segments of entropy such as behavioural entropy (Goodrich et al., 2004), entropy related to Coupled Human and Natural Systems (CHANS) (Mayer et al., 2014), and hitherto neglected aspects of teleoperation such as environmental, economic, and social impact which would need to be considered to improve sustainability.

Through an example of outsourcing business model in which both teleoperation and telepresence technologies are already playing considerable roles that are expected to enhance exponentially in future, Figure 2 introduces a basic overview to facilitate better appreciation of some of the critical factors, but much more would be needed to be researched to achieve increased sustainability through conceptual design framework in comprehensive but simple, practical and implementable terms so that it can permeate broadly across disciplines at the ground level. Our preliminary investigations indicate that there are interesting and promising insights that can potentially come out by the evaluation of sustainability factors at the conceptual design stages which may be generally ignored or oversighted in normal course of business decisions. For example, outsourcing need not be viable only from higher income country to lower income country as is traditionally thought of. It can be feasible even the other way round in fields such as teleoperation surgery provided that the entropy in the chain can be further reduced. Reduced entropy teleoperation systems also have the potential to open up new services in the developed world through remote providers in areas such as traditional knowledge applications. Public opinion against outsourcing in richer countries could be possibly pacified if the job losses can be shown by political establishments as compensated by reduced immigration coupled with creation of new opportunities provided by industries engaged in development of teleoperation and telepresence technologies, resulting in an overall reduction in entropy. Some of the questions pertaining to entropy reduction may be uncomfortable to answer, for example, reduction in global travel as well as local commute to work place that can be facilitated by teleoperation and telepresence technologies would cut down carbon footprint drastically, negatively affecting the passenger transportation and related industries. There are also technical challenges to reduce power consumption or to garner resources such as solar power to enable functioning of the teleoperation and telepresence technologies and also effective provisions for post-life disposal minimizing their environmental footprints too. Use of biodegradable materials such as bioplastics, aliphatic polyesters and new structural concepts to overcome the strength constraints would be the additional design challenges.

4. CONCLUSIONS

Conceptual design analyses considering sustainability can have broad and thought provoking repercussions on the way in which social and physical systems are perceived. It has the potential to lead to debates on the very notion of development in terms of market consumerism and affordability of goods in the name of higher living standards without ascertaining the sustainability factors. The agrarian societies which tend to be relatively more self-sustaining due to generally reduced entropy generation in biological processes- in fact negative entropy as Nobel laureate Schrödinger stated, are currently looked upon as under-developed, which may need a hard relook at perceptions. In the longer run, an informed and more objective design decision making at the conceptual stages keeping longer term sustainability factors in view would benefit the environments and societies which our future generations would inherit.

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ABOUT AUTHOR

Jyoti Prakash Naidu has worked in or has been affiliated with leading institutions, laboratories, and industry as well as start-ups and SMEs in the UK (University College London, University of Derby), USA (MIT-Spin-off Companies at Boston, University of Phoenix- Arizona), Canada (University of Toronto and Spin-offs, Meritus University, Carleton University), and India (Presidency University, MSRUAS, VTU affiliated institutions, CAIR-DRDO, IRIS, HMT) in different capacities. He has been recognized by several awards and honours including the Canadian Commonwealth Scholarship & Fellowship (1992-96), Defence Technology Spin-off Award received from the honourable Prime Minister of India as Project Director of Institute for Robotics and Intelligent Systems (2005), and National Mechanical Engineering Design Awards (Senior- 2003, Student- 1979) from National Design and Research Forum, Institution of Engineers, India; Canadian Star of Global Health Award (2013) from Grand Challenges Canada funded by the Government of Canada for Bold Ideas. He is the originator of the field of Design for Automation as an extension of the Axiomatic Design Theory established at MIT, and his research interests include Design Theory and Methodology with applications for Design of Intelligent Systems, Design for Patentability and Sustainability in the fields of medical devices, biotechnology, advanced manufacturing, mechatronics, robotics, automation, virtual reality, business methods and other areas overlapping with multi-disciplinary aspects of humanities and social sciences. He has vast hands-on design, development, and product realization experience ranging from manufacturing systems for specialized aerospace components to biomedical devices with several patents issued or under process; one of his major achievements being development of pioneering DNA Arraying System for biomedical applications culminating in sale of technology to industry for considerable fees and royalty. He is a licensed member of the Association of Professional Engineers of Ontario, Canada. He is an alumnus of University of Toronto Canada (Ph.D., 1997), IIT Madras (M.Tech., 1987), and Bangalore University (PGDM, 1984).

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