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Complementary implementation of best practice in environmental management with health and safety; context of the United Arab Emirates construction industry

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Abstract. This research study investigates the strategic implementation of health and safety (H&S) and its effect on environmental management in the UAE construction industry. For this purpose, two objectives are formulated to explore: (i) the extent to which there is a commitment to environmental management, and (ii) the extent to which environmental and H&S activities are appropriately integrated. Quantitative data were collected by a questionnaire survey from 27 respondents including contractors, consultants, clients and safety officers from the UAE construction industry. The data were analyzed using descriptive and inferential statistics. Results indicate a strong relationship between the variables. Some respondents were of the opinion that the best international H&S practice is applied in the UAE and information availability is appropriate. Many managers are committed to environmental management and the H&S of their employees, but there are some barriers and critical success factors to be addressed to assure continued improvement. There is potential for improving environmental and health and safety performance.

1 Introduction

International best practices in the management of the environment and health and safety (H&S) systems are inextricably linked together. It is inconceivable that companies could claim to be committed to one, without being committed to the other. Indeed, that can apply to many management systems, such as for example human resource management or quality control; in world-class companies, executives should arguably aim to become best-in-class in all spheres of business activity. Incidents that are primarily highlighted in a health and safety context, especially if they involve injuries or death to people, inevitably involve environmental damage. At its simplest level, that involves expenditure of resources arising from delays and investigations; in the context of the environment that can perhaps be measured in terms of CO_2 output, and use or waste of finite materials. There are many examples of more serious cases, such as the loss of life in the Chernobyl nuclear explosion in 1986 with 21 deaths as a direct consequence, or the Deepwater Horizon oil spill of 2010 costing eleven lives. The impact of these two incidents has been environmental catastrophic. It is therefore argued that international best practices in environmental management and health and safety should be complementary; management systems that are implemented, must work with each other and not in isolation.

Collaboration between environmental and H&S departments in organizations can lead to better productivity [1], and increased revenues and market share [2]. People may assume that improving quality practices improves environmental performance. Literature suggests that causality can also work in the other direction, with improvements in environmental practices leading to improvements in quality and H&S. Similar for community concerns, where H&S of employees is a key focus of risk reduction and risk communication initiatives [3]. H&S is not limited to company workers or on-site exposures but includes all parties who may be exposed to construction work. There is a need to improve tools and management systems for better results, and to achieve sustainable outcomes.

1.1 The research problem

Some literature suggests that there is a no more important thing than "health and safety". Researchers argue that H&S should not be a separate activity taking place outside main

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processes within the workplace. Anyone attempting to deal with H&S in the workplace or within a set process as a separate issue, soon finds that it is ephemeral. Robust H&S systems must ensure it is considered in production planning processes; it must not an after-thought such that it maybe forgotten and allowed to drift away. H&S needs to be firmly anchored to the realities of work activities or processes which are the main undertaking of organisations involved.

1.2 Scope of study context

United Arab Emirate construction activity contributed 9.9% based on preliminary estimates of the Gross Domestic Product (GDP) in 2017. The UAE construction market is expected to register a compound annual growth rate (CAGR) of 5.5% over the forecast period, 2019–2024. In November 2017, the combined value of the 11 755 active construction projects in the United Arab Emirates exceeded USD 818.2 billion (around Dh 3 trillion), accounting for 33% of total value and 52% of all construction activity in the GCC region. The total value of UAE contract awards in 2018 has been USD 31.6 billion till September 2018, while in 2017 it amounted to USD 28.6 billion. So, with this huge increase in construction in UAE, there is a compelling need to integrate health & safety and environmental management systems.

Environmental controls and Health and safety in the construction industry are governed by the Ministry of Labour and Social Affairs by the Department of Labour Sector. Environmental challenges in the United Arab Emirates (UAE) arise due to the exploitation of natural resources, rapid population growth, and high energy demand. The continuing temperature rises caused by global warming contributes to UAE's water scarcity, drought, rising sea levels and aridity. The UAE has modernized its infrastructure and constructed new facilities more rapidly than any other nation in world history. In the 40 years since its founding, the UAE has grown from a primarily nomadic and subsistence fishing population of $< 400\,000$ to a multicultural population of >4.4 million with a diverse industrial base [4]. It has two international urban centres, Dubai and Abu Dhabi, the latter of which is by some measures, the world's wealthiest city.

1.3 Aim and objectives

The aim of this research is to investigate the influence of integrating environmental management systems (EMSs) with safe and sustainable business practices in the UAE construction industry.

EMSs will be evaluated and examined as to how effective they are in reducing environmental impacts and controlling major H&S implementation restrictions effectively within construction. Several factors are investigated, including human, organizational, and system factors. Each of these factors has several contextual life dimensions that tackle culture, society, industry, education, knowledge, skills, cost, timeline, and manpower. In the context of the UAE construction industry and to achieve the above-mentioned aim, the specific objectives are given below:

OB1: the extent to which there is a commitment to environmental management, and

OB2: the extent to which environmental and H&S activities are appropriately integrated.

2 Literature review

2.1 Significance of the construction sector

Today, the construction industry is not only contributing to the social and economic development of countries but is also a major industry around the world that provides jobs to millions of people and contributes to the economy of countries and the whole world [5,6]. Therefore, the construction sector can be considered as one of the key engines for economic development. Jaber and Matloub [7]. argued markets become competitive, and therefore, it is important to make them as efficient as possible. For example, 6.10% in the UK [8] and 5.50% in Japan [9]. In the European Union (EU), the construction industry employs approximately 18 million people and contributes up to 9% of the entire EU's gross domestic product (GDP) [10]. Generally, the construction sector utilizes 7% of the world's workforce and provides about 13% of the worldwide GDP [11]. In the UK, there are 325 736 construction firms [12] that employed 2.7 million individuals in the year 2019 [12]. UK population in the year 2019 was more than 66 million people, and the construction sector provides work for around 4% [12]. The Gulf Cooperation Council (GCC) comprises five countries (Bahrain, Kuwait, Oman, Qatar, and Saudi Arabia). They rely heavily on gas and oil production, and distribution of both to create half of their overall GDP [13]. Regardless of the drop on oil price during recent years and its impact on GCC economies, demand in the construction sector is still high. The estimate of monies spent on construction projects in the GCC region in 2015 was around 1300 billion dollars, where the UAE takes procures most work and Saudi Arabia is second [14].

A report distributed in Arabian Business in the year 2017 shows there were about 20 000 construction projects worth 2.4 trillion dollars [15]. While there is an effect on the construction sector because of the economic circumstances, research shows that construction will grow in the coming years. As indicated in the budget report of Oman, the spending on construction projects was assessed at 3.12 billion dollars (Omani rials 1.20 billion dollars) in year 2017 [16]. The comparison between the construction contracts granted in the Gulf region, in the initial quarter of the year 2017 and the year 2018 shows a general decrease of 5 Billion dollars [17]. The estimation of the construction sector in Oman was around 6.85 Billion Omani Rialin year 2016 [13].

Bahrain's population was around 1.5 million in the year 2017. The per-centage of foreign people represented 55% of the entire population [18], and the percentage of the construction workforce represented 12% [13]. The percentage of Omani and Bahraini nationalists in the construction sector is around 8% of the construction workforce. Both countries employ more construction workers as a percentage of the population when contrasted with the UK construction sector; Bahrain construction sector employs three times more by percentage than the UK. Figures show

the UAE construction sector is one of the lead job providers in the country, providing employment for 1.65 million people, in more than 64 400 companies [19]. The construction sector is rapidly growing in the UAE and consequently, many international construction companies are attracted and enter the market [20]. The construction sector is essential to the UAE's economy and its development. Umar et al. [13] address the significance of the construction sector to GCC countries and the world.

The combination of completing projects on time, at lowest possible cost and with high quality is at the cornerstone of managerial and engineering professionalism, together with navigating strong competition that exists in construction businesses [7]. Between the years 2009 and 2015, about 40% of investment in the UAE was in the construction sector [21]. Studies show that investing in the construction sector is a key driver of economic development [22]. The construction sector generates growth in economies as it attracts investments and creates demand in other sectors, such as material manufacturing e.g. cement and steel. Additionally, the importance of the construction sector is attributed to its services and products which provides many benefits, such as the buildings in which other companies work and operate [23]. The Global Market Information Database has published statistics that show between the years 2009 and 2015, the construction sector in the UAE contributed about 11% to the UAE's gross domestic product (GDP). Many investors find the UAE market attractive and therefore, many of them invest in its markets. Investment spread between different sectors (e.g. gas, power, oil, industrial, commercial, transportation) [24]. The UAE construction market is expected to register a compound annual growth rate (CAGR) of 5.5% over the forecast period, 2019–2024. In November 2017, the combined value of the 11 755 active construction projects in the United Arab Emirates has exceeded USD 818.2 billion (around Dh 3 trillion), accounting for 33% of total value and 52% of all construction activity in the GCC region. All active construction projects in the GCC region come out to a staggering USD 2.43 trillion (AED 8.91 trillion). The total value of UAE's contract awards in 2018 has been USD 31.6 billion till September 2018, while in 2017 it amounted to USD 28.6 billion [6].

2.2 H&S conditions in the construction sector

Although occupational accidents are a global phenomenon, there are countries in which such occurrence of accidents is more frequent than others [14]. The accident rate in the GCC countries, for instance, is arguably alarming, although there is an absence of accurate and reliable data that identifies the number of fatalities and accidents in the GCC area [25]. For this reason, researchers tend to rely on independent institutions and the media for data [14].

2.3 Application of best environmental practice in the UK

The lead and often cited seminal reference to sustainability comes from the report by Brundtland (1987) "Our Common Future", thus: "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This has increasing importance in the context of CO_2 emissions and the use of finite resources. There is also focus on the triple bottom line concept by Elkington in 1998 (cited in Khalifeh et al. 2019) and as illustrated in Figure 1 from Silvius et al. (2013). The UK Government has historically appointed chief construction advisors, such that it could take advice about construction issues from one single source, rather than listen to competing views from disparate trade or professional bodies and associations. When Paul Morrell came to the post in November 2009, he stated profoundly "we're going to need to start counting carbon as rigorously as we count money and accepting that a building is not of value if the pound signs look okay, but the carbon count does not" (Richardson [26]). Ten years later, research by Ibbotson (2019) found that in the construction of flood defence schemes in the UK, as projects went through their life-cycle, cost was discussed at every major 'Gateway' point; whilst organisations had access to an innovative carbon counting tool, it was not used to its capacity, and there was too little discussion about reducing carbon at key decision-making points.

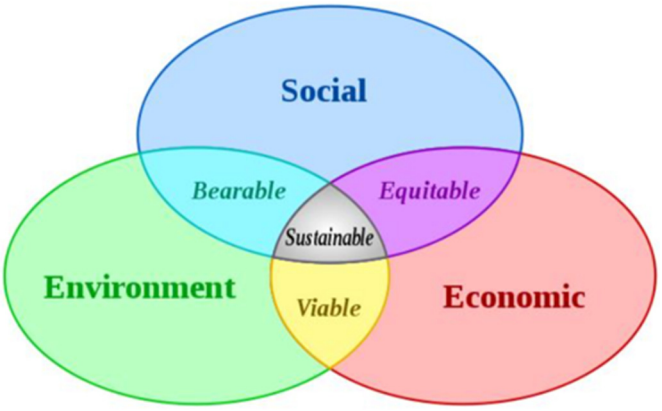

Fig. 1. The triple bottom line (TBL) of sustainability.

The lead flagship project in the UK over the last five years has been the Cross Rail infrastructure rail scheme running east to west through central London, and comprising 21 km of twin-bore tunnels, valued at circa £19 BN (Crossrail, 2021a). The project makes its contribution to rolling out the sustainability agenda through its 'learning legacy' publications (Crossrail, 2021b). There are twelve areas in which Cross rail promote best practice and reflects upon lessons learned. The environmental area includes eleven sub-themes, including for example 'energy efficiency and carbon', 'air quality' and 'bio-diversity'; the legacy web site comprises both publications and interactive webinars. The construction of the Hinkley Point C nuclear power station in Somerset, south west England, by the energy company EDF is also prominent as a flag ship project; it is valued at circa £23 BN, started in 2018 and estimated to complete in 2025 (EDF, 2021a). EDF makes

its contribution through research under the umbrella title of 'Innovating to help Britain achieve Net Zero' (EDF, 2021b). It reports for example on projects such as the use of drones to monitor jellyfish blooms and free-floating seaweed that may clog nuclear power station cooling water intake systems (EDF, 2021c); there are 110 staff researching in four sustainability themes: (digital innovation, (ii) nuclear, (iii) renewables, and (iv) smart customers. The largest construction project in Europe presently on site, is the High Speed 2 (HS2) development, a rail link from London to north west and north east England, with possibilities to also travel to Scotland (HS2, 2021). Project costs are still uncertain, perhaps £100 BN plus, and HS2 still needs to publish learning legacy possibilities, there is ample information available about the efforts being made to promote its sustainability credentials; anecdotally, the development has been described as 'one huge environmental project'. Many leading companies, for example Persimmon (2021), a leading UK private house builder, are keen to ensure they are leading the field internationally in sustainability governance. This is particularly important in the context of promoting a positive image amongst investors, and members of the public. The UK Government through the Ministry of Housing, Communities and Local Government are consulting on a UK 'Future Homes Standard' with proposals to introduce legislation around the conservation of fuel and power, aligned with stricter ventilation requirements. Alongside BREEAM and using similar principles, the UK operates the Civil Engineering Environmental Quality Assessment (CEEQUAL, 2021) system, which is an international evidence-based sustainability assessment, rating and awards scheme for civil engineering, infrastructure, landscaping and works in public spaces. It was established following work promoted by the Institution of Civil Engineers and operated with a group of 14 industry shareholders. The UK Green Building Council publish a wealth of information, including webinars, around climate change, nature and biodiversity; for example, research 'Unlocking the barriers to low carbon heat: an industry view' (UK GBC, 2021). It also proposes to publish a 'net zero whole life carbon roadmap', to be launched at the United Nations Climate Change Conference in Glasgow, UK in November 2021 (UK COP26, 2021) The Construction Industry Research and Information Association (CIRIA, 2021a) writes of itself as a "neutral, independent, not-for-profit body, we link organisations with common interests and facilitate a range of collaborative activities that help improve the industry". CIRIA's on-line learning platform includes for example eLearning modules on environmental good practice (CIRIA, 2021b). Finally, the Supply Chain Sustainability School (2021) reports its work on a "wealth of topics. From waste and carbon ... as well as many more sustainability issues" (Silvius et al., 2013: 3).

2.4 Commitment of construction enterprises towards adopting best practice health and safety

One of the most widely recognized components in building safe environments is the commitment of organizations. In the year 1980, the first assessment tool was designed by Zohar; it includes forty items and eight distinctive factors. This tool was promoted the concept of management thinking about the issue of safety [28]. Management commitment to safety can be manifested in various ways. The literature associated with the management commitment indicates that there is a correlation between the senior management commitment and the reduction of accident occurrences in construction projects [27]. In commercial organizations, senior management decide the needs and priorities of businesses. Consequently, indirectly or directly, senior managers are the primary source of information associated with goals and priorities of any organization [28]. The same source further cited that theories of commitment to the environment can be mirrored in safety behaviour, and it depends on company practices, rules, policies, and procedures.

2.5 The importance of green building rating tools to promote sustainability and worker safety

The codes for green and sustainable buildings are typically used interchangeably, but these rating tools can also have different concepts. To have the ability to sufficiently understand the impact of how sustainability impacts on building values, it is important to describe what 'green buildings' are. Definitions of building sustainability, as per Lutzkendorf and Lorenz [29] "goes far beyond the narrower concept of lowering a building's energy consumption"; it is also necessary to develop building sustainability with practical, innovative and specialised qualities related to urban planning. The US Leadership in Energy and Environmental Design (LEED) system and UK Building Research Establishment Environmental Assessment Method (BREEAM), were adapted by the UAE in the design of its Estidama Pearl Rating System. Estidama is used as a base and key initiative of the Abu Dhabi Urban Planning Council (UPC), with integrated modifications for country specific issues; it has rating tools bespoke to the middle east context, and its framing focuses on ratings and categories specified by areas such as sustainability, water efficiency, energy, materials, indoor air quality and innovation. There are various standards of accreditation based on goals established for those classes.

Given there is little reference to H&S performance, Estidama projects are unlikely to be sustainable, because it may be argued that H&S is an important element of being environmentally compliant. Since safety of occupants is given due consideration in Estidama, proper attention must be paid to the welfare and H&S of construction workers for projects whilst they are being constructed and maintained for them to be truly classified as sustainable. Estidama has already transformed mindsets, as well as enforcing practices for construction industry that have improved performance [30]. It is hoped that by including H&S of workers as a key element of Estidama categories, it is possible to make sure that H&S is considered and enforced more robustly, and it will increase awareness its overall significance.

Table 1. 15 statements to which respondents indicated the extent to which they agreed or disagreed: there is commitment to environmental management (Variable of VAR1).

Rank order	Questions	Mean score for each question
1	There are clear roles and responsibilities for designated environmental functions	65.43%
2	Environmental management is relied upon to implement good safety practices	56.85%
3	There are publicity posters to make people aware of environmental risks	56.79%
4	Materials are carefully fully stored to minimise the risk of physical damage or damage by weather	56.36%
5	There are risk assessments when there are potential environmental problems	54.94%
6	There is clarity in environmental procedures	54.32%
7	There is appropriate investment in work that may be required to protect the environment	54.26%
8	There are procedures to deal with ways of minimising waste of materials	52.35%
9	Actions are taken to minimise the amount of dust created by site operations	52.10%
10	Waste materials of different kinds are kept in separate skips or areas before disposal off-site	51.98%
11	Professional staff are qualified in environmental management	51.91%
12	There is an effective and comprehensive framework to deal with environmental problems	51.48%
13	Employees are trained to recognise potential environmental dangers	50.56%
14	There is a commitment to spend money to attain environmental benefits	49.69%
15	Actions are taken to minimise the amount of noise created by site operations	49.01%
Overall mean score for all participants		**53.87%**

3 Methods and materials

3.1 Study design and procedure

An electronic cross-sectional questionnaire survey of construction professionals based in the UAE was conducted, with 27 replies. It was a sample of convenience (and non-probabilistic), based on the accessibility to the study population, and on their disposition to take part in the research. This sampling technique was chosen mindful that it is quick, economically low cost and adaptable to participant schedules [31]. Appropriate ethical protocols were followed, including emphasis that participation was voluntary with no obligation to reply, confidentiality and anonymity were assured, and data would only be used for research purposes. Respondents were invited to participate in the research through a verified inter-institutional mailing list shared among companies. It was deemed that consent to participate was implied by completing the survey. The importance of answering honestly to all the questions was emphasized, as well as the non-existence of wrong or right answers. The survey was fully completed by all 27 respondents, with no missing data.

3.2 Sample

Respondents were consultants and safety officers from the construction industry of UAE. 4 No (14.81%) respondents were working in companies relating to project management, 11 No (40.74%) were in engineering consultants, 2 No (7.41%) were in construction infrastructure, 2 No (7.41%) were in construction/commercial, 1 No (3.70%) were in construction/housing and 7 No (25.93%) were in other fields. Out of the 27 respondents, 3 No (11.11%) fell within the age group of 21–29, 13 No (48.15%) age group of 30–49 and 11 No (40.74%) age group of 50 and above. 20 respondents (74.07%) had BSc. degree, 6 respondents (22.22%) had a Masters/PhD degree and one respondent (3.07%) had another degree. Out of 27 respondents, 2 No (7.41%) had the experience of 1 to 10 years, 10 No (37.04%) had of 11 to 20 years and 15 No (55.56%) had the experience of 21 or more years in this sector.

3.3 Description of the questionnaire

The structured questionnaire was administrated in English. It consisted of two main sections; the first part of the instrument asked about individual and demographic variables, such as age, qualification, and experience. The second part was used to measure two variables thus: (i) the extent to which there is commitment to environmental management (Variable or VAR1), and (ii) the extent to which environmental and H&S activities are appropriately integrated (Variable or VAR2). Each variable is measured using a multiple item scale, both with 15 statements as indicated in Tables 1 and 2. A six wide Likert type scale was used, where respondents were asked the extent to which

Table 2. 15 statements to which respondents indicated the extent to which they agreed or disagreed: environmental and H&S activities are appropriately integrated (Variable of VAR2).

Rank order	Questions	Mean score for each question
1	The plan identifies SHE requirements, citing clear performance requirements	58.64%
2	The current SHE policy is up-to-date	58.46%
3	There is established and maintained SHE procedures	58.09%
4	There are periodic reviews of the SHE management system	57.10%
5	There are arrangements to communicate externally SHE performance	56.98%
6	There is an accidents' investigation system that includes a requirement to identify causes and provide for preventive or corrective actions	56.36%
7	There are documented procedures to cover situations where their absence could lead to deviations from the policy objectives and targets	56.30%
8	There are procedures related to the use of SHE aspects of goods and services	56.23%
9	There are documented records of any changes in the certified procedures resulting from corrective and preventive action	55.74%
10	The policy defines the allocation of responsibilities and accountabilities in the management structure	55.25%
11	Adequate resources are allocated commensurate with size and nature of the project	54.94%
12	Individual responsibilities are clearly set out	53.46%
13	The policy defines the allocation of responsibilities and accountabilities in the management structure	52.72%
14	There are externally verified third-party audits for all elements of the SHE management system	51.36%
15	There are contingency plans for unforeseeable emergencies to mitigate their effects	50.93%
Overall mean score for all participants		**55.50%**

they agreed or disagreed with each individual statement. Codes or scores were attributed to answers thus: very strongly agree 5, strongly agree 4, agree 3, disagree 2, strongly disagree 1, very strongly disagree. Scores for each respondent were summed, and for ease of analysis converted to a percentage scale. Since there were 15 questions, the maximum score that could be achieved by individual respondents was $15 \times 5 = 75$, and the minimum score was $15 \times 0 = 0$. Thus, for example, a score of 50 out of 75 expressed as a percentage became $50/75 \times 100 = 66.67\%$. Means scores expressed in percentages were calculated arising from results of all respondents. Additionally, further descriptive statistics such as median, mode, minimum, maximum, range, standard deviations, though these are not reported in this paper for brevity; none of these scores were 'unusual'. The answers to each of the 15 questions were ranked in order. High scores on the percentage scales indicated (i) high commitment to environmental management, and (ii) high integration of H&S and environmental activities. Low scores indicated the opposite. An inferential Spearman's rho correlation coefficient was calculated to test the hypothesis that there is a relationship between the two variables; the alternative hypothesis is established thus: the extent to which there is commitment to environmental management (VAR1) influences the extent to which environmental and H&S activities are appropriately integrated (VAR2).

4 Results, findings and discussion

To test the internal reliability of the scales, Cronbach's alpha was calculated; both scales gave scores in excess of 0.90 with a p value of <0.05. It is judged the scales are internally reliable.

For VAR1, the first ranked variable in the multiple-item scale ('There are clear roles and responsibilities for designated environmental function') scores far higher than others at 65.43%. The remaining 14 variables have a relatively narrow range of 7.84% (56.85% item 2, minus 49.01% item 15). The 14th ranked single question item for VAR1 'There is a commitment to spend money to attain environmental benefits', scores 49.69%, and is particularly disappointing. Figure 2 indicates scores for individual respondents in class intervals. The range of mean scores for individual respondents is 20.00% to 84.44% with consequently a range of 64.44%. This range is unusually large, and would seem to indicate a difference in performance in companies. Two scores in the range of 20.00% to 38.00% is alarmingly low, although 'excellent'

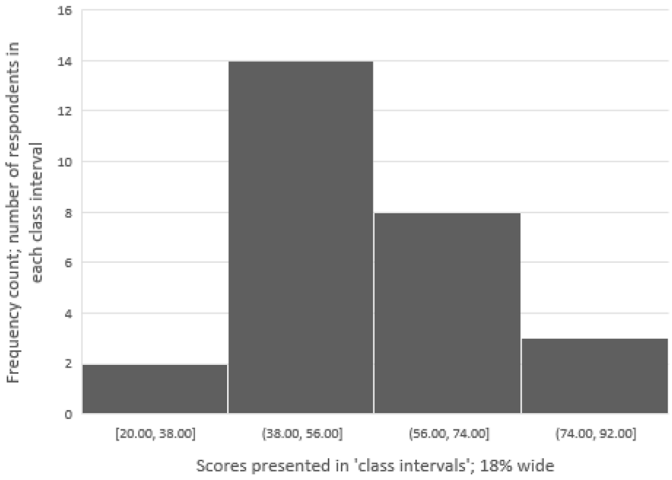

Fig. 2. Histogram to indicate mean scores for individual respondents for VAR 1 the extent to which there is commitment to environmental management.

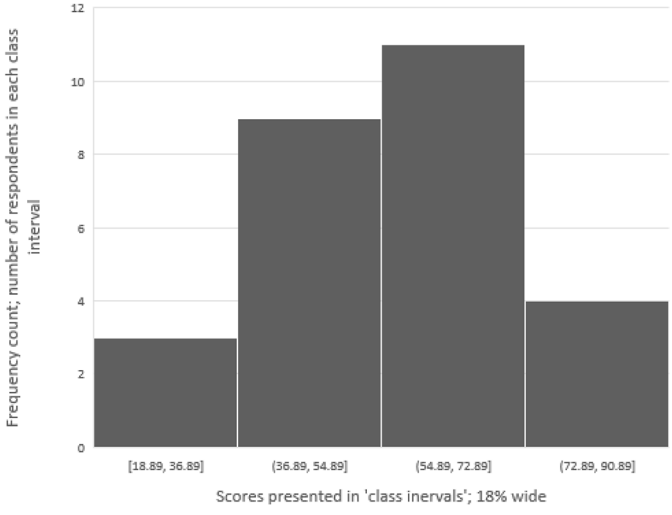

Fig. 3. Histogram to indicate mean scores for individual respondents for VAR2 the extent to which environmental and H&S activities are appropriately integrated.

performance is also noted is some cases with three scores above 74.00%.

For VAR2, the range between the first and last ranked items is relatively narrow at 7.71% (58.64% item 1, minus 50.93% item 15). Figure 3 indicates scores for individual respondents in class intervals. The range of mean scores for individual respondents is 18.89–83.33% with consequently a range of 64.44%. This range is again unusually large, and would seem to indicate a difference in performance in companies. Three scores in the range of 18.89–36.89% is alarmingly low, although 'excellent' performance is also noted is some cases with four scores above 72.89%.

The Spearman's rho correlation to test the hypothesis that there is a relationship between the two variables yielded a correlations coefficient of 0.95 indicating a strong

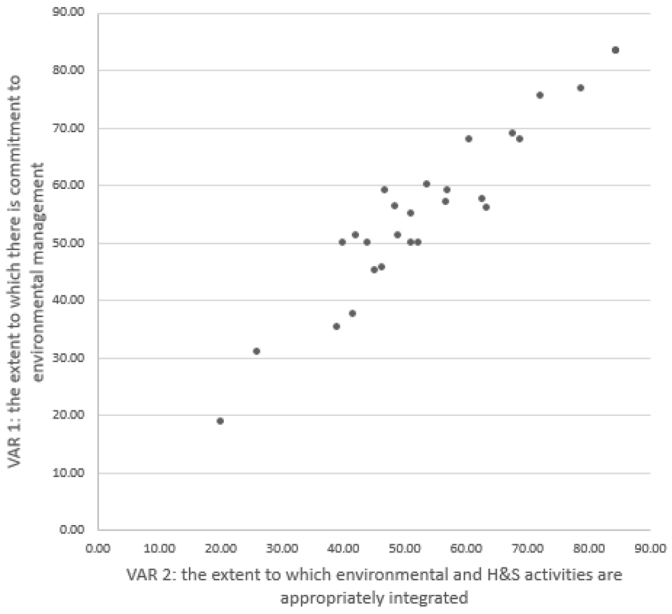

Fig. 4. Scatter plot to indicate the relation between the extent to which there is commitment to environmental management (Variable of VAR1), and (ii) the extent to which environmental and H&S activities are appropriately integrated. Correlation coefficient 0.995, $p < 0.05$.

positive relationship between the variables, with a p value of <0.05. The null hypothesis is rejected; commitment to environmental management (VAR1) influences the extent to which environmental and H&S activities are appropriately integrated (VAR2). The scatter diagram is indicated in Figure 4.

Most importantly, it can be argued that the mean scores for both VARS 1 and 2 are also disappointing. In the context that both these items are of immediate concern internationally, 53.87% and 55.50% respectively indicate there is much room for improvement. Many individual items in these scales ought reasonably be scoring much higher. It is notable that when Paul Morrell came to the newly created post of UK Government Chief Construction Advisor in November 2009, he stated "we're going to need to start counting carbon as rigorously as we count money and accepting that a building is not of value if the pound signs look okay, but the carbon count does not" [26].

Most importantly, it can be argued that the mean scores for both VARS 1 and 2 are also disappointing. In the context that both these items are of immediate concern internationally, 53.87% and 55.50% respectively indicate there is much room for improvement. Many individual items in these scales ought reasonably be scoring much higher.

5 Conclusions

It is a limitation of the study that the results are based on questionnaire responses; also, the sample size is relatively low. It is recommended that methodologies are designed to yield greater validity, though given the sensitivity of some

of the issues raised, that can be difficult in research terms. Larger sample sizes are required, with some data collection exercises also based on qualitative work. In practice, it does mean increasing the rigor of inspection and auditing schemes, such that there is a regulatory requirement upon companies to open their doors in a transparent fashion, with potential for penalties if standards do not meet those required. It is a journey of continual improvement, change and pro-activity to ensure international climate change initiatives are implemented, and targets are met.

References

1. W.J. King, T.P. Klassen, J. LeBlanc, A.C. Bernard-Bonnin, Y. Robitaille, D. Coyle, M. Tenenbein, I.B. Pless, The effectiveness of a home visit to prevent childhood injury, Pediatrics **108**, 382–388 (2001)
2. M. Delmas, M.W. Toffel, Stakeholders and environmental management practices: an institutional framework, Bus. Strat. Environ. **13**, 209–222 (2004)
3. K.R. Chinander, Aligning accountability and awareness for environmental performance in operations, Prod. Oper. Manag. **10**, 276–291 (2001)
4. S.J. Peale, P. Cassen, Contribution of tidal dissipation to lunar thermal history, in: Lunar and Planetary Science Conference, 1978, vol. 9, pp. 870–872
5. K. Beven, Environmental modelling: an uncertain future? (CRC Press, 2010)
6. UAE Construction Market Growth, Trends, Covid19 Impact and Forecasts for 2021–2026, 2021. https://www.mordorintelligence.com/industry-reports/uae-construction-market
7. V. Bodolica, M. Spraggon, S. Zaidi, Boundary management strategies for governing family firms: a UAE-based case study, J. Bus Res. **68**, 684–693 (2015)
8. Office for National Statistics, Construction statistics, Great Britain, 2017. https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/articles/constructionstatistics/number182017edition
9. Deloitte, GCC Powers of Construction 2015 Construction – The Economic Barometer for the Region, 2015. http://business-humanrights.org/sites/default/files/documents/Deloitte-GCC-Powers-of-Construction-2015.pdf
10. Statistical Handbook of Japan, Statistical Handbook of Japan for the year 2017, 2017. http://www.stat.go.jp/english/data/handbook/pdf/2017all.pdf
11. European Union Construction Sector, The European construction sector – a global partner – 2016 edition, 2016. http://ec.europa.eu/DocsRoom/documents/15866/attachments/1/translations
12. R. de Best, Construction Industry in the UK – Statistics & Facts, 2020. https://www.statista.com/topics/3797/construction-industry-in-the-uk
13. R. de Best, Employment figures forecast in the construction industry UK 2019, by occupation, 2020. https://www.statista.com/statistics/600691/job-roles-in-uk-construction-sector
14. T. Umar, C. Egbu, G. Ofori, M.S. Honnurvali, M. Saidani, A. Opuku, High fatalities risk found in Gulf construction, Int. J. Sustain. Real Estate Constr. Econ. **1** (2020)
15. T. Umar, C. Egbu, M.S. Honnurvali, M. Saidani, M.M. Al-Mutairi, An assessment of health profile and body pain among construction workers, Proc. Inst. Civil Eng. Munic. Eng. **173**, 125–135 (2020)
16. Arabian Business, 2017, GCC construction market worth $2.4trn, has 22, 000 active projects
17. Times of Oman, Oman budget: despite austerity, Oman committed to investment, Time of Oman, 2017. https://timesofoman.com/article/99741/Oman/Government/Oman-budget:-Despite-austerity-Oman-committed-to-investment
18. Ventures, US$ 29.4 Bn worth of contracts awarded in GCC in Q1, 2018. https://venturesmiddleeast71550.activehosted.com/index.php?action=social&chash=1c383cd30b7c298ab50293adfecb7b18.70 (accessed November 23 2020)
19. Gulf Research Center, Bahrain Population by Nationalities, 2018. http://gulfmigration.org/bahrain-population-nationality-bahraini-non-bahraini-sex-age-groups-2017
20. Ministry of Human Resources and Emiratizations, Open Data. Ministry of Human Resources and Emiratizations. Dubai, United Arab Emirates, 2020. http://www.mohre.gov.ae/en/data-library/statistical-report.aspx
21. S. Jaber, H. Matloub, An empirical study of the impact of lean on the performance of the construction industry in UAE, J. Eng. Des. Technol. **16**, 694–710 (2018)
22. UAE Ministry of Economy, The annual economic report, 2015. http://www.economy.gov.ae/EconomicalReportsEn/MOE%20Annual%20Report%20English%20-%202015.pdf
23. J. Lopes, The construction industry and macroeconomy in Sub-Saharan Africa post 1970, Constr. Manag. Econ. **16**, 637–649 (1998)
24. UAE Construction, An economic analysis of the sector, 2013. https://www.alarabiya.net/aswaq/special-stories/2020/11/22/
25. Health and Safety Executive, Workplace fatal injuries in Great Britain 2018, 2020. http://www.hse.gov.uk/statistics/pdf/fatalinjuries.pdf
26. R. Richardson, Evangelism outside the box: New ways to help people experience the good news (InterVarsity Press, 2009)
27. G.M. Waehrer, X.S. Dong, T. Miller, Y. Men, E. Haile, Occupational injury costs and alternative employment in construction trades, J. Occup. Environ. Med. **49**, 1218–1227 (2007)
28. D. Zohar, Safety climate in industrial organizations: theoretical and applied implications, J. Appl. Psychol. **65**, 96 (1980)
29. T. Lutzkendorf, D. Lorenz, Integrating sustainability into property risk assessments, Build. Res. Inf. **35**, 644–651 (2007)
30. M. Kaftangui, B. Mohamed, A methodology for successful retrofitting in the UAE old residential sector towards. Obsolescence and Renovation – 20th century housing in the new millennium. Universidad de Sevilla, Spain: Abu Dhabi University, 2015
31. S. Tyrer, B. Heyman, Sampling in epidemiological research: issues, hazards and pitfalls, BJPsych Bull. **40**, 57–60 (2016)

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