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Exploring Safe Behavioural Potentials of Local Oil & Gas Construction Workers: From the Perspectives of Human Failure Types

Hon-Kuan Lai[1], Nor Mariah Adam[2], Mohamad Ibrani Shahrimin Adam Assim[3], Nurul Hidayu Mat Jusoh[4] and Omar Faruqi Marzuki[5]

[1,3,4]Department of Social Science and Management, Faculty of Humanities, Management and Science, Universiti Putra Malaysia Bintulu Campus Sarawak, [2,5]Department of Science and Technology, Faculty of Humanities, Management and Science, Universiti Putra Malaysia Bintulu Campus Sarawak

Corresponding Auhtor's Email: laihk71@gmail.com

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Abstract

A large body of research shows that human failures, the tendencies of which are expressed as safe behavioral potential in this study, are the main culprit of industrial accidents in oil and gas sectors, the antecedents of which might be the combinations or interactions of demographic and psychometric attributes of workers, and organizational safety culture. The purpose of study is to explore workers' profile of safe behavioural potentials, and its corresponding remedies, from the perspective of human failure types that could be classified into human errors (unintentional actions) and violations (intentional actions). Human errors can be further categorized into slips, lapses, rule-based mistakes, knowledge-based mistakes; while violations consist of exceptional violations, situational violations, optimizing violations, and routine violations. Broadly speaking, local oil and gas construction industry is dominated by male workers. Result of demographic indicates most workers are aged above 25-year-old with presumably adequate safety knowledge and experience, probably that is the reason why majority of the workers showed the propensity to behave safely at work by agreeing to statements advocating committing fewer human failures. However, result also revealed of human failures simply could not be ignored because 5.0% - 34.2% respondents revealed their tendencies towards committing violations, and 6.5% - 13.1% of them indicated their proneness to human errors. Therefore, interventions to curb human failures are still of utmost importance. This study contributes to theoretical domains and practical applications

in two ways, firstly, this study lays the foundation for future studies to explore distal and proximal determinants of a human failure with significant accident risks, skill and knowledge required to perform such behavior, its environmental constraints, and their relative importance in forming that failure. Secondly, it may also inspire the development of predictive and prescriptive tools for accident preventions, taking advantage of rapid advancement in Artificial Intelligence and Big Data technologies.

Keywords: Safe Behavioural Potentials, Local Oil & Gas Construction, Human Failure Types

Introduction

In 2019, Malaysia was the 5th largest Liquefied Natural Gas (LNG) exporter with annual output of 26.2 million tones with approximate world market share of 7% (IGU, 2020; Fadilla, 2020). Value of LNG export stood at RM43.5 billion in 2019, increased from RM42 billion in 2018 (Borneo Post, 2020). In addition to LNG, Malaysia is also a net crude oil producer with a daily production of approximately 560,000 barrels per day (Muhamad, 2022). BMCC (2018) propounds that Malaysia's Oil and Gas sector plays an integral role in Malaysia's economy, accounting for approximately 20% of Malaysia's national Gross Domestic Product (GDP). In 2017, with an average annual growth of 7.3 per cent, crude petroleum and natural gas extraction sector was the largest contributor of gross output value at RM125.8 billion (90.8%) with a total value of RM138.6 billion, while support activities for petroleum and natural gas extraction sector accounted for another RM12.8 billion (9.2%). A total of 36,776 workers were engaged by the sector with salaries and wages paid at RM6.9 billion, of which 49.3% was employed by supporting activities (HRDF, 2019).

Problem Statement

Sarawak's oil and gas sector has some noteworthy industrial accidents in the past. Most notably, Laeng & Kiew (2022) cited that a worker was killed together while three others injured to various extent in a fire and explosion at a local gas pipeline project. Remarkably, there were four other accidents at this project in the past, specifically, an explosion between Lawas and Long Sukang in 2014; a gas leak followed by an explosion in 2018, that led to an emergency evacuation of students from an affected school; a gas leak at Long Segaman in Lawas in 2019; and an explosion between Long Kawa and Ba Selulong in Ulu Baram in 2020. Although the outcomes of investigations are largely unavailable in public domains, however Mariana et al (2018) argued that many accidents in oil and gas sectors are essentially caused by human-related failures. This argument is also substantiated by findings of Health and Safety Executive of United Kingdoms (HSE), in which approximately 80% of accidents may be accredited, at least partially, to misjudgments or actions of people as human influence is significant throughout the lifecycle of a project, from design to operation, maintenance, management and demolition of facility in question (HSE, 1999). The purpose of study is to explore workers' profile of safe behavioural potentials from the perspective of human failure types that could be classified into human errors (unintentional actions) and violations (intentional actions).

Literature Review

Reason (2016) explained that organizational accidents occur when latent conditions as such accumulation of delayed-cation failures or fallible decisions mainly by management and critical decision-makers, interact with active failures i.e., errors and violations by frontline workers and local triggering factors for instance high workload, time pressures, inadequate

skills and experience, and poor equipment. In addition to penetrate or bypass system defenses by engineered process safeguarding, automated process control and monitoring systems, rules, procedures, management systems, etc. Latent conditions typically transmit along organizational and departmental pathway to various local workplaces, manifesting themselves as conditions that encourage errors and violations such as local triggering factors. At personal level, these conditions in conjunction with psychological errors and violations tendencies to create unsafe acts like unsafe behavior and non-compliance which threaten to defeat defense. Moreover, the safeguards to give rise to undesirable outcomes like accidents, near misses, unsafe conditions.

Therefore, the unsafe behavior can be categorized into errors and violations. In that sense, Voon & Ariff (2019) defined human errors as unintended action or decision which involves deviations from established standards, and which results in undesirable consequences. On the contrary, violations is defined as any intentional or deliberate deviation from safety and health related rule and procedure which is primary cause work-related accidents. Human errors could be further characterized as slips, lapses, and rule-based mistakes and knowledge-mistakes (Reason, 2016). Slips are observable actions associated with attentional and perceptual failure such as absent-minded arise from inattention, whereas lapses involve failure of memory as forgetfulness in performing an intended action.

Rule-based mistake is linked to application of wrong rule when dealing with familiar condition, while knowledge-based mistake often occurs when one is running out of prepackaged solutions and being forced to formulate haphazard solutions in a hurry to tackle novel and often complicated circumstances. Reason (2008) also categorized violations into four main subcategories, namely routine violations, optimizing violations, situational violations, and exceptional violations. Routine violations involve cutting corners promoted by ineffective procedures and indifferent work environment, in other words, one neither gets punished for violations nor rewarded for compliance. Optimizing violations are synonymous with thrill-seeking violations to get rid of boredom or for instinctive indulgence. Situational violations are variations provoked by regulatory or systematic over-specifications of permitted actions that lead to circumstances, for which violations offer feasible, or probably the only solution to a problem. Exceptional violations take place in atypical or novel circumstances for which any prepackaged solutions is unlikely to be available, therefore one falsely believes that the benefits of improvised action example given as violations outweigh the consequential risks.

Methodology

Design of measurement instrument

Research questionnaire was developed upon reviewing relevant literature, content validation by subject matter experts (SME) and pilot study to ascertain its validity and reliability (see the table 1). The questionnaire consists of 24 statements segregated into 2 sections: Part A - Workers' personal characteristics (demographic information), and Part B – safe behavior potentials. Part A is constituted by 12 demographic and personal experience related statements (APD1-APD12). Whereas Part B accumulates evidence in connection with workers' potential to commit human failures at worksite through 12 statements in 2 subcomponents (ABV1-ABV6; ABM1-ABM6), it is constituted by statements with five-Likert type scale response options (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree).

Table 1
Validity, reliability, and communality of initial constructs of pilot study

Construct Name	Question Coding	KMO	Sig.	Communality	Removed Items	Remark
Workers' personal Characteristic	PS1 – PS13	0.517	0.000	0.314 – 0.898	PS6 (0.314)	
Workers' safety compliance potential	V1 – V10	0.845	0.000	0.344 – 0.813	V3 (0.593); V6 (0.344)	
Agreeableness	PA1 – PA9	0.566	0.000	0.376 – 0.821	PA2 (0.493); PA4 (0.480); PA9 (0.376)	
Conscientiousness	PC1 – PC9	0.708	0.000	0.448 – 0.772	PC6 (0.558); PC7 (0.448)	
Company top management's safety and health commitment	TMC1 - TMC10	0.815	0.000	0.586 – 0.838	TMC5 (0.586); TMC10 (0.595)	
Site manager's safety and health commitment	SMC1 - SMC10	0.793	0.000	0.591 – 0.879	SMC8 (0.591); SMC10 (0.592)	
Emergency response	ER1 – ER7	0.861	0.000	0.253 – 0.840	ER1 (0.253); ER5 (0.525)	
Perceived risks	PR1 – PR9	0.720	0.000	0.522 – 0.885	PR7 (0.535); PR8 (0.522)	
Violations	BPV1 – BPV8	0.697	0.000	0.146 – 0.827	BPV4 (0.146); BPV5 (0.549)	*BPV3 (0.496)
Lapses, Slips and Mistakes	LSM1 – LSM8	0.763	0.000	0.545 – 0.822	LSM4 (0.572); LSM6 (0.545)	*LSM5 (0.597)

*** Note:** Communality <0.6 but yet is retained, with valid dispensation, due to risk of non-representation in future research.

Cronbach Alpha of overall research framework is 0.926 to indicate internal consistency or reliability (>0.7)

Procedure to Take Sample

The respondents were 565 construction workers (including site supervisory and administration personnel) aged 18 years old or above at that material time, from various trades and designations, employed by local onshore oil and gas main contractors and service providers. Hardcopy questionnaires, available in both English and Bahasa Malaysia versions, were delivered to focal person of each cluster, namely 2 main project management and construction contractors; a blasting and painting provider; a scaffolding provider; and a heavy lifting and transporting service provider. The entire survey at sites was administered, but not guided, by author or focal persons. Worker's anonymity and discretion were strictly upheld to ensure impartiality with minimum biases. Acknowledgement of written consent from respondents had been obtained prior to their participation during briefing sessions.

Data Analysis

The descriptive statistic of this study was performed utilizing Statistical Package for the Social Sciences (SPSS) software, Version 23.

Results and Discussions

Demographic of Construction Workers

From Table 1, most of construction workers in this study were presumably at the early stages of their career in construction industry, of which 10.1%, 32.0% and 27.8% aged 18 to 24, 25 to 31 and 32 to 38 respectively. However, it is noteworthy that 13.3% were above 46. This cohort was found to be predominately male, contributing to 78.4% of the respondents. About 55.9% of the respondents were married with at least one child while 28.7% were single. Result indicated 39.8% and 28.3% of the workers had 1 to 2 and 3 to 4 family members to support. Interestingly, 10.3% revealed that they supported 5 to 6 family members, and 3.4% had 7 or more. Increased numbers of family members require support often means additional financial responsibility to the respondents (Baeriswyl et al., 2022).

As far as income is concerned, 28.1% of the workers were employed by subcontractors on daily pay, and 26.0% were monthly paid hired by main contractors. The rest were monthly paid workers engaged either by main contractors or subcontractors under employment contracts, and as permanent staffs of main contractors. Daily paid workers were those who were exposed to financial vulnerability in the light of their unstable income might not be able to make ends meet as postulated by To et al. (2020) where workers' financial well-being influences work satisfaction through family financial well-being. Substantial numbers of workers were relatively inexperienced, which 36.1% of respondents had 5 years or less experience in Oil & Gas industry. Therefore, they might be unconsciously exposed to latent hazards at worksites that were left unaddressed or inadequately assessed. In addition to that, 33.8% and 18.2% declared they have 6 to 10 and 11 to 15 years of experience.

Generally, the workers lived a relatively healthy lifestyle, of which 43.7% and 40.5% identified themselves as non-smoker and non-drinking respectively, in contrast to 23.2% and 35.2% as occasional smoker (1-5 sticks of cigarette a day) and drinker. However, a minor portion of these workers were self-confessed heavy smokers (3.5%) and drinkers (1.1%). Majority of the workers were moderately educated, of which 52.9% of the respondent received secondary education, whereas another 25.1% possessed vocational qualification at certificate, and diploma level. Therefore, it is safe to presume that workers were usually able to comprehend OSH requirements (i.e., higher safety literacy) in Oil & Gas construction as they are usually written in plain languages hence better safety performance (Saleh & Pendley, 2012).

It is interesting to observe that 73.5% of respondents indicated they experienced between 1 to 3 times occupational injuries, illnesses or environmental pollutions through observation of others or by own encounter. However, 22.5% revealed that they had experienced the same predicaments at a higher frequency, such as 4 to 6 times. In a similar fashion, 2.8% and 1.2 % had a staggering encounter of 7 to 9 and 10-12 times respectively. Although 77.7% of the respondent said they were rarely experiencing violations in HSE procedures, amounting to between 1 and 3 times. However, a significant portion of these respondents registered much higher frequency of committing violations: 18.4% at 4 to 6 times; 3% at 7-9 times; and 0.7% and 0.2% at 10 to 12 times and more than 12 times respectively. That is a clear indication that interventions are required to address violations of different forms. Vast majority of the workers possessed adequate level of HSE knowledge and experience, in which 46.0% of respondents identified themselves having basic HSE knowledge through internal safety induction, 38.1% acquired working knowledge through NIOSH approved courses, 8.3% had actual HSE experience by involving in Job Hazard Analysis (JHA)

and Risk Assessment. Nevertheless, 7.4% indicated they had no OSH knowledge and experience which necessitates further analysis and interventions.

Table 2
Demographic of workers (n=565)

Parameters	Scales	Frequency	Percentage	Mean	Mode	Std Dev
Age	18-24	57	10.1	2.91	2	1.191
	25-31	181	32.0			
	32-38	157	27.8			
	39-45	95	16.8			
	46 & above	75	13.3			
Gender	Male	443	78.4	1.22	1	0.412
	Female	122	21.6			
Marital status	Single	162	28.7	2.27	3	0.880
	Married with no child	86	15.2			
	Married with child / Children	317	56.1			
No of family members to be supported	None	103	18.2	2.41	2	1.007
	1-2	225	39.8			
	3-4	160	28.3			
	5-6	58	10.3			
	7 and above	19	3.4			
Status of employment	Subcon daily paid	159	28.1	279	3	1.427
	Subcon monthly paid under contract	94	16.6			
	Subcon permanent staff	91	16.1			
	Main con monthly paid under contract	147	26.0			
	Main con permanent staff	74	13.1			

Parameters	Scales	Frequency	Percentage	Mean	Mode	Std Dev
Duration working in oil & gas industry	5 years or less	204	36.1	2.10	1	1.102
	6-10 years	191	33.8			
	11-15 years	103	18.2			
	16-20 years	44	7.8			
	>20 years	23	4.1			
Smoking habit (cigarette)	Nonsmoker	247	43.7	2.08	1	1.176
	1-5 sticks a day	131	23.2			
	6-10 sticks a day	104	18.4			
	11-15sticks a day	63	11.2			
	16-20 sticks a day or more	20	3.5			
Drinking habit (alcohol)	Nondrinker	229	40.5	1.87	1	0.875
	Occasional drinker	199	35.2			
	Regular drinker (Weekends drinker)	122	21.6			
	Very frequent drinker (Daily drinker)	9	1.6			
	Heavy drinker	6	1.1			
Education level	Below primary	35	6.2	3.09	3	0.878
	Primary	66	11.7			
	Secondary	299	52.9			
	Vocational certificate / certificate /diploma	142	25.1			
	Degree or higher	23	4.1			

Parameters	Scales	Frequency	Percentage	Mean	Mode	Std Dev
Experience in occupational injuries,	1-3 times	415	73.5	1.32	1	0.590
	4-6 times	127	22.5			
	7-9 times	16	2.8			

Parameters	Scales	Frequency	Percentage	Mean	Mode	Std Dev
illnesses, and pollution at worksite through observation of others or by own encounter	10-12 times	7	1.2			
	>12 times	0	0			
Experience in rule violation	1-3 times	439	77.7	1.27	1	0.568
	4-6 times	104	18.4			
	7-9 times	17	3.0			
	10-12 times	4	0.7			
	>12 times	1	0.2			
Knowledge and experience in safety and health	No knowledge & experience	42	7.4	2.48	2	0.759
	Basic HSE knowledge from internal safety inductions	260	46.0			
	HSE knowledge from inductions & NIOSH approved courses	215	38.1			
	Experience as safety / work supervisor, involving in JHA & risk assessment	47	8.3			
	Expert in HSE management	1	0.2			

Safe Behavioral Potentials

Optimizing Violations

Referring to table 2, in ABV1, approximately 68.7% of respondents revealed they or people around them would not take shortcuts to complete work faster just for personal glory, in which 28.7% strongly agreed to the statement with another 40.0% expressed their agreement to a lesser extent. Notwithstanding, 12.9% of respondents opined that such thrill-seeking optimizing violations could actually occur at worksites. It is recommended target-specific interventions should be contemplated such as selection of workers base on their profile safety behavioral potentials, inculcating the importance of safe teamwork instead of personal thrill-

seeking behavior, and befitting disciplinary actions to regular offenders (Zaira & Hadikusumo, 2017; Ramos et al., 2021).

In ABV2, roughly 62.0% of respondents revealed they or people around them do not expect anyone to rush their schedule for bonuses and incentives, in which 28.7% strongly agreed to the statements with another 40.0% expressed their agreement to lesser extent. Notwithstanding, 17.5% of respondents stated that someone could have taken unwarranted violations due to bonuses and incentives in the expense of OSH. It is essential to establish site OSH management system that strikes a balance between monetary rewards and OSH compliance in order to prevent over-zealous workers taking unwarranted violations at worksites for monetary gains, in addition to the development of a more feasible and logical work schedule planning to devoid the necessity of violations as Buniya et al. (2021) opined that tight project schedule adds more pressure and stress, which often leads to health and safety issues.

Exceptional Violations

ABV3 indicates 53.1% of the respondents would not attempt to rescue someone who were supposedly being trapped in confined space without proper tools and skill to do so. Unfortunately, a substantial no of workers (34.2%) has different opinion, revealing the willingness to rescue even without adequate gears, largely due to being overcome by overwhelming emotion. Deployment of new technology (e.g. drones, robots, work automation etc.) at high-risk work environment instead of human-being should eradicate the need to over-expose workers to unacceptable occupational risk that may lead to accidents Nnaji & Karakhan (2020), followed by flawed rescue operations.

Situational Violations

As shown in ABV4, 73.5% of the respondents claimed that they would not take shortcuts due to unrealistic production goals. Nevertheless, there was approximately 8% of workers expected themselves or the others to violate rules even if it was caused by unrealistic production goals. Situational violations in construction are typically associated to poor work planning where unavailability of equipment and manpower, illogical work sequence, and ad-hoc or even conflicting activities become unavoidable. Consequently, a realistic schedule planning and thorough Constructability Review (CR) might be an answer to the crux of these violations as Shash & Almufadhi (2021) postulated that CR yields great benefits to project in term of reducing engineering and construction cost, shorten project schedule durations, and improvement in safety performance.

Routine Violations

In ABV5, approximately 81.0% of respondents claimed that they would not take shortcuts just to conform to the norm at workplace, in which 28.0% showed their strongly approval to the statement with another 49.9% expressed their agreement to a lesser degree. Nevertheless, 5.0% of respondents opined that they might adapt to prevailing work culture. ABV6 disclosed that roughly 76.7% of respondents admitted that they would not expedite work unduly even if there was little chance to get caught, in which 28.7% strongly agreed to the statement with another 48.0% expressed their support albeit in lighter tone. Anyhow, 9.0% of respondents stated that they might acclimatize to suit the prevailing norms even it means violating existing OSH rules.

Routine violations in construction are typically associated to flawed collective behaviors that could be attributed to poor organizational safety culture where violations become an acceptable norm. Thus, Behavioral Based Safety (BBS) programme to improve safety culture, improved supervision, automation to reduce human involvement at work, selection of workers, and disciplinary action against regular rulebreakers might be options worth exploring (Zaira & Hadikusumo, 2017; Gao et al., 2020).

Slips

As shown in ABM1, about 72.2% of respondents opined that they would not mistakenly perform their work with wrong tools or at wrong area due to distraction and misinformation, in which 26.0% disclosed their strongly endorsement to the statement with another 46.2% stated their agreement to a lesser degree. However, approximately 12.4% of respondents thought that they might make the slips at work. ABM2 unveiled that 75.0% of respondents claimed that they would not bring inadequate or wrong tools unintentionally even if they were overloaded with works, in which 34.5% strongly agreed to the statement with another 40.5% lent their support although in lesser extent. Remarkedly, 10.3% of respondents stated that they might unintentionally commit such slips.

Slips at worksites are typically associated to unintentional actions influenced by external factors such as misinformation, distractions or confusions. Therefore, a realistic schedule planning and thorough Constructability Review (CR) to steer clear of illogical work sequence and ad-hoc activities; clear and concise work instructions; and frequent open communication should be interventions that worth considerations to address slips (Shash & Almufadhi, 2021).

Lapses

As revealed in ABM3, 72.5% of the respondents accentuated that they would not easily forget to bring back their tools and instruments from worksites upon job completion, in which 32.7% strongly agreed to the statement with another 39.8% opted for “agree”. It is noteworthy that 13.1% of workers still anticipated themselves or the others to lapse in similar circumstances. Lapses in construction are typically associated to unintentional actions due to forgetfulness. As a result, good housekeeping practices; improved site supervisions; constant reminders; and safety campaign are allegedly essential to minimize lapses (Zaira & Hadikusumo, 2017).

Rule-based Mistakes

As shown in ABM4, 80.5% of the respondents believed that they would not ignore real alarm even though they had experienced numerous false alarms previously, in which 29.2% expressed strong approval to the statement with another 51.3% supported in lesser degree. It is noteworthy that 13.1% of workers still anticipated themselves or the others to lapse in comparable settings. Rule-based mistakes are generally linked to applying wrong work methods when one was dazed by misleading indicators or circumstances. Consequently, there should be a thorough process safety analysis by taking resilience engineering into consideration during design phase of a project to minimize redundant alarms and inaccurate detection of critical process parameters; and to enhance critical alarms with distinctive audio or visual effects as appropriate (Anwar et al., 2019; Shanmugam & Razak, 2021)

Knowledge-based Mistakes

As shown in ABM5, about 77.9% of respondents thought that no new worker will overlook critical aspects of the work that lead to application of procedures or equipment in a safe manner, in which 28.0% expressed their strongly support to the statement with another 49.9% voiced their approval to a lesser degree. Still, approximately 8.0% of respondents thought that wrong procedures or equipment could be used in a harm way by inexperienced new workers. ABM6 disclosed that 79.9% of respondents stressed that nobody will accidentally use a wrong procedure to do a work because of inexperience or unfamiliar with the work, in which 20.9% strongly approved the statement with another 49.9% supported in lighter tone. Noticeably, 6.5% of respondents held the opposite opinion.

Knowledge-based mistakes construction are generally connected to mistakes committed because of inexperience, unfamiliar with work requirement, etc. As a result, OSH induction to newcomers, mentoring mechanism, improved site supervisor, selecting workers with appropriate qualification or experience for critical jobs, as suggested by Zaira & Hadikusumo (2017); Gao et al (2020) might be some of most desirable interventions to address knowledge-based mistakes.

Potential Contributions to Nation's Sustainable Safety and Health Development

This research contributes to the realization and operationalization of strategic thrusts of Malaysia's Occupational Safety and Health Master Plan 2021-2025 (OSHMP25) and Sustainable Development Goals (SDGs). The profile of workers' safe behavioral potentials might provide information to conceptualize and operationalize some of OSHMP25 strategic thrusts (NCOSH & DOSH, 2022) from the perspective of safety culture and workers' safety behavior at work, particularly Strategy 1: OSH Empowerment in Public Sector, Strategy 2: Strengthening Self-Regulation Practice in the Workplace, Strategy 3: Promotion of OSH Education & Research, and Core Strategy 6: Strengthening OSH Through Technology.

This research is also possibly providing better understanding in determining, promoting and sustaining workers' safe behavior at work, in alignment with United Nation's Sustainable Development Goals (SDG), in particular SDG8: Decent Work and Economic Growth of which its Target 8.8 stipulates the need to protect labour rights and promote safe and secure working environments of all workers. United Nations (2020) in its "The Sustainable Development Goals Report, 2020" stressed the significance of OSH as the core of decent work, in which implementing of OSH and promoting supporting working environment are fundamental to protect the wellbeing of workers and viability of business in a sustainable manner.

Conclusion

Oil and gas construction industry is dominated by male workers. Result of demographic indicates most workers are aged above 25-year-old with good OSH knowledge and experience, probably that is the reason why majority of the workers showed the tendency to behave safely at work by agreeing to committing fewer human failures. Notwithstanding, there are workers who indicate human failures are still possible within their domains albeit to various extents, particularly exceptional violations. Therefore, interventions to curb human failures are still of utmost importance.

This study provides the initial insights of local oil and gas construction workers' demographic, and types of prevailing human failures (violations, slips, lapses and mistakes) they are likely to commit. Hence, it lays the foundation for future studies using integrative

behavior model to explore distal and proximal determinants of a human failure with significant accident risks, skill and knowledge required to perform such behavior, its environmental constraints, and their relative importance in forming that behavior. With that, statistical valid and reliable interventions could be developed to address a well-defined human error so as to manage occupational accident risk at oil and gas construction sites to as low as reasonably practicable. Profile of workers' demographic and safe behavioral potentials, with the aid of Artificial Intelligence (AI) and Big Data technology, could provide the initial platform for development of a predictive analytic architecture, capable to analyze large data sets of health and safety risks by incorporating proven statistical correlations among constructs to accelerate data searching operations and analysis. Data could then be extracted to reveal and forecast potential factors that contribute to the likelihood of accidents, followed by prescriptive analysis which recommends an optimal integrated safety intervention for a given situation (Ajayi et al., 2019; Zaira et al., 2017), eradicating biased opinions leading to well-informed and rational decision making (Tixier et al., 2016).

Table 3
Result of Safe Behavioral Potentials

Item	Item Statement	Nature of Error	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
ABM1	Nobody will perform work activities at wrong equipment or areas due to distractions and misinformation.	Slips	4.6%	7.8%	15.4%	46.2%	26.0%
ABM2	No workers will bring inadequate or wrong tools unintentionally even if there is so many jobs to be done in such a short time	Slips	1.2%	9.0%	14.7%	40.5%	34.5%
ABM3	No workers will easily forget to bring back their tools and instruments from worksite after job completion.	Lapses	3.4%	9.7%	14.3%	39.8%	32.7%
ABM4	Workers will not be ignoring real emergency alarm because of experiencing so many false alarms before this	Rule-based mistakes	2.1%	5.0%	12.4%	51.3%	29.2%
ABM5	No new workers (most likely are not familiar with the site) will overlook some critical aspects of the work thus use wrong methods / equipment to work in unsafe ways.	Knowledge-based mistakes	1.2%	6.7%	14.2%	49.9%	28.0%
ABM6	Nobody will accidentally use a wrong procedure to do a work because of inexperience or unfamiliar with the work itself.	Knowledge-based mistakes	1.4%	5.1%	14.5%	49.9%	29.0%
Item	**Item Description**	**Type of Violation**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
ABV1	Nobody will attempt to complete work faster just for personal glory even if it is not complying to procedures.	Optimizing	4.6%	8.3%	18.4%	40.0%	28.7%

ABV2	Nobody will try to catch project schedule due to bonuses and incentives for early work completion.	Optimizing	4.4%	13.1%	20.5%	36.3%	25.7%
ABV3	If I see my colleague trapped in confined space at worksite, it is unlikely that without much thinking, I will immediately try to rescue by entering confined space without proper gears.	Exceptional	18.6%	15.6%	12.7%	29.9%	23.2%
ABV4	I will not be forced to take shortcuts even if that is not what I want, due to unrealistic production goals.	Situational	2.1%	5.8%	18.6%	43.4%	30.1%
ABV5	I will not take shortcuts at work just because everyone is probably doing the same.	Routine	2.1%	2.8%	14.0%	46.7%	34.3%
ABV6	As an experienced worker, I will not try to do things my own ways just because there is probably little risk to get caught while making job progress faster	Routine	2.1%	6.9%	14.3%	48.0%	28.7%

References

Anwar, Z., Mustafa, A., & Ali, M. (2019). Appraisal of process safety management practices in refining sector of Pakistan. Process Safety and Environmental Protection, 128, 36-40. https://doi.org/10.1016/j.psep.2019.05.036

Baeriswyl, M., Girardin, M., & Oris, M. (2022). Financial support by older adults to family members: A configurational perspective. Journal of Demographic Economics, 88(2), 167-194. doi:10.1017/dem.2021.21

Borneo Post Online. (2020). Mustapa: Malaysia's LNG exports for nine months at RM23 bln.

Retrieved from: https://www.theborneopost.com/2020/12/04/mustapa-malaysias-lng-exports-for-nine-months-at-rm23-bln/

British Malaysia Chamber of Commerce (BMCC). (2018). BMCC Sector Report 2018/2019: Oil, Gas & Energy. Retrieved from: http://www.bmcc.org.my/vault/publications/bmcc-sector-report-2018-2019-oil-gas-energy

Buniya, M., Othman, I., Sunindijo, R., & Kineber, A. (2020). Barriers to safety program implementation in the construction industry. Ain Shams Engineering Journal. 12. 10.1016/j.asej.2020.08.002.

Fadilla, F. (2020). Malaysia to play more active role in gas, LNG exports: Mustapa. Retrieved from: https://www.nst.com.my/business/2020/12/646518/malaysia-play-more-active-role-gas-lng-exports-mustapa

Gao, Y., González, V. A., & Yiu, T. W. (2020). Exploring the relationship between construction workers' personality traits and safety behavior. Journal of construction engineering and management, 146(3), 04019111. DOI: 10.1061/(ASCE)CO.1943-7862.0001763.

Health and Safety Executive (HSE). (1999). Reducing error and influencing behaviour. TSO (The Stationery Office). ISBN: 978 0 7176 2452 2

Human Resource Development Fund, & Ministry of Human Resources. (2019). Industrial Insight Report, Issue: 4/2019. Retrieved from: https://hrdcorp.gov.my/wp-content/uploads/2021/03/4.-HRDF_Insights_Report_Issue04_2019.pdf

International Gas Union. (2020). World LNG Report. Retrieved from: https://www.igu.org/resources/2020-world-lng-report/

Laeng, J., & Kiew, P. (2022). Explosion reported at Sabah-Sarawak Gas Pipeline in Lawas, one fatality. Retrieved from: https://www.theborneopost.com/2022/11/16/explosion-reported-at-sabah-sarawak-gas-pipeline-petronas-to-issue-statement/

Mariana, M., Sahroni, T.R., & Gustiyana, T. (2018). Proceedings of the International Conference on Industrial Engineering and Operations Management, Bandung, Indonesia, March 6-8, 2018

Mohammad, M., & Hadikusumo, B. (2017). Structural equation model of integrated safety intervention practices affecting the safety behaviour of workers in the construction industry. Safety Science. 98. 124-135. 10.1016/j.ssci.2017.06.007.

Muhamad, S. 2022. Malaysia to cut daily oil output by 27,000 barrels as OPEC+ reduces production. Retrieved from: https://www.theedgemarkets.com/article/malaysia-cut-daily-oil-output-27000-barrels-opec-reduces-production

National Council of Occupational Safety and Health (NCOSH), & Department of Occupational Safety and Health. (2022). Occupational Safety and Health Master Plan 2021 – 2025.

Nnaji, C., & Karakhan, A.A. (2020). Technologies for safety and health management in construction: Current use, implementation benefits and limitations, and adoption barriers. Journal of Building Engineering, Volume 29, 2020,101212. https://doi.org/10.1016/j.jobe.2020.101212.

Ramos, A.K., McGinley, M., & Carlo, G. (2021). The relations of workplace safety perceived occupational stress, and adjustment among Latino/a immigrant cattle feedyard workers in the United States. Safety Science, Volume 139, July 2021, 105262. https://doi.org/10.1016/j.ssci.2021.105262.

Reason, J. (2008). The Human Contribution: Unsafe Acts, Accidents and Heroic Recoveries. CRC Press. ISBN: 13: 978-0-7546-7400-9

Reason, J. (2016). Organizational Accident Revisited. CRC Press. ISBN: 13: 978-1-4724-4765-4

Saleh, J.H, & Pendley, C.C. (2012). From learning from accidents to teaching about accident causation and prevention: Multidisciplinary education and safety literacy for all engineering students. Reliability Engineering and System Safety 99 (2012) 105–113. doi:10.1016/j.ress.2011.10.016

Shanmugam, K., & Razak, M. A. (2021). Assessment on process safety management implementation maturity among major hazard installations in Malaysia. Process Safety and Environmental Protection, 149, 485-496. https://doi.org/10.1016/j.psep.2020.11.013

Shash, A.A., & Almufadhi, S. (2021). Constructability: Owners, Designers, and Contractors Practices in Industrial Projects. Journal of Engineering, Project, and Production Management 2021, 11(3), 169-180. DOI 10.2478/jeppm-2021-0017.

Tixier, A., Hallowell, M., Rajagopalan, B., & Bowman, D. (2016). Application of machine learning to construction injury prediction. Automation in Construction. 69. 10.1016/j.autcon.2016.05.016.

To, W. M., Gao, J. H., & Leung, E. Y. W. (2020). The Effects of Job Insecurity on Employees' Financial Well-Being and Work Satisfaction Among Chinese Pink-Collar Workers. SAGE Open, 10(4). https://doi.org/10.1177/2158244020982993

United Nations. (2020). The Sustainable Development Goals Report 2020. United Nations 's Department of Economic and Social Affairs. ISBN 978-92-1-101425-9

Voon, H.Y., & Ariff, T.M. (2019). Safety Accidents at the Workplace. International Journal of Recent Technology and Engineering. DOI: 10.35940/ijrte. B1041.0782S319

Zaira, M.M., & Hadikusumo, B.H. (2017). Structural equation model of integrated safety intervention practices affecting the safety behaviour of workers in the construction industry. Safety Science, 98, 124-135. DOI: 10.1016/J.SSCI.2017.06.007