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BAYESIAN BASED RISK MODEL FOR ONSHORE DRILLING OPERATIONS

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ABSTRACT

Active monitoring of risks is critical as it provides feedback on barrier performance before the risk results in disastrous impacts such as personnel or asset damage. The current article focuses on presenting an active risk monitoring method which evaluates barriers and transforms the existing Bow-Ties to a Bayesian risk model considering an onshore gas drilling environment. The Bayesian risk model is used to identify the operational risks associated with the major accident hazards for personnel and asset impacts. This article presents a novel approach to transform the Bow-tie to a Bayesian Risk model. The results of this model have been validated and well received by drilling engineers and Safety/ HSE professionals.

KEYWORDS: Bayesian Network, Dynamic Risk Analysis, Safety Barriers, Operational Risk, Major Accident Hazards, Onshore Gas Drilling.

INTRODUCTION

Barrier based model was originally derived from the Swiss cheese model developed by James Reason. The model focused primarily on latent and active failure with focus on more psychological factors.[26] From an industry perspective, Royal Dutch/ Shell group was the pioneer in integrating the bow-tie methodology into its business practices.[25] The method was developed as an assurance tool that ensured fit for purpose risk controls were consistently implemented throughout all their worldwide operations. Meanwhile, regulators recognized the importance of a risk based approach to evaluate major accident hazard risks during the operational stage of an asset lifecycle (POST, 2001). It has been emphasized that active monitoring of risks is critical as it provides feedback on barrier performance before the risk results in disastrous impacts such as personnel or asset damage. It was identified that several reactive risk assessment techniques (Incident investigation) have been developed linking incident investigation to facility risk assessment bow-ties depicting which bow-ties have failed in order to have an accident through a review of various accident pathways (Pitblado et al., 2015).

50% of the major losses are due to incidents in the upstream industry and it is estimated that 33% of world gas fields are contaminated by Hydrogen Sulphide.[27] Recently, the Chongqing blowout in China of an onshore sour gas well helps us to relate to the magnitude of such an event.

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The Chongqing blowout resulted in 243 fatalities, 1242 hospitalizations and over 65000 evacuations. The related economic loss of this event was around USD 10 Million.[15] This is the background for the focus into onshore sour gas drilling.

The current article focuses on presenting an active risk monitoring method which evaluates barriers and transforms the existing Bow-Ties to a Bayesian risk model. The Bayesian risk model is used to identify the operational risks associated with the major accident hazards.

REVIEW OF EXISTING BARRIER BASED RISK ASSESSMENT FRAMEWORKS

In this section, we will appraise several barrier based risk frameworks (qualitative and quantitative) based on review of published literature.

Real time risk management and response were evaluated through transformation of risk management tools to a real time risk management environment.[16] This model followed the typical process safety assurance steps through monitoring of process instrumentation and subsequent surveillance actions are initiated through barrier specific workflows. Trost had used a qualitative barrier categorization technique to be considered while evaluating an accident or potential accident situation. The factors included energy, the target and the existing barriers/ control placed between the energy and the target. The barriers were classified based on type, location and function.[30] Jacinto used a semi-quantitative risk assessment approach to represent occupational risks in the Ship Building industry using bow-ties. The qualitative technique focused on the bow-tie technique and identified the need to breakdown the bow-ties into relevant accident pathways.[14] This approach used the bow-ties to map the events on a one to five scale based risk matrix by experts using actual accident statistics data available for the relevant industry sector. Pitblado has highlighted that human aspects are not effectively captured in risk assessments. The model prescribed integrated the bow-tie model with the Success pathways approach typically used in the nuclear industry. This model focused on human and organizational factors having an overarching influence on technical, administrative and procedural controls. The model was developed under the assumption that barriers degrade over time during operations. Therefore, a real time barrier status was developed using inspection, maintenance, audit and incident investigation methods.[23] The conclusions of the above model were not derived or verified against real data.

Leger had used a safety barriers based approach for risk analysis of socio-technical systems. The proposed methodology was based on system knowledge unification and its structuring to enable quantitative estimation of risks. The proposed approach integrates safety barriers and structural alignment of barriers in the form of Bayesian networks. This approach was limited as its focus was on safety instrumented systems.[20] Barrier and Operational risk analysis method was qualitatively and quantitatively assessed for hydrocarbon release scenarios considering the effect of safety barriers and analysis barrier performance based on the various risk influencing factors. The risk influencing factors included technical, human and operations. The method was verified using a case study approach for an offshore oil and gas production platform.[28]

Lewis had presented the learnings based on the real world application of the Bow-Tie method. The Bow-Tie is used as a visualization tool to present the relationships between the causes, escalation events and safety controls including preventive and recovery preparedness measures. The Bow-tie cannot be used to quantify risk based on the barrier failure and it does not account for inter-dependency of barriers.[21]

Several industry regulations (such as UK COMAH and ADNOC HSEMS) stipulate the requirement to demonstrate the control of hazards by linking the safety controls to elements of the management system [2,12]. In addition, ADNOC guidelines have an associated Code of Practice on Control of Major Accident Hazards (COMAH) that elaborates on the bow-tie methodology to demonstrate the visual depiction of safety controls and its hazards.[4]

Based on the review of risk assessment frameworks, several gaps were identified. There was no linkage identified in any of the risk frameworks between barrier performance and the associated risk impacts. Therefore, risk analysis is static and does not consider barrier performance. This article outlines a method and application of a dynamic risk assessment for major accident hazards which consider the failure of safety barriers.

REVIEW OF EXISTING MAJOR ACCIDENT HAZARD BOW-TIES FOR ONSHORE SOUR GAS (SERVICE) DRILLING OPERATIONS

Sour service refers to a well environment containing significant amounts of Hydrogen Sulfide (H_2S). H_2S is toxic and is considered hazardous to human health, living organisms, and the environment in general. Failures in sour wells are a major concern to Oil & Gas companies due to their consequential effects.[7] In the majority of areas, gas is categorized as sour if H_2S comprises of more than 2.5% of gas contents. The Middle-East region has highly sour fields with H_2S up to 30% in some fields. Canada was one of the earliest discovered sour fields for high H_2S with one of its wells containing up to 90% H_2S. H_2S can be found in oil and/ or gas fields, onshore and offshore, High Pressure High Temperature Fields (HPHT) and conventional fields, etc. H_2S content can keep on increasing during the aging of the asset irrespective of initial composition.

The International Energy Agency (IEA) published in their 2014 medium term gas market report a 1.2% growth in global natural gas demand over the span of 2013. And BP forecasts in their energy outlook an increase in global natural gas demand by an average of 1.9% per year to 2035. With increasing demand of gas worldwide, some highly sour oil and gas reservoirs are being explored, mainly in Russia, the Middle East, China, North America, and are now more and more associated with complex well profiles-such as deep reservoirs or extended reach wells. As time passes, more of the previously uneconomical sour fields will become viable development projects.

Major Accident Hazards (MAH) put personnel, production, capital investment and corporate reputations at risk. The management of MAH risk includes a structured approach to minimize the event likelihood and reducing the consequence of a Major Accident Event.[9]

A review of MAH was conducted for three onshore sour gas drilling operations within the region of the United Arab Emirates (UAE). The review was conducted to compare the various MAH along with the number of threats and consequences identified for each of the drilling operations. The summary of the review is presented in Table 1. (end of the article)

Based on the review, Asset-3 was selected as the asset for further study due to the comprehensive listing of the MAH and the associated safety barriers. The listed information in Table 1 was sourced from the Health, Safety and Environment Impact Assessment (HSEIA) and details were referred in the COMAH Reports. Based on the identified MAHs for Asset-3, only six (out the eleven hazards were related to the core drilling operations. Due to the confidential nature of such reports, it has been kept anonymous and not referenced.

MAH 1 focuses on the Simultaneous Operations (SIMOPS) aspect of the well campaign. SIMOPS typically occur within process facilities when multiple activities (two or more) occur at the same time and place. This may introduce risks that are not identified when each activity is considered in isolation [8,13]. The consequences of this MAH have been subdivided into the affected group; neighboring field personnel (e.g. second drilling rig, construction personnel etc.) and the general public. MAH 2 focuses on the loss of well control whilst operating in the Habshan section (Deeper drilling depths) of the wells. MAH 3 relates to loss of well control whilst drilling the Pilot Hole through the Arab Reservoir. MAH 4 relates to loss of containment whilst performing data acquisition in, and plugging of the Pilot Hole. MAH 5 relates to loss of containment whilst drilling the 8 ½” hole to the landing point in the Arab Reservoir and cementing the 7” Corrosion Resistant Alloy (CRA) Liner. MAH 6 relates to loss of well control while drilling through the Arab reservoir to Total Depth. MAH 7 to MAH 11 have not been analyzed due to their non-applicability to core drilling operations.

RISK MODEL

Based on the review of the Company Risk Analysis report, Bow-Tie analysis has been applied to all major accident hazards to identify and assess the prevention, control, and mitigation measures proposed to manage these hazards and risks. The approach adopted is based on that presented in the ADNOC COMAH Code of Practice.[3] The below sub-sections list the transformation of the Bow-Tie into a Bayesian based dynamic risk model, evaluation of risk using this approach and results of a model validation workshop.

CONVERSION OF BOW-TIES TO BAYESIAN NETWORKS

Initially the drilling major accident hazard bow-ties into potential threat and consequence accident pathways. This approach proposed by Pitblado and Fischer transforms the Full-Bow ties into various incident Bow-Ties.[22] An illustration of the proposed approach is shown in Figure 1 1.

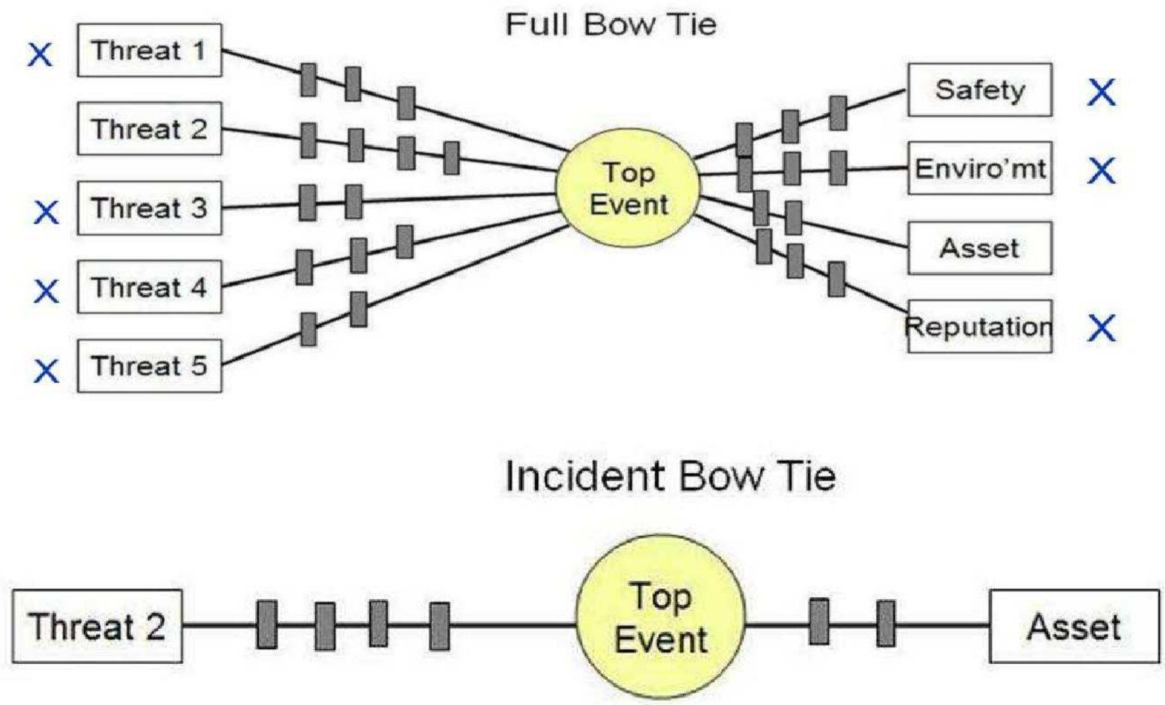

Figure 1.Transformation of Full Bow-Tie to an Incident Bow-Tie

The above approach was modified to meet the purposes of risk calculations. The term 'risk' is according to international standards (such as ISO 2002) a 'combination of the probability or an event and its consequence'. Other standards, like ISO 13702 (ISO 1999), have a similar definition: 'A term which combines the chance that a specified hazardous event will occur and the severity of the consequences of the event'.[31]

An operational expression for practical calculation of risk is the following, which underlines how risk is calculated, by multiplying probability and numerical value of the consequence for each accident sequence i, and summed over all (I) potential accident sequences:

$$R = \sum_{i} (p_i \cdot C_i)$$

where:

- p = probability of accidents
- C= consequence of accidents

Therefore, based on the above definition of risk, it was decided to split the Bow-Tie into Threat and Consequence event pathways respectively. The current article focuses on evaluating risk impacts on personnel and assets. All the Major Accident Hazards related to drilling operations (MAH 1 to MAH 6) are attached as part of Appendix 1.

EVALUATION OF SAFETY BARRIERS PERFORMANCE USING THE FACTORS

Research was conducted to identify safety barrier performance factors for onshore gas drilling operations. The factors included performance, defense, trust, limit, perception, dependency and robustness.[24] The grouped variables under each of the factors are listed below:

a. Factor 1-Performance factor
   - Availability
   - Validity
   - Lagging indicators
   - Effectiveness
   - Barrier test simulation
   - Safety critical tasks

b. Factor 2-Defense factor
   - Adequacy
   - Redundancy
   - Impact of safety critical tasks
   - Survivability

c. Factor 3-Trust factor
   - Reliability
   - Response time
   - Integrity

d. Factor 4-Limit factor
   - Triggering event
   - Capacity
   - Maintainability

e. Factor 5-Perception factor
   - Level of confidence during operations
   - Error promptness
   - Operational complexity
   - Barrier reputation

f. Factor 6-Dependency factor
   - Human dependence
   - Barrier inter-dependence

g. Factor 7-Robustness factor
   - Robustness

Drilling and HSE personnel were required to rate each of the safety barriers using the identified factors. Drilling personnel included two senior drilling engineers who worked in the specific asset. HSE personnel included a Drilling HSE Manager and a Senior HSE staff.

The ratings were carried on a 5 point scale, where 1 relates to Very Low (Highly ineffective) and 5 relates to Very High (Highly effective). A total of 28 threat barriers and 18 Recovery measures were identified. The categorization of barriers is listed in the below table:

Table 2.Categorization of Barriers

Type of Barrier	No. of Barriers on Threat Side	No. of Barriers on Consequence Side
Hardware	15	7
Operating Procedures	10	3
Training	1	1
Design	1	2
Maintenance Management	1	-
Emergency Response Planning	-	4
Communications	-	1
Total	28	18

The summary of the ratings based on the average score is listed as part of Appendix 2. The average scores from all the participants were normalized (Conversion of the rating scale from 1-5 to a normalized scale of 0-1) for usage as input in the Bayesian Networks.

OPERATIONAL RISK EVALUATION THROUGH BAYESIAN NETWORKS

Bow-Ties (BT) has not been recognized as a dynamic analysis technique, since it is composed of static methods such as Fault tree and Event tree.[18] Weber has highlighted the usage of Bayesian networks in reliability, risk and maintenance function due to their ease of use with domain experts. Bayesian networks are particularly suitable for collecting and representing knowledge on uncertain domains. It also enables probabilistic calculus and statistical analyses in an efficient manner.[32] In this stage, the static Bow-Ties are transformed into a dynamic risk model using Bayesian Networks.[5,6,17,19] Bayesian Network (BN) is a graphical technique that has started to be widely applied in the field of risk analysis. BN is composed of nodes, arcs and probability tables to represent a set of random variables and the conditional dependencies among them.[18] The Bayesian network was developed using AgenaRisk Version 6.0 software. This software has been in use from 2005 and is widely used in defense, transport, banking, telecommunications and safety engineering companies which owned safety critical systems and for which quantitative risk assessment was required.[10]

The drilling Bow-Ties were transformed into a dynamic Bayesian network as shown in Figure 2, Figure 3, Figure 4, and Figure 5.

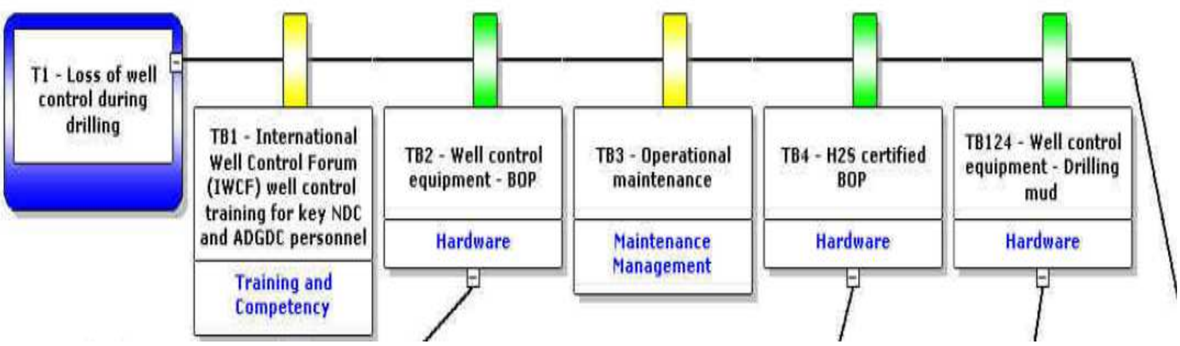

Figure 2.Static Bow-Tie for a Threat in the Drilling Bow-Tie

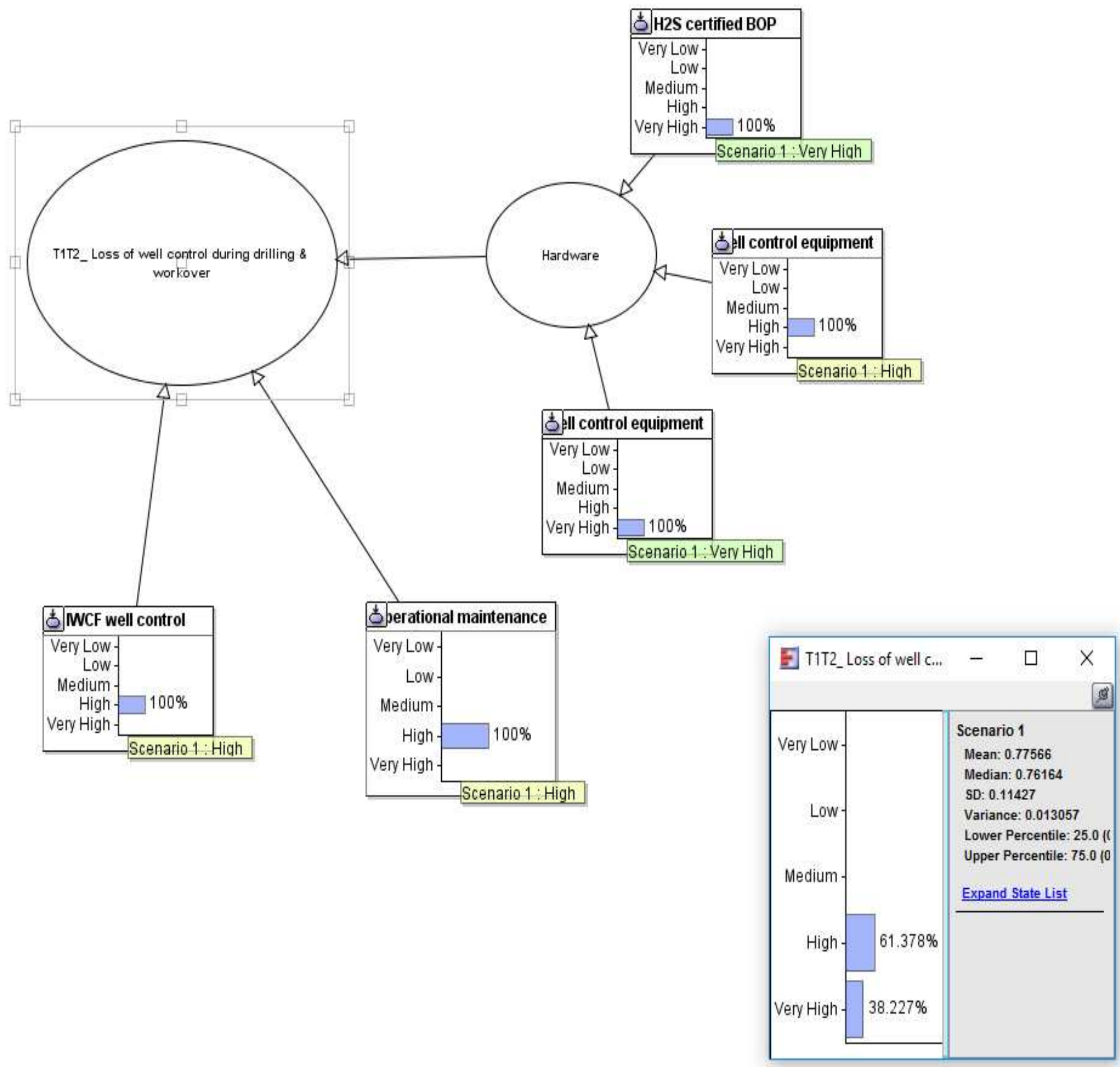

Figure 3.Transformed Bayesian Network-Threat line

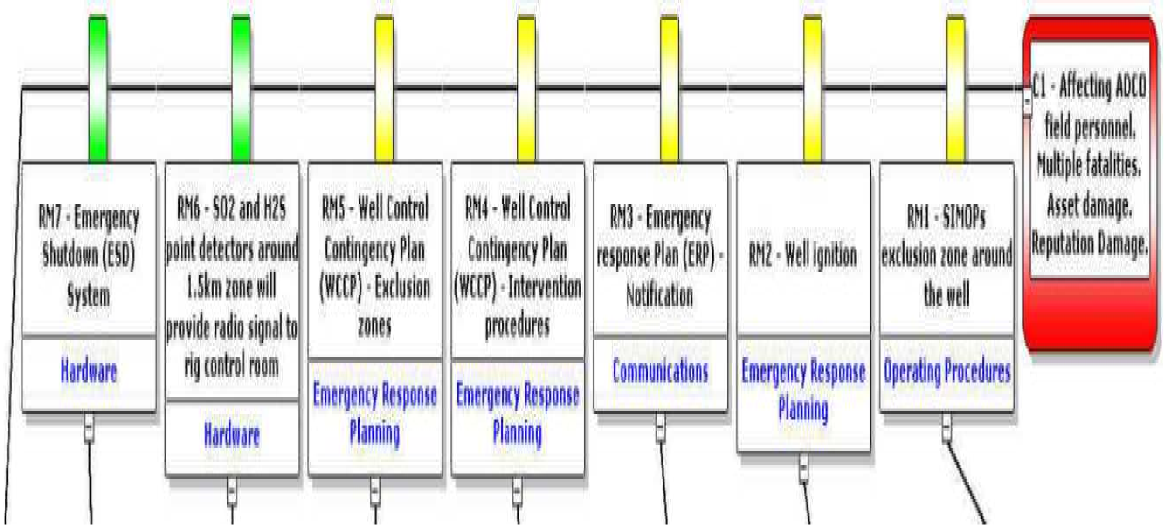

Figure 4.Static Bow-Tie for a Consequence in the Drilling Bow-Tie

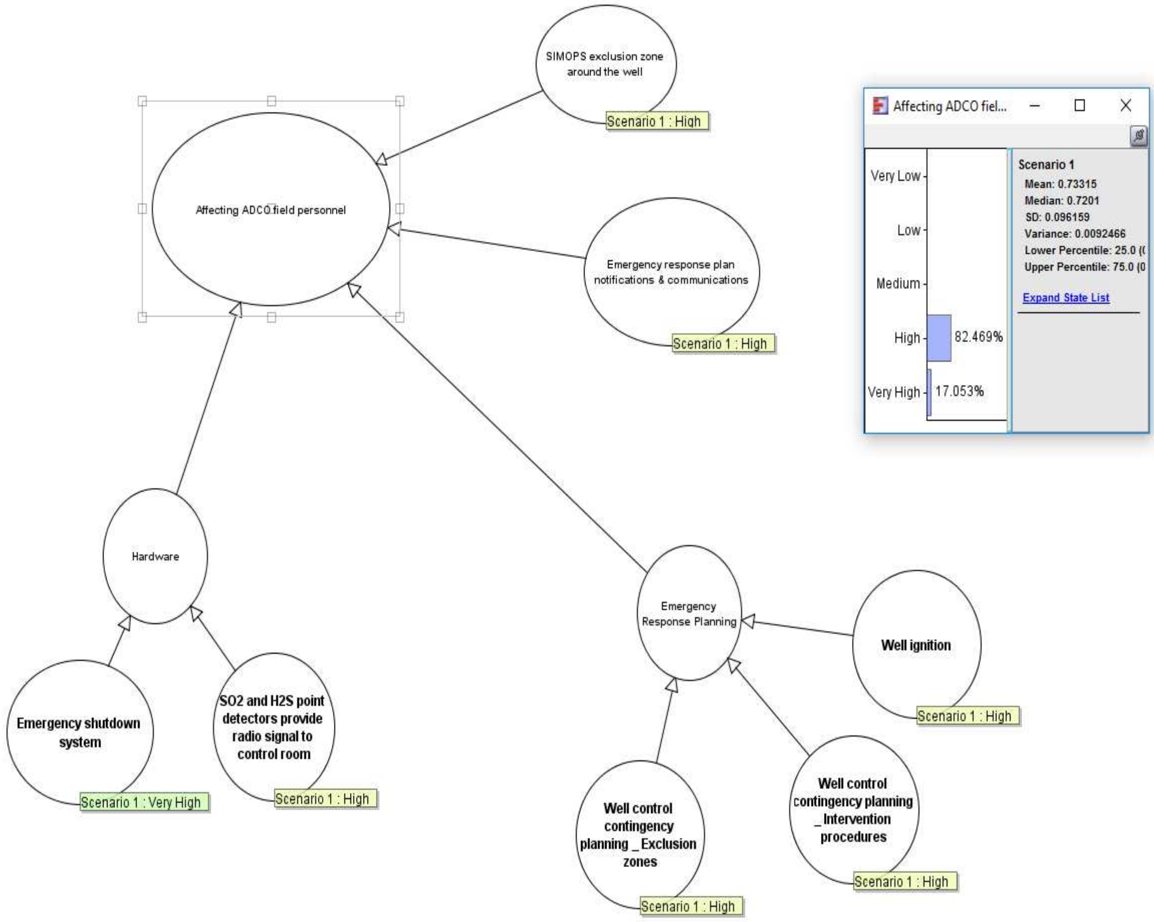

Figure 5.Transformed Bayesian Network-Consequence line

Each of the safety barriers were modeled using the ranked nodes. Ranked nodes represent discrete variables whose states are expressed on an ordinal scale that can be mapped onto a bounded numerical scale that is continuous and monotonically ordered.[11] Ranked nodes have been defined on an underlying unit interval [0-1] scale. A five point scale such as {very low, low, average, high, very high}, is chosen to model the individual safety barriers in the Bayesian network. The interval width for each state is 0.2. Thus, “very low” is associated with the interval [0-0.2), “low” is associated with the interval [0.2-0.4), and so forth. Ranked nodes enable the BN construction and editing task much simpler than is otherwise possible. Through this method, each of the threats and consequences were transformed into a dynamic Bayesian network diagram.

Threat barriers and Consequence barriers were evaluated using the constructed Bayesian networks-an overall barrier performance is thereby evaluated for each threat and consequence associated with a MAH is presented in Table 3 (end of the article). Inherent risk is evaluated as a criteria for MAH identification considering “NO” safety barriers. Mitigated risk is ranked considering Safety barriers are perfectly functional (100%). Inherent and mitigated risk were ranked using ADNOC 5 X 5 Semi-quantitative risk matrix (ADNOC, 2014).

Typically, these rankings are usually agreed in a HAZID Risk Ranking workshop. Meanwhile, Risk control is built on the reduction of the frequency of occurrence of the major dangerous phenomena taking into account the safety barriers performance, so that the dangerous phenomena are defined with an acceptable couple, i.e. gravity-frequency of occurrence. In reality, the actual risk exposure should be directly correlated with Safety barriers performance.

Based on the results listed in Table 3, it is identified that the actual operational risk is between 3C and 3D in terms of the ADNOC risk matrix. Inherent Risk (IR), Mitigated Risk (MR) and the calculated Actual Risk (AR) have been mapped in the ADNOC Risk matrix for personnel in Figure 6. It is observed that the Actual Risk (AR) is very close to the High Risk region and the risk is in the higher ALARP+ region in comparison to the Mitigated Risk (MR). The medium Risk region is considered to be acceptable but must be managed by ALARP. Reducing risks to ALARP means reducing them to a level at which the cost and effort of further risk reduction is grossly disproportionate to the risk reduction achieved.[3] The inference from these results would prompt the organizations to focus on enhancing the performance of the safety barriers to reduce the risk to lower ALARP levels.

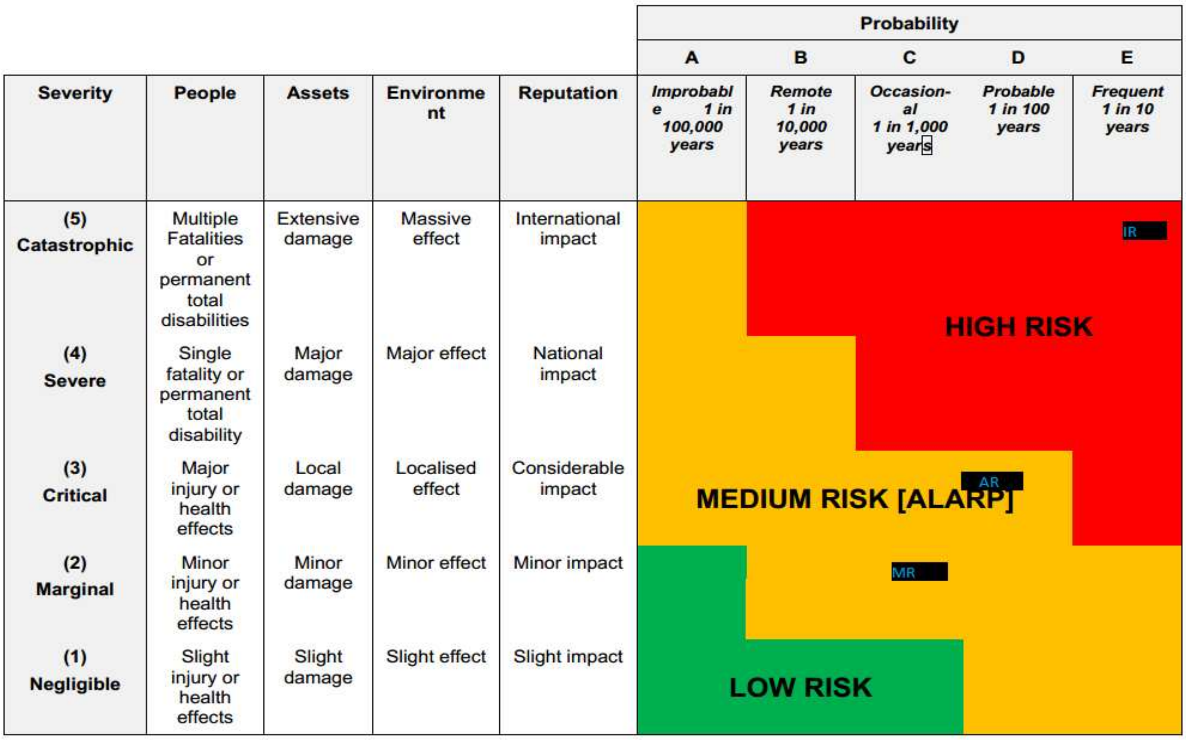

Figure 6.Mapping of IR, MR and AR in ADNOC's semi-quantitative risk matrix

Meanwhile, for the Asset related MAH which was identified only for MAH 1, the actual risk (AR) is 2A which can be around the lower ALARP region. Therefore, comparing the Personnel and Asset Risk, the Actual risk exposure of Personnel risk is slightly higher.

MODEL FEEDBACK & VALIDATION

The barrier based risk model & results were validated through a workshop consisting of mixed group comprising of HSE Manager, Process Safety Engineers, Senior Drilling Engineers, Senior Well Integrity and Regulators (Safety Department Manager). A total of nine members participated in the workshop conducted in December 2016.

The model development approach and the results were presented to the audience, followed by a question and answer session for further clarification. A five-point scaling technique was used through a structured questionnaire. In the five-point scale, 1 represents the worst and 5 represents the best situation, meaning the degree of the validity of the model varies from 1 to 5

+ALARP – As Low As Reasonably Practicable

The parameters included were overall conceptual framework (Barrier performance factors), relevance of data, models/ techniques, interpretation of risk and overall applied value of the risk model.[1]

The summary of the scores and the average scores for each of the parameters are listed in Table 4.

Table 4.Summary of Scores-Model Feedback and Validation Workshop

Member	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**		**9**	**Average Score**
Overall Conceptual framework - Barrier Performance Factors	5	5	5	5	5	5	5	4		5	**4.89**
Relevance of Data	4	4	5	5	5	4	4	4		4	**4.33**
Models and Techniques	5	5	5	5	5	5	4	5		5	**4.89**
Interpretation of Results	5	4	5	5	5	3	5	4		5	**4.56**
Overall applied value of the Risk model	5	4	5	5	5	4	4	5		5	**4.67**

Based on the scores listed, the respondents have given a score of 4.89 to overall conceptual framework and models/ techniques, 4.67 to overall applied value of the risk model, 4.56 to the interpretation of the results and 4.33 to the relevance of the data. The average of all the components was 4.67 which means that the model is highly reliable. In conclusion, the respondents found value for the model application in real life.

Apart from the ratings, the respondents gave positive comments in the feedback form. Excerpts from the forms are given below:

- Use of Bayesian Network and combination of Bowtie is a very excellent idea & its self-learning ability will maintain a dynamic overview of Barrier Risk Management.
- Excellent presentation. Clearly a deep understanding of the topic. The presentation was well received.
- Very good project and good research.

CONCLUSION AND RECOMMENDATIONS

This article has presented a novel approach to transform the Bow-tie to a Bayesian Risk model. Through the use of the Safety barrier evaluation factors, a subjective rating was assigned to the individual barriers and the scores were used as an input for the Bayesian model. The Dynamic Bayesian Risk model can be used to evaluate the operational risk of the drilling major accident hazards. Through this model, it was identified that the personnel risk during drilling operations was found to be higher in comparison to the asset risk. The results of this model could assist the drilling operators to prioritize their efforts on safety barriers performance which could have a positive effect in reducing the operational risk to personnel. The model was validated through a workshop and the approach along with the results was presented to a multi-disciplinary group. The model and the results were well received by the group with an average rating of 4.67 out of 5 for all the parameters. Future work could be carried out in the areas of benchmarking safety barriers performance across various asset locations and safety barrier performance optimization to manage the operational risk in an effective manner. Further, this model could be extrapolated to other disciplines such as Environment and Enterprise wide Risks.

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Table 1.Review of Major Accident Hazards-3 onshore gas drilling assets

Asset	MAH Number	MAH Description	Risk Classification Category	Applicability to Drilling Operations	No. of Threats	No. of Consequences
Asset-A	1	Loss of containment during site preparation	People	No		
	2	Loss of sub-structure stability during 26 inch hole drilling	Asset	Yes	2	1
	3	Loss of containment during 16 inch hole drilling	Asset	Yes	1	1
	4	Loss of containment during 12.25 inch and 8.5 inch hole drilling	People	Yes	4	1
	5	Loss of well bore integrity during 12.25 inch and 8.5 inch hole drilling	People, Asset	Yes	2	2
Asset-B	1	Loss of containment during Onshore well drilling	People, Asset	Yes	4	5
		- During casing		Yes		
		- During wireline logging		Yes		
		- During drilling		Yes		
		- Retrieving core to the surface (logging)		No		
Asset-C	1	Loss of containment during well operations - During drilling activities - During work over - During well testing Resulting in multiple fatalities onsite and offsite and asset damage	People, Asset	Yes	3	2
	2	Loss of containment (Blowout scenario) - During drilling through Habshan Reservoir - While running 9 5/8" x 10 3/4" casing	People	Yes	2	2
	3	Loss of containment (Blowout scenario) - During drilling 8 1/2" Pilot Hole through Arab Reservoir	People	Yes	1	3
	4	Loss of containment - Formation fluid influx (kick) during coring - Induced well control while retrieving core to the surface - Unstable well conditions from pumping HC's into	People	Yes	3	3

Asset	MAH Number	MAH Description	Risk Classification Category	Applicability to Drilling Operations	No. of Threats	No. of Consequences
		the well bore while logging on the drill pipe				
	5	Loss of containment (kick and well flow) during - Drilling 8 1/2" hole through Arab reservoir - Well flow while running 7" casing - Running 7" CRA liner	People	Yes	3	3
	6	Loss of containment (kick) during - Drilling 6" hole through Arab reservoir	People	Yes	1	3
	7	Loss of containment (kick) during - While running 7" CRA Production tubing - While installing XMT - While nippling down BOP and nippling up XMT	People	No	3	3
	8	Loss of containment - Equipment failure in riser while coil tubing within hole - Down hole conditions leading to stuck well tools in the tubing	People	No	2	3
	9	Loss of containment - Human Error while stimulating the well	People	No	1	3
	10	Loss of containment during Well operations (surface related issues) - Erosion - Corrosion - Vibration - Hydrate formation - Overpressure in the downstream of choke manifold - Improper operation of 3 phase separator - PAGE 692	People	No	11	3
	11	Loss of containment during flaring	People	No	1	3

Table 3.Summary of Barrier Effectiveness-Threat and Consequence

Asset	MAH number	MAH description	Risk Classification category	Applicability to Drilling operations	Inherent Threat (without barriers)	Mitigated Threat (with barriers)	Actual Threat barriers effectiveness (%)	Actual Threat (considering barriers effectiveness)	Inherent Consequence (without barriers)		Mitigated Consequence (with barriers)		Actual Consequence barriers effectiveness (%)		Actual consequence (considering barriers	
									P	A	P	A	P	A	P	A
S	1	Loss of containment during well operations - During drilling activities Resulting in multiple fatalities onsite and offsite and asset damage - affecting offsite personnel - affecting onsite personnel - affecting public	People, Asset	Yes	E	C	78%	Between C & D	5	5	2	1	75% (offsite field personnel) 70% (on site field personnel) 75% (General public)	75% (offsite field personnel) 0% (on site field personnel) 75% (General public)	3	2
	2	Loss of containment (Blowout	People	Yes	E	C	78%	Between C & D	5		2		70% (toxic) 70% (fire) 70%		3	

		scenario) - Formation fluid influx into well bore - during drilling through Habshan Reservoir - while running 9 5/8" x 10 3/4" casing resulting in major toxic release, fire and explosion											(explosion)			
	3	Loss of containment (Blowout scenario) - during drilling 8 1/2" Pilot Hole through Arab Reservoir resulting in major toxic release, fire and explosion	People	Yes	E	C	78%	Between C & D	5		2		70% (toxic) 70% (fire) 70% (explosion)		3	
	4	Loss of containment - Formation	People	Yes	E	C	78% (Coring) 68%	Between C & D	5		2		70% (toxic) 70% (fire) 70%		3	

		fluid influx (kick) during coring - Induced well control while retrieving core to the surface - Unstable well conditions from pumping HC's into the well bore while logging on the drill pipe - Plug failure while plugging pilot hole resulting in major toxic release, fire and explosion					(Induced well control) 70% (while logging) 68% (plugging pilot hole)						(explosion)			
	5	Loss of containment (kick and well flow) during - Drilling 8 1/2" hole through Arab reservoir - Well flow while running 7" casing	People	Yes	E	C	78% (Drilling) 76% (Casing) 78%(CRA Liner)	Between C & D	5		2		70% (toxic) 70% (fire) 70% (explosion)		3	

		- Running 7" CRA liner resulting in major toxic release, fire and explosion														
	6	Loss of containment (kick) during - Drilling 6" hole through Arab reservoir resulting in major toxic release, fire and explosion	People	Yes	E	C	78%	Between C & D	5		2		70% (toxic) 70% (fire) 70% (explosion)		3	

