



Effective management of health, safety, environment and sustainability: sharing international good practice and learning

16 - 18 May 2017 Mövenpick Hotel and Apartments Dubai, UAE

Middle East **HSE Forum**

Conference Report

Organised by:







16 - 18 May 2017 Mövenpick Hotel and Apartments Dubai, UAE

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CONFERENCE REPORT

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فجموعة أبو ظبى للإستدافة

CONTENTS

1 Forum Summary

2-5 Keynote Speeches

Louise Kingham OBE FEI, H.E. Alastair Long, H.E. Ahmed Mohammed Al Kaabi, H.E. Ahmed Buti Al Muhairbi, Zaid Al Qufaidi

6-10 HSE and Sustainability

Eva Ramos, Prof. Eugene Coyle FEI, Dr Waddah S. Ghanem Al Hashmi FEI, Fraser Goodey, Matthew Jackson

11 - 12 Improving HSE Outcomes

Tahir Hakim MEI, Jennifer Palmer, Islam Adra CRSP

13 - 15 Sustainable Energy Management

Alia Ali Busamra, Dr Sunil Manjrekar, Krishna Murthy, Mustafa Vahgjipurwala MEI

16 - 19 Hazard, Health and Safety and Risk Management

Dr Waddah S. Ghanem Al Hashmi FEI, Dr Jose Puno Villanueva BsBio, LFOM, MFOM, Engr Raed Mohammed Al Marzouqi, Ghanim Abdalla Jasim Abdalla Kashwani, Ismail Mohd Ahmed, Mike Sachs MEI, Dr Maitland Hyslop MEI, Glyn Addicott CEng MEI

20 Mining Data for HSE Management David McDade, Ken Maddox

21 - 22 Reducing Environmental Impacts Michael Grimley FEI, Engr Shadha Mazin Al Taie Grad EI, Beate Hildenbrand

23 - 25 Understanding and Preventing Accidents Ken Maddox, Dr Mark Scanlon MEI



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Middle East

FORUM SUMMARY

The Energy Institute Middle East HSE Forum

The EI's HSE forum brought energy sector leaders together to share best practices, communicate the results of important research and provide delegates the opportunity to learn, inquire and take away ideas







The forum had over 200 delegates from private and public sector entities around the Gulf, including but not limited to ENOC (the forum's sponsor), BAPCO, EAD, BEAAT, Sphere and EPEX.

Day 1

The first day's session was introduced by His Excellency Alistair Long from the British Embassy, Dubai, and featured speeches from His Excellency Ahmed Mohammed Al Kaabi, Assistant Under-Secretary for the Oil and Gas Industry and Mineral Resources at the Ministry of Energy, UAE and His Excellency Ahmed Buti Al Muhairbi, Secretary General, Dubai Supreme Council of Energy (DSCE). Topics ranged from Dubai's 2050 Energy Strategy, ENOC's HSE and sustainability programs to recommendations for HSE strategies from IOSH, the importance of HSE communication, an introduction to the "zero by choice" concept and energy management and the application of energy audits. Speakers included Ms Eva Ramos from EAD, Ms Alia Ali Busamra of ENOC and Tahir Hakim, Chairman of the El Middle East Branch.

Over 200 delegates from private and public sector entities around the Gulf

Day 2

Day two's focus was case studies and research into aspects of health and safety. In the first session, Dr Jose Villanueva highlighted the business benefits of occupational health and Engr Raed Mohammed from Dubai Municipality explained the need for Respiratory Protective Equipment (RPE). The second session provided insights into organisational methods for hazard identification, risk reduction and business performance enhancement. Topics included the importance of human factors in safety (ADCO) and contractor management best practices (BAPCO). Other day two sessions looked at how hazards can be managed, the use of the BowTie risk analysis method, Tripod Beta's approach to incident investigation, and methods and technologies for preventing the release of harmful materials to the environment. Greenhouse Gas (GHG) accounting standards and methods rounded out day 2.

Day 3

Day three of the forum was dedicated to a Tripod Beta workshop, in which Dr Mark Scanlon and Ken Maddox introduced the Tripod Beta methodology and gave the delegates the opportunity to practice applying the Tripod Beta model. The delegates took away valuable lessons in how to investigate incidents to find underlying causes, immediate causes and factors that affect worker performance.

Welcome address

The El offers a platform for sharing concerns, good practices, innovation and research. Though it is based in the UK, it has a global reach; a third of its members are international



The forum was opened by Louise Kingham OBE FEI, Chief Executive, Energy Institute. After acknowledging the sponsors and guest speakers, and thanking the EI Middle East branch or its commitment and effort, she briefly described the EI, the purpose of the forum and the value that it would bring to the delegates.



Representing all industry sectors, El members face real challenges in achieving business goals while keeping their workforces safe and building sustainable practices. In the UAE, the El has over 1,000 members, including 20 members of its local committee.

The purpose of the forum was to share experience, information and guidance that leads to a healthy, accident-free workplace and a sustainable environment for energy businesses. Presenters were there to communicate issues, describe their responses to key challenges, learn together and showcase innovative solutions and research results. Louise expressed confidence that the forum, the first of its type hosted by the EI, would enhance the competency of industry personnel in the Middle East and globally.



Louise Kingham OBE FEI, Chief Executive, Energy Institute

How HSE ensures productivity and business success

The El provides an invaluable service to the energy sector, continuing a tradition of professionalism and high standards



H.E. Alastair Long, Her Majesty's Deputy Consul General in Dubai

is Excellency Alastair Long began by expressing his appreciation of the EI in the Gulf since its establishment seven years ago. He clarified the UK government's support for the EI and the importance of professional institutions to the UK's presence abroad, and the role that diplomats play in helping institutions to spread best practices and knowledge. He was delighted to be able to share the platform with what he described as a "UK asset" – a tradition of professionalism and high standards – with nations in the Gulf. The El is one of many UK exports operating independently of government. His Excellency acknowledged Dubai's initiatives in

sustainability and ambitious targets, and said that the UK would be able to share knowledge and thus support the emirate's journey towards a future of sustainable energy.

Coming to HSE, His Excellency pointed out the UK's record of world leadership in HSE regulatory frameworks and implementation, demonstrating that good HSE practice helps to reduce cost and improve productivity in addition to achieving regulatory compliance. He emphasised that HSE must be a priority for businesses, particularly those in the energy sector, not an add-on for compliance purposes. The audience was pleased to learn of a new

UK government department for international trade, set up since the EU membership referendum in June last year. This department will gather different government functions and provide focused support to trade and professional institutions as part of promoting the UK abroad. One example of the new department's work is its role in promoting the EI's HSE forum. While it was impossible to predict what will happen after the UK general election in June the initiative is expected to continue.

His Excellency concluded by reiterating the importance of HSE as a driver of productive, sustainable business operations.

Energy strategies and the importance of HSE

HSE is the link between achieving targets for efficiency, profitability, productivity and business growth



H.E. Ahmed Mohammed Al Kaabi, Asst. Under-Secretary for Oil and Gas Industry and Mineral Resources at the Ministry of Energy, UAE H is Excellency Ahmed Mohammed Al Kaabi opened with thanks to the sponsors, Dubai Supreme Council for Energy, ENOC and the EI, and described the event as important, bringing experts from different sectors and regions onto one platform.

The road to diversification

Although the UAE is a leading oil exporter, steps have been taken at federal level to reduce fossil fuel dependency, including the use of nuclear and renewable sources for power generation. The strategy is expected to decrease overall consumption by 40 percent and save AED 700 billion in energy costs. It has three goals: balance supply and demand; meet the UAE's international environmental commitments (e.g., emission levels); and ensure a positive economic environment.

Managing supply and demand

The supply-demand component includes initiatives for power consumption efficiency and diversification of power sources to ensure supply security. Dubai's goal for its 2050 energy mix is 44 percent renewables, 38percent gas, 6 percent nuclear and the balance from clean fossil fuels. AED 600 billion will be invested to meet demand and ensure sustainable economic growth. Solutions to complement power and transfer systems are also important, so research and innovation will be prioritised and funded.

HSE's role in the 2050 energy strategy

Concerning HSE's role in the 2050 Energy Strategy, His Excellency emphasised that it will be central to industry activity and significant in the strategies of all companies. HSE is the link between achieving targets for efficiency, profitability, productivity and business growth. ●

Dubai's sustainability energy model for driving green growth

The UAE is a leader in countering the effects of climate change, and has demonstrated success in sustainability by driving solar energy, subsidy reforms and regulatory changes

Dubai Supreme Council of Energy (DSCE) was formed six years ago to create a sustainable future for Dubai by managing energy supply and demand. Challenges are being turned into opportunities through a strategy that links clean energy with economic development.

DSCE's role

Renewables are at the top of the agenda. Investor confidence is high, leading to public-private partnerships, and Dubai has built on momentum generated by its initiatives to establish the World Green Energy Organisation (WGEO), to help nations build renewable industries and fund green energy research and development. Since 2013, DSCE has been communicating its vision to government entities and building capacity, and has aligned its programs with Dubai's Smart City vision.

Goals and achievements

Goals include diversifying fuel types and sources, and optimising resources for safe, energy-efficient cities. Nine programs have been launched already to retrofit buildings, construct rooftop solar units and support hybrid power and electric vehicles.

Sheikh Mohammed bin Rashid Solar Park is an example of supply diversification, as is Dubai's success in driving down the price of solar PV. Achievements to date include the generation of 2,000 MW from solar plants, with plans to scale up to 5,000 MW by 2030.

Dubai's sustainable energy model is a regional benchmark, the result of DSCE's determination to achieve a sustainable future and set standards in energy management.



H.E. Ahmed Buti Al Muhairbi, Secretary General, Dubai Supreme Council of Energy (DSCE)

ENOC's HSE journey

For the ENOC Group, HSE stewardship is non-negotiable priority

he El provides leadership in developing standards and best practices, contributing to a safe and reliable future for the energy industry. Mr Al Qufaidi welcomed the delegates, EI members and the forum organising committee, and shared ENOC's HSE philosophy and the way in which HSE has been integrated into management systems and operations. At ENOC, HSE stewardship is a nonnegotiable priority. HSE culture is embedded into policies, procedures and contracts, protecting stakeholders, assets and the environment from harm

Four key ENOC programs

ENOC's programs demonstrate that HSE practices are a strategic priority at Group level. Mr Al Qufaidi focused on four programs:

Building effective

- governance
- Effective management systems
- Excellence in operational risk management and auditing
- Building the competence and capacity of the workforce

Governance links HSE with ENOC's development agenda and contributions to Dubai's energy strategy. The company has invested in energy conservation and supports Dubai's demand side strategy for reducing energy use over the long term, which supports ENOC's culture of sustainability.

Management, operational excellence and training

The EHS Assurance Directorate works with corporate development to ensure that EHS is part of each department's management system. Operational excellence programs involve risk management and auditing, process safety and EHS systems. Training and development are a priority for regulatory compliance and building capabilities. EHS training is a KPI across the Group for senior and operational staff, encompassing units and sites, from office safety to advanced fire response, change management and other competencies.

Building a safety culture

A "hearts and minds" safety culture program has been developed, and ENOC is working closely with the EI to deliver energy management and technician learning. EHS initiatives this year focus on safety leadership, to deliver ENOC's business mandates to stakeholders without compromising EHS. The EHS team is working closely with risk management, sustainability and business development.



Zaid Al Qufaidi, representing Mr Saif Al Falasi, on behalf of ENOC's board of directors

Panel Q&A and closing remarks

Questions and answers for the keynote speakers and awarding of memorial plaques



H.E. Ahmed Buti Al Muhairbi

Initial targets for clean energy were five percent by 2020; that has now been raised to 25 percent. is Excellency Ahmed Buti Al Muhairbi was asked how youth could be attracted to help support the DSCE's mission, and replied that WGEO has played a major role in academia, through which youth can participate, as well as through careers in businesses and smart city initiatives. He highlighted a WGEO smart city project to start soon in Seoul.

Answering a guestion about meeting and overcoming challenges in the implementation of DSCE's initiatives, he spoke about Dubai Electricity and Water Authority (DEWA) initiatives in building a strong utility base, record low solar energy prices, the promotion of green energy businesses by DSCE and its strong leadership across the industry. He addressed guestions regarding the promotion of policies for efficiency and clean energy by commenting that

initial targets for clean energy were five percent by 2020. That has now been raised to 25 percent. Concerning energy storage initiatives, he recognised the value of existing storage methods, and talked about studies for concentrated solar power storage methods, on which the Dubai target of 75 percent for 2050 will depend. Dubai is looking to public-private sector initiatives to support research, and the WGEO will be involved.

The keynote session was closed by Dr Waddah S. Ghanem Al Hashmi and Mr Zaid Al Qufaidi. Dr Al Hashmi acknowledged contributions from His Excellency Ahmed Al Muhairbi and His Excellency Ahmed Al Kaabi at Ministry of Energy, and thanked Mr Al Qufaidi for standing in for Saif Al Falasi. A memorial plaque was given to His Excellency Alastair Long, and a gift was presented to Ms Kingham.



Dr Waddah S. Ghanem Al Hashmi FEI, Executive Director, EHSSQ & Corporate Affairs, ENOC





DAY 1

HSE & SUSTAINABILITY

Climate action post-Paris: shifting the energy sector towards a low-carbon path Changes in subsidy reform, demand side management and the use of nuclear and renewable energy sources can enable the UAE to reduce CO₂ emissions significantly

E va Ramos spoke about how EAD and Abu Dhabi Sustainability Group have been working towards a sustainable energy future.

EAD's role in building a sustainable future

EAD has been supporting the development of government strategies, action plans and policies to decouple economic growth from environmental impact. Its work includes highlighting the effects of climate change and the need for a policy-driven shift to low carbon plans. The Paris Climate Change Accords, ratified in 2016 by 195 nations, are a framework for government action. By 2015, more than 160 states had made plans to reduce emissions, but evidence suggests that there is still a great deal to be done to achieve these targets.

Solutions for reducing GHG emissions

The UAE is hoping to supply 27 percent of domestic energy needs from clean sources by 2021.

Subsidy reforms are a useful step in this direction. The situation is urgent in Abu Dhabi, where more than 74 percent of greenhouse gas emissions come from the energy sector.

Solutions include efficiency, changing the energy resource mix, reduced use of fossil fuels and further subsidy reform. There are opportunities for investment in this area, and EAD is working on strategies for water use and climate change as part of the Abu Dhabi Plan. Innovations such as Pioneering and Procarbon and methods for capturing CO₂ emissions in mangrove forests and other ecosystems have been piloted in Abu Dhabi and other countries.



Eva Ramos Director Environmental Analysis and Economist, EAD

Towards imbuing an ethos of effective management in health and safety

Good HSE practices are implemented through policies and stakeholder engagement; a safe working environment is assured by clear communication, effective monitoring and management commitment

Prof. Eugene Coyle described how effective health and safety management and practices were embedded into the development, building and operations of the Military Technological College (MTC) in Oman.

Prof. Coyle, who is a fellow of the EI and has been involved in the energy industry for the past three decades, leads the MTC, which opened in 2012 to educate Armed Forces personnel and Ministry of Defense engineers in partnership with University of Portsmouth.

The MTC occupies an area of nearly one million square metres, with 250,000 square metres of buildings for classrooms, workshops, accommodation and services. Health and safety are a priority for students, faculty and MTC staff.

The MTC has health and safety policies for managing safe systems of work and study, providing safety and occupational health training, assessing risk, achieving statutory compliance and ensuring the safety of people working or living in the college's facilities. HSE is also used in designing academic programs: the EI has been licensed by the Engineering Council of the UK to accredit chartered engineer competency for MTC students.



Prof. Eugene Coyle FEI, Dean, Military Technological College, Sultanate of Oman

From high risk to high reliability - through effective EHS governance

High reliability organisations operate safely over extended periods of time, have strong links between safety culture maturity, leadership, management systems and operations



Dr Waddah S. Ghanem Al Hashmi FEI, Executive Director, EHSSQ & Corporate Affairs, ENOC

It has been suggested that over 80% of maritime incidents are caused by human error

r Waddah S. Ghanem Al Hashmi introduced his talk with an overview of recent serious HSE incidents such as the Deepwater Horizon accident in the Gulf of Mexico in 2010 and the explosion at a BP Refinery in Texas in 2005. Incidents like these impact organisational, financial and reputational outcomes, and have resulted in closer scrutiny of energy sector operators by regulators, shareholders and the public. Losses are virtually crippling to organisations, exemplified by the experience of Union Carbide after the Bhopal incident over 30 years ago.

Understanding why organisations repeat mistakes

Referring to Marc Gerstein's book, Flirting with Disaster, Dr Al Hashmi spoke about why organisations do not learn - why, in effect, they repeat mistakes. The reason is that studying past behaviour leads to blame and penalties, meaning organisations may prefer not to study problems. This is particularly problematic for companies in high risk industries. A way out of this situation is transformation to what Gerstein, and Dr Al Hashmi, call "high reliability".

High-reliability organisations

High reliability organisations have a strong learning orientation, prioritise safety over other goals, train and develop their people continuously, share performance goals and build a culture of reliability using highorder learning. In high reliability organisations, redundancy is built in beyond technology.

Building high reliability into the organisation

Safety governance and processes weave a culture of safety and reliability into the organisation. Initiatives for advanced safety can be launched from this foundation. Strategies for redundancy, such as having more than one fuel source for a pump, work alongside the safety culture to ensure reliability in performance. Dynamic leadership leverages competencies. Management by exception and a focus on strategic issues enable competent managers to make the right decisions. Learning occurs at multiple levels and safety-critical information is communicated through different channels.

Risk assessment and loss control are part of risk management, focusing on protection and prevention. Risk management starts at enterprise levels and cascades to HSE and operations. Risk profiles need to be updated after changes and significant events.

Addressing human factors

Human factors are the main cause of incidents - which are, in most cases, preventable. Errors can be controlled by engineering improvements and technological controls, but the priority should be human factors (antecedents of behaviours) and human performance (the direct outcome of action by individuals). Addressing human factors starts with recruitment, and includes integrating human factors in design, developing a safety culture and effective safety communication. Human performance can be enhanced by supervision, leadership and training.



Monitor, measure, communicate: best practices for increasing safety performance

The right process leads to the right outcomes – organisations that have strong processes in place, and that follow them have much better barriers and achieve lower incident rates

raser Goodey presented methods, metrics and indicators that organisations can use to improve operational risk management and safety performance. The aim of managing operational risk should be to identify and eliminate or mitigate risk to the point that the organisation achieves zero significant incidents. Incident management systems normally involve reactive event reporting and audits to uncover operational risk, followed by implementation of corrective action.

Challenges in monitoring and measuring HSE performance

Challenges include prioritising (time), incentives for identifying and reporting hazards and incidents, following up and training to provide people with the skills needed to report, monitor and control action taken. One particular problem is the need to capture process data (e.g., the status of action taken), which can overwhelm management. This can be addressed by prioritising high potential incidents in the risk reduction cycle, but there needs to be visibility into data so that business units, locations and performance can be compared, indices built and predictive measures established and monitored.

A four-step process to address challenges

Mr Goodey described a process to address these challenges: 1, communicate all possible risk types and sources; 2, decide appropriate mitigation or control strategies; 3,



complete action items (controls); 4, assess the effectiveness of risk mitigation. The process should be embedded in work routines across the organisation.

The right process leads to the right outcomes

Sphera conducted a benchmarking study in 2016 to find out how organisations go about implementing the four-step process. The main conclusion was that the right process leads to the right outcomes - organisations that have strong processes in place, and that follow them, have much better barriers and achieve lower incident rates. In addition, Sphera identified four types of performance predictors: learning and optimising, (team competency, root cause analysis and proactive learning); barrierfocused approaches (discipline, risk ranking and exposure ranking); process discipline

(engaged leadership and careful investigations); and reporting engagement.

Technological solutions include reporting, leading indicators, competitor benchmarking. Mr Goodey provided the example of a riskbased process, where events are captured every day across the organisation, enabling managers to focus efforts on the main issues. Other examples included near miss and follow-up reporting and analysis, learning from data analysis and building a reporting culture where event rates across the business units could be compared regularly and subjected to study. The disciplined application of processes, supported by training, leadership and robust data analysis can enable organisations to monitor safety performance and bring about improvements in incident reduction.



Fraser Goodey, Client Services Director, Sphera Solutions

Development and implementation of a health and safety strategy

Health and safety strategies sound simple, and they are. However, successful implementation requires commitment, attention to detail and management support



Matthew Jackson, Chair of IOSH in the UAE

Atthew Jackson began by asking two questions: what is a health and safety (H&S) strategy and why is it important? A health and safety strategy is a high-level plan to assist an organisation in achieving its H&S goals. A strategy consists of determined actions, objectives and tasks to achieve the objectives.

Assessing current H&S status and objectives

The first step is to determine the organisation's current situation in terms of safety records, incident rates and other indicators, and where it needs to be. Audit reports provide information for trend analysis, and employee communication can reveal perceptions of H&S in the organisation. The second step is to identify what is important – for example compliance, reducing accidents - followed by defining objectives with clear accountabilities and resources. Finally, monitoring implementation and reviewing the objectives will tell management what still needs to be done.

Mr Jackson described a case study that used the five steps. The subject organisation was a mature, global firm, so strategy planning was conducted over 12 months, and included a global strategy. A gap analysis was conducted to define a baseline for the organisation and identify focus areas.

Developing strategic focus

Internal surveys were used to capture employee perceptions. This generated focus areas for the strategy, including commitment, behaviour, trust, procedures, engagement, attitude, resources and reporting.

Taking action

Comparison of the data with H&S expectations provided opportunities for improvement and areas where action was required: governance, processes and culture. Standards were adopted for governance, processes were simplified and integrated and an integrated management system enabled process optimisation and streamlining. Additional assessment uncovered competency gaps, addressed by training sessions, and communication was emphasised to address cultural issues. The study found that management capability and management buy-in were essential to achieving results.



A health and safety strategy is a high-level plan to assist an organisation in achieving its H&S goals. A strategy consists of determined actions, objectives and tasks to achieve the objectives.

Panel Q&A and closing remarks Questions and answers for the first plenary session speakers



Following the presentations, questions were posed by audience members. Ms Ramos explained how training enforces positive learning policies and integrates and refines existing policies, and referenced the value of incorporating HSE into training programs

She gave examples such as how EAD is engaging with professionals to support international recognition for training, and courses at university level.

Ms Kingham explained that the El has a similar approach, where industry, regulatory authorities and other bodies collaborate to develop new regulations and standards for technical planning concerning the cost-effectiveness of policies and implementation. The process is time consuming but effective, because it captures valuable stakeholder input.

In answer to a question about conflict between HSE and production departments and how it can be overcome, Mr Jackson said that effective HSE management results in productivity improvement, simply because the cost of implementing HSE is less than that of accidents.

There is a need to make the case for HSE to bring management thinking around. Dr Al Hashmi added that the purpose of HSE procedures is not always understood, and that HSE professionals need to be aware of the attitudes and motivation of production people.

According to Dr Al Hashmi, benchmarking data quality depends on the reporting requirements and incident reporting depends on the culture. Good reporting across the entire organisation is difficult.

Ms Kingham closed the session with a summary of the main presentation topics and outcomes: cooperation between governments; what energy strategies and clean growth plans can bring to the future; the need to place HSE at the heart of company strategies; the role of public private partnerships in raising the contribution of clean energy to national energy strategies; and taking organisations from high risk to high reliability through a risk-based approach and by focusing on human factors and learning.

IMPROVING HSE OUTCOMES

Welcome address from the Chairman of Energy Institute Middle East

HSE procedures are only one step towards achieving successful HSE performance



Tahir Hakim MEI, Chairman of the EI Middle East Branch

The forum resumed with an introduction by Tahir Hakim MEI, Chairman of the El Middle East Branch. He summarised the purpose of the forum and the morning sessions, and gave a brief overview of upcoming talks. Describing the importance of HSE culture, which goes beyond formal HSE management systems, he referred to examples of companies refusing to share their HSE procedures out of fear that other organisations would copy them. He made the point that having HSE procedures is only one step towards achieving successful HSE performance. Management commitment and direction, and a culture of empowered employee decision making, are required if HSE management systems are to be useful.



Safety communications in the Middle East

HSE messages should be conveyed using methods and channels that meet the needs of the audience



Jennifer Palmer, Managing Director Middle East, Myriad Communications

Jennifer Palmer identified reasons that HSE communication is essential to building and executing HSE strategies. Strategies start with employee engagement, and continue through to competency in policies and procedures and the avoidance of incidents and near misses by understanding and acting upon the right information.

The need to understand your audience

Good communicators understand their audiences, use a variety of message types and media, and actively seek feedback to know whether their messages have been received and understood. Audience needs differ across cultures, organisational units and work categories; some people need high-level information concerning policies, while others need detailed work instructions to carry out operations safely.

Choosing the right methods and channels

Varying the means of communication can help to ensure that the audience is engaged. Methods should take account of education levels, language barriers and expectations. For example, video and animations can be useful to show causes and effects because they are easy to remember and cross language and cultural barriers. Similarly, LCD panels can be used to spread key messages to large audiences in multiple workplaces. Graphics are essential for people who do not have time to go through detailed reports, and statistics can be presented in tables and even animated presentations.

A common excuse for not improving HSE communications is lack of budgets, but this need not be an obstacle. Creative solutions can be found at relatively low cost, to be scaled up when budgets are available.

IMPROVING HSE OUTCOMES

Zero harm by choice

Achieving zero lowers the costs of incidents, occupational illnesses and environmental impacts

The "zero" concept means setting ambitious targets, e.g., for zero incidents, fatalities or environmental impacts. It is used by companies such as Shell, Exxon Mobil, Toyota and Pepsico. "Zero by choice" describes the level of safety culture maturity that an organisation must reach in order to achieve outstanding reduction in incident rates.

Why try to achieve zero?

Achieving zero is attractive to companies because of the costs of incidents, occupational illnesses and environmental impacts. As an indication, the global cost of incidents and HSE-related problems reached four percent of GDP, according to the International Labour Organisation (ILO) in 2002.

Mr Adra used Rio Tinto Alcan's journey to zero to illustrate the concept, the benefits that it brings and challenges in achieving zero. Before 1998, HSE was a priority and the company had HSE management, but it was up to individual unit managers to implement them as well as they could. The turning point was the Lassing Talc Mine disaster in Austria.

Rio Tinto's response to the Lassing disaster

Following the incident, Rio Tinto Alcan instituted changes in HSE management: standards were developed; performance audits were conducted and reviewed by the CEO; poor performers were removed from duty; bonuses were linked to HSE performance; and top performers were promoted. The company, post-Lassing, saw dramatic declines in incident rates (80 percent from 1998 to 2006 and 15 to 20 percent per year from 2006 to 2010) and Rio Tinto was recognised as a global leader in mining safety.

How safety results are linked to safety culture

What explains the transformation, and why is it that companies can have similar HSE management systems yet achieve significantly different HSE results? The answer may be found in what is known as the Bradley curve. Developed by DuPont, the curve seeks to explain a relationship between safety results and the maturity of an organisation's safety culture. Companies that are not mature in terms of HSE depend on the natural instincts of employees and have high incident rates and HSE problems. Organisations with mature safety cultures have low incident rates, such as Rio Tinto has achieved, because people are empowered.

Where the journey starts

Organisations move along the curve from "zero not possible" through "zero by chance" to "zero by choice". As Rio Tinto found, the journey starts with management commitment to policies and aims, and participation in the implementation of standards and systems. Success depends on employee involvement, transparency and freedom of expression, which leads to reporting, guestioning and honesty about HSE issues, driven by inspirational leadership that builds trust and confidence.



Islam Adra CRSP, HSE Manager MENA & Turkey, Fortive



Zero Harm by Choice: The Bradley Curve

SUSTAINABLE ENERGY MANAGEMENT

Sustainability, energy efficiency and the energy mix: drivers and industry response

Sustainability is built into the company's value chain, starting with the climate impact of raw materials that the company uses



Alia Ali Busamra, Chief Sustainability Officer, ENOC

NOC's mission and vision promote sustainability, which the company sees as beneficial for strategic and business reasons and critical not only for the company itself but to achieving economic growth for Dubai and the UAE. The company is aligned to the UAE's sustainability initiatives and targets through the following strategies: utilising UAE national employees; building a culture of sustainability; transparent reporting; effective day-to-day decisions; long-term careers.

HSE and sustainability

HSE supports sustainability, with KPIs for employees, the community and the environment, including targets for energy efficiency and low carbon resources, governance and transparent performance reporting. Upstream, midstream and downstream units cooperate and communicate to achieve targets while remaining profitable.

Sustainability starts with the climate impact of raw materials that the company uses. Economic growth for the UAE is supported when the company buys inputs and services in local markets and builds infrastructure and supports innovation. Finally, the company supplies products that provide energy for Dubai and the wider UAE community.

Managing for a sustainable future

Examples of how sustainability is managed include CNG fuel distribution for public transport and airports, part of an initiative to encourage hybrid and electric vehicles. The company is part of Dubai's carbon reduction strategy, aiming at a 16 percent reduction by 2021 through cleaner fuel for transport, which should affect ENOC positively by increasing operational energy efficiency.

ENOC's Executive Committee (EXCOM) provides direction and governance to ensure the performance of start-up projects. A focus for ENOC is the E&RM (Energy and Resource Management) strategy. This is directed by the EXCOM and targets resource use, conservation and cost reduction with goals for energy conservation, and for how ENOC can support customer conservation and energy savings.



SUSTAINABLE ENERGY MANAGEMENT

Energy management – why it is in CSR

Energy management contributes to society's best interests

The purpose of Dr Manjrekar's presentation was to explore links between Corporate Social Responsibility (CSR) and energy management.

What is energy management?

Energy management means improving how resources are spent in an organisation or community. Action can include refurbishing or retrofitting assets, new fuel sources and using efficient technologies and components. A strategy must take innovation from outside the company into account. Monitoring is essential once decisions have been taken, and people must be competent to implement and manage the system.

Implementation should follow four steps: 1, identify opportunities for savings; 2, prioritise actions rationally; 3, achieve objectives; 4, maintain actions.

Risks to successful implementation

Dr Manjrekar emphasised a common risk that companies face when beginning the energy management journey – starting before the most effective actions have been identified. Each action item should be managed as a project, and accountabilities must be assigned to ensure that success is maintained. In many instances, benefits such as cost savings or return on investment (ROI) will not be seen for some time, so persistence is key to long-term success.

Connecting CSR and energy management

The link between CSR and energy management lies in how energy management contributes to the interests of society and affects a company's impact on its stakeholders. CSR programs can interface with energy management. However, it is important that energy management be given due priority and not simply be treated as another CSR initiative.



Dr Sunil Manjrekar, Dignitary of American Society of Safety Engineers Global Region CEO, Sanbook Quality Consultancy, UAE

A journey towards improvement in energy efficiency and profitability

Energy audits are the central component in an energy reduction strategy, but management has to follow them up energetically

Krishna Murthy began his presentation by summarising increases in CO₂ concentration in the atmosphere and the impact of human activity on CO₂ levels. He went on to describe the link between fossil fuel extraction and utilisation and rises in global temperatures resulting from CO₂ concentrations. Targets have been set, but a great deal of work will need to be done simply to maintain temperature increases to 2°C.

Using energy audits as a basis for energy reduction

Mr Murthy presented what he

called a "Step-wise Approach to Energy Reduction", based on energy audits. To be useful, audits must be conducted by the right people and follow an agreed process, including walk throughs, data analysis and evaluation and instrumentation audits in the field. The results will identify "low hanging fruit", which along with a post-audit study are presented to management with a recommended action plan.

Examples and reminders

Companies that retain competent auditors and act on their recommendations have

reduced costs significantly. For example, the petrochemical industry saves between three and eight percent on its operating costs per year, and Environmental Solutions and Consultancy has saved its clients 38,000 tonnes of CO. since 2016 (CO₂ emission for every MWh = 0.56 tonnes). However, like all management initiatives, energy reduction can only work if a company's management is committed, the auditors do their work correctly and conscientiously, and efforts are sustained, measured and reinforced over time.



Krishna Murthy Dy Director – Energy, Environmental Solutions and Consultancy Environmental Solutions and Consultancy -UAE

Don't waste your waste - improve energy efficiency by recovering energy from waste

Waste can be a valuable fuel source, and waste management offers opportunities for savings as well as reducing unwanted environmental impacts



Mustafa Vahgjipurwala MEI, Energy Specialist, Petrofac

Mustafa Vahgjipurwala explained how waste in the petroleum industry derives from sources such as construction and operations (1 kg of crude can generate up to 20 g of waste). Waste can be used to generate, rather than consume energy because petroleum industry waste normally contains organic matter.

How waste can be put to use

To illustrate his point, Mr Vahgjipurwala presented a case study showing how waste received by BeAAT, Sharjah Government's waste treatment and handling facility, was analysed for its potential as a

fuel source.

Research found that around 18,000 tonnes of waste are incinerated or sent to landfill per year. Approximately 90 percent of this waste is non-hazardous, and can be used to produce up to 4,000 tonnes / year of syngas, generating up to 1.5 MWh of electricity annually, powering the equivalent of 300 households and saving around 154 million BTU/year of fuel.

Overcoming hurdles

Given the costs of gasification technology and potential savings, payback for the project could be achieved in five years, which is fast for this kind of project. Barriers such as lack of awareness of potential benefits, a shortage of expertise in the processes and technologies involved, and few precedents in the industry for this kind of project have to be breached in order for waste recycling and reuse for generation purposes to be adopted on a large scale. In addition, the amount of savings may be too small to interest most players.

That said, there are openings for innovation in this area. It remains to turn the challenges into opportunities by thinking boldly and taking the first steps.

Panel Q&A and closing remarks

Questions and answers for the second plenary session speakers

Questions to the panel began with an audience member asking whether it was possible for a company to ensure that leaders will carry out HSE policies. Mr Adra responded that it is essential to start by hiring the right people. The relationship between HSE and ethics compliance was addressed by Ms Palmer, who agreed that industry mindsets have changed a great deal in the last 20 years, but that leadership still plays a vital role.

Concerning how profits are affected by HSE policies, Ms Palmer referred to consensus within the industry that



promoting HSE makes financial sense.

Mr Hakim summarised the key points of the presentations: the importance of communication to achieve HSE objectives, how companies can set zero targets and achieve them, energy strategies, alternatives to disposing of waste by using it as a source of fuel, the purpose and structure of energy audits, energy management and CSR. He concluded by thanking the speakers.

Welcome address

The HSE Forum: delivering knowledge and practical experience



r Waddah S. Ghanem Al Hashmi welcomed delegates to the second day of the forum and emphasised its purpose: delivering knowledge and best practice experiences, supporting improvements in organisational safety performance and sustainability and discussing key HSE challenges and opportunities facing the Middle East's energy sector players. He introduced the theme of the first morning session: managing health hazards and reducing their impact on workers' health.



Dr Waddah S. Ghanem Al Hashmi FEI, Executive Director, EHSSQ & Corporate Affairs, ENOC

Why occupational health should be a priority

Occupational health reduces accidents and contribute to positive business results

Dr Jose Puno Villanueva's presentation highlighted the business benefits of occupational health.

After presenting global statistics on types and costs of occupational illnesses, he described the links between a healthy workforce and benefits such as productivity, improved brand image and higher levels of employee commitment.

Why occupational health should be a priority

The presentation included common health screening methods, surveillance and health clinics at sites, followed by a detailed analysis of potential cost savings and benefits, including reduced employee absence and incident levels, improved retention and the productivity increases that come from enhanced employee health. Links between accidents and health levels (e.g., how lack of physical fitness increases the risk of accidents) and the cost of ignoring occupational health were explored.



Dr Jose Puno Villanueva BsBio, LFOM, MFOM

Dubai Municipality initiatives for effective RPE use in industrial workplaces

Respiratory effects of the work environment are cumulative and are often not observed until they have become chronic



Engr Raed Mohammed Al Marzouqi, Head, OHSS -Department of Public Health & Safety Dubai Municipality Engr Raed Mohammed Al Marzouqi's theme was the need for, and use of Respiratory Protective Equipment (RPE) as a PPE strategy in Dubai Municipality.

Why emphasise RPE?

The reason for this focus is that respiratory effects in the work environment are cumulative and often not observable until they have become chronic. Mr Mohammed explained environmental respiratory damage in detail, and provided insight into potential solutions. RPE filters or eliminates pollutants from the air supply to the wearer. There are a variety of methods, some of which use a separate air supply to prevent the inhalation of harmful substances.

What Dubai Municipality has achieved

The use of RPE reduces occupational illness and incident rates. Challenges to achieving these objectives include lack of awareness, corporate culture, management systems and standards.

To overcome these challenges

and help to assure the health and safety of its employees, Dubai Municipality has adopted methods and standards for measuring hazards and for approving RPE. Management commitment, corporate culture and workforce education drive the implementation of policies and support the achievement of HSE objectives.

How HSE and energy are related

When implemented through HSE governance and systems, design and management can have a powerful impact on incident rates and worker attitudes to safety



Ghanim Abdalla Jasim Abdalla Kashwani, HSE Engineer, ADCO G hanim Abdalla Jasim Abdalla Kashwani's presentation introduced the importance of human factors (environmental, organisational, job factors and individual characteristics) in causing and preventing HSE incidents. According to Mr Kashwani, engineering, safety management and human factors in design are interrelated.

Building human factors into design

Written procedures are often ignored. Training can provide some assurance of safe working practices by increasing worker competency, and can complement procedures. However, a third factor is essential: incorporating human factors into the design process. In practice, this means that equipment, operations, procedures and the work environment accommodate potential human behaviour such that sites and process technologies are compatible with the capabilities, limitations and needs of the workers.

The importance of safety management

Safety may be built into design, but also requires management commitment, good communication and rewarding the right kind of behaviour. In this way, management sends a clear message to employees that their safety is a priority.

When implemented through HSE governance and management systems, design and management can have a powerful impact on incident rates and worker attitudes to safety.

Contractor management best practices: **BAPCO** case

OHS maturity and good safety practices are underpinned by cultures that empower employees

smail Mohd Ahmed presented a case study of BAPCO's experience in building a safety culture.

After introducing the company, Mr Ahmed discussed definitions of an Occupational Health and Safety (OHS) culture and reasons that OHS culture is essential to influencing the behaviour of employees.

How OHS cultures support good HSE practice

OHS culture supports the HSEMS, increases employee awareness and understanding of workplace hazards, and addresses "hearts and minds" aspects of safety management.

BAPCO has committed resources to building its OHS culture and Mr Ahmed described the process with reference to a five-level OHS maturity model. Beginning with technical procedures targeting safety risks.

Achieving OHS maturity

OHS maturity is achieved as the organisation progresses from level 1 (emerging) to level 5 (continually improving)

through employee involvement, shared perceptions and visible management commitment.

To keep the OHS culture alive, management needs to measure employee perceptions, audit and assess results, and ensure that complacency is combatted.

Mr Ahmed described this last point as the real challenge - achieving the culture is not enough; it has to be maintained.

Ismail Mohd Ahmed, Superintendent Safety & Occupational Hygiene, Bahrain Petroleum Company (BAPCO)

Managing risks in oil tankage – lessons from the past and solutions for the future

Management must consider both assets and people in order to prevent incidents

he two biggest risks in oil tank farms are overflow and integrity failure. Both have a low probability but can result in serious loss because of the quantities of material involved. Mike Sachs presented a case study of the Buncefield tank farm incident and a site in Asia to explain incident cause and effect, and described how Orpic, an Omani tank farm operator, implemented the recommendations of the Buncefield investigation team.

A network of causes and contributing factors

Causes of the Buncefield incident included the shift handover process, employee failure to calculate tank levels and set alarms, faults with the DCS, lack of management technical skill, low levels of operator supervision, insufficient operator understanding of the systems that they were using and dependence on "last line of defense" protections. Tank fire in Asia was caused by problems in the integrity of the internal floating roof, damage to the tank and inadequate measures to rectify the damage. Proximate causes included employee technical capabilities, inexperience and failure to understand the damage to the tank and what measures should have been taken.

Addressing technical, human and systemic causes

Orpic formed a multidisciplinary task force, which recommended changes in operating philosophies,

policies and procedures, different inspection and integrity assurance methods, training for field operators and increased safety hazard awareness. Orpic instituted a program to implement the recommendations.

The main lessons from Buncefield and other incidents are that management must consider assets and people. A barrier to successfully addressing tank-related risk is that jobs in tank farms are not seen as highgrade positions or perceived as requiring much in the way of competency. This needs to change, so that employees have adequate technical skill to operate tank farms safely.



Mike Sachs MEI, Company Director, Newfield **Honley Limited**



The problem of static and dynamic dropped objects

Training is essential to ensuring a shared approach and awareness among employees of the problem and its consequences for safety



Dr Maitland Hyslop MEI, CEO, Durham Consulting Group Limited

Dr Maitland Hyslop's presentation looked at the problem of static and dynamic dropped objects, and provided solutions.

Static and dynamic dropped objects are an operational issue on rigs and production platforms. This costs the industry many millions of dollars a year.

The solution is multi-faceted. One part of the solution is leadership. Training is essential to ensuring a shared approach and awareness among employees of the problem and its consequences for safety. Research indicates that employee health and resilience are also contributing factors. Technology such as sensors, satellites, drones and digital rig technology can reduce the need for human involvement in many tasks, thus improving safety and cutting down the risk of dropped objects.

Finally, the use of big data can enable organisations to study trends in dropped object incidents and to study causes and effects.

Managing safety critical devices to prevent or mitigate major accidents

Improvements in exchanger design lead to better process safety

lyn Addicott described **J** tube failures in shell-andtube heat exchangers (STHEs) and common causes of failure, such as fatigue, corrosion, erosion and fretting wear. The increasing use of high pressure STHEs, their criticality and threats to the environment and to process assets from failure have prompted changes in STHE design and new approaches to relief device selection, affecting valve response times and acceptability criteria for relief valves.

The objective of these changes is to enable STHEs to operate safely, and to withstand the impact of a tube failure. Mr Addicott presented an overview of how relief devices have been tested, and how test results have led to recommendations for valve opening times and the calibration of valves.



Glyn Addicott CEng MEI

MINING DATA FOR HSE MANAGEMENT

Learning within industries by sharing BowTie risk analyses to improve safety

Communication enables BowTie users to see what other organisations have identified as top risks, and what and where the main critical barriers are

David McDade's objective was to explain how sharing information and knowledge can lead to safety improvements.

Mr McDade discussed some of the challenges to information sharing and communication in general, such as language barriers. His focus was the use of the BowTie method for assessing risks and consequences.

Using the BowTie

To use the Bowtie effectively, people need to understand it, and they need practice in using it. Methods and channels for creating understanding include HSE booklets, intranet sites and the use of the BowTie Server, which captures relevant data in a central repository.

Sharing and benefiting from experience

Through communication inside companies and within the industry, organisations can share experience of using the BowTie, how they overcame challenges and what they recommend to others. In the oil and gas sector, this should be feasible because most companies' operations are similar. In particular, communication enables BowTie users to see what other organisations have identified as top risks (e.g., hydrocarbons in formation and/or under pressure, H2S, air, water and road transport) and what and where the main critical barriers are.



David McDade, Principal Engineer at Risktec Solutions

Identify underlying causes of unwanted events as elements within OHSAS 18001/ ISO 45001

Tripod Beta enables organisations to see what happened, how and why it happened, and to diagnose the causes through a fault tree

Ken Maddox presented the use of Tripod Beta incident analysis in the context of HSE management system standards (OHSAS 18001 and ISO 45001), and how Tripod Beta can reveal deficiencies in the design and / or implementation of HSE management systems.

Standards for HSE and risk management

HSE management systems follow the plan-do-check-act cycle and are integrated into an organisation's business operations. Risk management typically follows a Hazard and Effect Management Process (HEMP), through which hazards are identified, assessed and controlled, and incident recovery is planned. Both standards provide for hazard and risk management, emphasising leadership and worker participation and the use of documented management systems to ensure planning, execution and evaluation.

The Tripod Beta model

Mr Maddox presented an Agent+Event+Object model for understanding how incidents occur, highlighting

preventive and protective barriers to unwanted events. Occasionally, barriers fail at one or more of the following points: underlying conditions (features of the management system), preconditions (e.g., lack of controls at the workplace) or immediate causes (the worker). Tripod Beta enables organisations to see what happened, how and why it happened, and to diagnose the causes through a fault tree. This enables an organisation to improve barriers at each of the three points and thus to enhance its safety performance.



Ken Maddox, Tripod Beta Trainer, Engineering Performance

Economical approach to preventing releases of vanadium and nickel to the environment

GSAe has developed processes to remove vanadium and nickel from HFO combustion ash, refinery residue, spent refinery and sulphuric acid catalysts



Michael Grimley FEI, Managing Director, GSA Environmental

SA Environmental ☐ (GSAe) specialises in the hydrometallurgical extraction of transition metals such as vanadium and molvbdenum from secondary sources. In the Middle East region, hundreds of thousands of tonnes of ash containing vanadium and nickel are produced, in most cases sent to landfills. Michael Grimley addressed this situation by explaining how the release of vanadium and nickel could be prevented, without negative financial impact on a company.

Why recovery is needed

Vanadium and nickel are

found in crude oil, and are a hazardous waste product of crude distillation and other refining processes. They are captured in catalysts and released to the atmosphere as fly ash, from combustion. Because this ash contains harmful chemicals, it cannot be processed in refineries, so it is sent to land fill sites.

How the process works

GSAe has developed processes to remove vanadium and nickel from HFO combustion ash, refinery residue, spent refinery and sulphuric acid catalysts. GSAe's hydrometallurgical process treats ash through precipitation. The technology is environmentally friendly, robust and scalable, and use no solvents or exotic reagents. GSAe's rate of metal recovery is greater than 90 percent, and waste is minimal. Products include nickel carbonate, vanadium pentoxide and carbon fuel, all of which can be sold. Byproducts include molybdenum, silica and caesium

Because of the high cost of land fill, treatment makes financial sense, and payback periods on Capex can be as low as four years.

Climate change and greenhouse gas accounting

Accounting for its GHG inventory enables Dubai to manage and reduce emissions



Engr Shadha Mazin Al Taie, Grad EI, Technical Officer, Dubai Carbon Center of Excellence

Engr Shadha Mazin Al Taie Started with an overview of Dubai Carbon, an agreement between the Dubai Supreme Council of Energy (DSCE) and the United Nations Development Programme (UNDP).

Objectives

Dubai Carbon's aim is to establish an effective greenhouse gas (GHG) inventory, in line with international standards and best practices. He then introduced the status of GHG emissions and a range of GHG accounting standards and methods, e.g., IPCC 2006 guidelines, Global Protocol for Community-Scale GHG Emissions and World Resources Institute (WRI) and World Business Council for Sustainable Development (WBCSD) guidelines and standards.

The GHG inventory and other initiatives

The business goals of Dubai Carbon's GHG inventory initiative are to identify opportunities for efficiency, develop a baseline for reporting, provide accurate, timely GHG data and participate in GHG markets. Accounting for the inventory enables Dubai to manage and reduce GHG and emissions, with planning that takes into account a range of scenarios and strategies.

The UAE has a roster of active Clean Development Mechanism (CDM) adopters, including Masdar, Shams 1 CSP plant, GASCO, various waste recovery and solar projects, and wind farms. Dubai Carbon has programs for developing and supporting future initiatives, in line with Dubai's 2050 Energy Strategy.

REDUCING ENVIRONMENTAL IMPACTS

Identification, management and prevention of releases of hydraulic fluids from SPC systems

Guidelines establish good operational practice in managing anticipated hydraulic fluid use and discharge

Subsea production control systems (SPCSs) operate in harsh and remote conditions. They are managed remotely using hydraulic power. The El's Upstream Environmental Working Group (USEG) commissioned a guidance document to raise awareness amongst subsea engineers and non-specialists across the industry of good operational practice for managing subsea production control systems and associated hydraulic fluid.

How hydraulic fluid is released

Hydraulic fluid is used in SPCSs to transmit hydraulic pressure from topside to operate valves and equipment. Hydraulic fluid is used and discharged from the system as part of normal operations, according to the manufacturer's design. Unintentional or unplanned releases can also occur.

Why it matters

Hydraulic fluids generally have low toxicity, are biodegradable and have non-bioaccumulative characteristics. Consequently, the environmental risk from discharges or releases is low. However, because of the growing age, scale and complexity of these systems there is a potential for an increase in use and discharge of chemicals over time and/ or the potential for a release of chemicals due to unplanned events.

The USEG guidelines

The guidelines establish good operational practice in managing anticipated fluid use and discharge, planning responses in the event of abnormal conditions and minimising releases through design features and operational controls. They also aim to minimise volumes released, with processes for release identification, rectification and root cause analysis aimed at preventing recurrence. System design features and the enhancement of ageing systems are also critical to managing potential releases.

Although the guidelines were prepared for operations at the UK's continental shelf, they can be applied around the world to subsea systems of different types, enabling organisations to anticipate where releases might occur and plan responses.



Beate Hildenbrand, Technical Manager Environment and Health, Energy Institute

Panel Q&A and closing remarks

Questions and answers for the third plenary session speakers

uestions to the panel covered the presentation topics. Mr Al Taie responded with information about CO₂ sources and the use of substitution of machinery to reduce GHG emissions. Ms Hildenbrand provided details of guidelines available for duct systems to valve lines. Dr Simons was asked about developments in nickel removal, and commented that there are seven companies working in the field, mostly with power plants. He said that awareness

of the hazards and opportunities needed to be developed.

The Chair, Mr Khalil, thanked all the speakers for participating and highlighting advancements in the industry and encouraged all the guests to continue in their commitment to developing and enhancing the HSE sector with innovative approaches to problems and opportunities. He concluded by thanking the El for hosting the forum and ENOC for sponsoring and participating in the sessions.



Workshop: Tripod Beta - an introduction to the 21st century root cause analysis tool

Delegates were introduced to accidents, causes and effects, and the way in which Tripod Beta classifies and approaches them



Ken Maddox, Tripod Beta: Practitioner, Trainer and, Assessor, EPEX - Engineering Performance Excellence Limited

en Maddox, the Tripod Beta workshop facilitator and Dr Mark Scanlon MEI, HSE Team Manager, Energy Institute, representing the EI, welcomed the delegates. The purpose of the workshop was to introduce the conference attendees to the Tripod Beta method, give them an opportunity to practice using the method and enable them to share their perceptions and discuss how they could apply Tripod Beta in their own organisations.

The presenters introduced accidents, causes and effects, and the way in which Tripod Beta classifies and approaches them.

The nature of accidents

The subject was introduced using the example of railway accident involving the collision of two trains, the Clapham rail disaster of 1988. The incident had multiple causes, involving operating procedures, managerial failings and technical factors.



©EPEX The nature of accidents: Slide 3 of 31, Clapham Rail Disaster: Photograph of the Incident

How and why accidents occur

Accidents can be explained in terms of a model, consisting of a hazard, a barrier that is breached, and an unwanted event. The context in which unwanted events occur starts with organisational policies and extends to risk management, standards, operational procedures, all designed to put barriers in place. Analysis of cascading factors ends with factors influencing performance and sub-standard acts, those that breach barriers. This context comprises three main components: the HSE management system (policies, instructions and standards), the workplace (employee capability, capacity and resilience) and day-to-day activity (the actions

Workshop: Tripod Beta - an introduction to the 21st century root cause analysis tool



©EPEX The nature of accidents: Slide 2 of 31, Clapham Rail Disaster 1988



©EPEX The nature of accidents: Slide 4 of 31, Details of the Clapham Disaster

that breach barriers). Barriers are implemented successfully when safety critical activity is performed correctly. Barriers are defeated when activity is performed incorrectly.

Personal and process incidents

Incidents can be classified by their causes as personal (those where people are the cause) or process incidents (those where management systems, controls and technologies are the cause). Personal incidents have fewer causes, occur more frequently and can have relatively minor consequences (e.g., thousands of unsafe acts with one or two LTIs or fatalities. Process incidents include the Piper Alpha and Clapham events; they are relatively infrequent but can have devastating results.

Organisations have personal and process incident profiles, reflecting the types and nature of incidents that occur. Because causes are different, the profiles should not be compared or combined.

Progress in tackling incident rates

Incident rates have fallen over the past 40 years as a result of improvements in three areas: technology and standards (engineering controls, hardware and a safety emphasis); HSE management systems, with better reporting, performance monitoring and competence; improvements in culture, leading to shared values, recognition that HSE affects business performance and greater accountability. Currently, the focus is on culture.

The Tripod Beta model

A simple cause-and-effect relationship comprises an agent (a person or thing that introduces a change (an event) in an object (someone or something that could be harmed). Barriers are defined through performance evaluation, risk assessment and hazard analysis and lessons learned.

Tripod Beta looks at events, agents and objects in terms of four factors: underlying causes (UC); preconditions (PC), immediate causes (IC) and failed barriers (FB). The four factors in combination lead to actions by people that breach barriers. UCs can reside in management systems, with PCs as performance influencing factors. The causal relationships can be explained as a "Swiss cheese" model, with the IC as a hole in the barrier, connected to holes in other layers (the

Workshop: Tripod Beta - an introduction to the 21st century root cause analysis tool

UCs and PCs). Most recent major accidents occurred where policies were in place but were not implemented; barriers in the workplace are manifestations of the HSEMS; unsafe acts have multiple causes, and poor controls, if they are not corrected, will allow accidents to recur.

Incident investigation

The Swiss Cheese framework is the basis for the Tripod Beta incident investigation method: Basic Risk Factors (BRFs), Hazards (Unsafe Acts) and Events (Accidents, Incidents and Losses). The aim of incident investigation is to draw a "core trio", using methods such as fault tree analysis.

Investigation starts with the event. The next point of study is the agent. Using Tripod Beta, investigators identify what happened, and who or what was the agent of change. The third step is to clarify the object, then place the three elements in a logical diagram: event, agent and object. Elements can be combined, if necessary, to show more complex relationships (e.g., event-agent or eventobject).

The three elements are placed on a timeline, and the investigator can go as far back in time as is useful. Using diagrams helps to arrange event-agent-object groups in sequence, and the groups can be linked to show cause and effect.

Understanding barriers

Barriers can be hard (physical or technical) or soft (e.g., organisational or behavioural). Barriers serve to prevent, limit, contain or otherwise reduce the likelihood of an event or action by an agent. For example, an engineering control is put in place to eliminate a hazard.



©EPEX The nature of accidents: Slide 15 of 31, Trio from Core Diagram



©EPEX The nature of accidents: Slide 17 of 31, Tripod Beta Diagram

Engineering controls are seen as the most effective barriers, whereas procedures, PPE and safety signs (aimed at containing or controlling) are considered the least effective. Barriers are defined in procedures, policies, engineering standards and management systems. Investigators using Tripod Beta can place barriers into the diagrams to show where a barrier was, or should have been present. Analysis then categorises barriers as effective, failed, inadequate or missing.

How barriers are defeated

This session of the workshop dealt with how barriers are defeated. The starting point is competence (skills, knowledge and attitude), along with the familiarity of the task to the employee and the corresponding level of attention paid to the task. Unsafe acts may be the result of errors, which may be skill-based (e.g., lack of attention) or knowledgebased (e.g., inadequate planning or poor training) or the result of violations.

Preconditions

Tripod Beta analysis looks at the immediate causes of an event before other causes. Immediate causes may be violations or errors, or failures of a barrier. The next step is preconditions – those factors

Workshop: Tripod Beta - an introduction to the 21st century root cause analysis tool



©EPEX The nature of accidents: Slide 19 of 31, The Swiss Cheese Model

that led to, or failed to prevent the immediate causes. Finally, underlying causes are added to the diagram. Preconditions can be classified as follows: the person (including competence), procedures (work methods and controls), parts (equipment and assets), place (the site) and performing authority / line manager. Preconditions can be matched to sub-standard acts (events).

Underlying causes

Underlying causes are the systems and policies or standards in place in the organisation. They indicate whether or not barriers are in place. A Tripod Beta diagram without underlying causes suggests that barriers are probably not in place. Delving into the history of an incident to find underlying causes provides the kind of information needed to institute barriers to recurrence.

Remedial action

After using Tripod Beta to uncover preconditions,

underlying causes and immediate causes, HSE managers can take remedial action. Such action must be documented, people must be accountable, changes communicated and competency needs to be assured. Action has to be followed up and assessed to determine whether it has been effective in creating barriers that will prevent unwanted events.

Critical success factors in using Tripod Beta

Key to Tripod Beta's effectiveness is leadership by management and participation by the workforce. Using the diagrams helps to visualise each element and the chains of causes that need to be documented to achieve a complete understanding of the agents, events, objects and barriers. Participation in the investigation and subsequent analysis by subject matter experts and employees increases the likelihood of accurate findings and thus the strength of corrective action. Tripod Beta's worker / management participation matrix highlights their respective roles and the ways in which lack of participation can result in failure. The ways in which line managers use their authority to empower employees are also an important contributing factor.

Summary

Tripod Beta is a root cause analysis methodology, which can be used in a management system to provide the kind of information necessary to generating effective barriers to unsafe acts and improving safety performance.



Ken Maddox, Tripod Beta Trainer, Engineering Performance



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