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Enhancing Safety Performance through Cultural Maturity: A Comprehensive Framework for Multinational Oil and Gas Operations

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This article presents the results of a comprehensive HSE Review conducted through four subsidiaries of an oil & gas company to provide insights and recommendations to enhance its existing HSE culture and system. The HSE review was carried out for subsidiaries in North America, Middle East and Western Europe. It involved reviewing more than 600 documents, conducting over 100 interviews, spending about 130 hours on field visits to evaluate the effectiveness of HSE system implementation, and gathering input from more than 1,500 participants in a safety climate survey.

The methodology relies on one hand, on a Safety Culture Maturity framework to analyze perceptions at different levels of the organization, and on the other hand, on expert judgment following field observations and interactions with workforce and management across all subsidiaries. The overall results highlight perceived strengths and gaps in the current different elements of Safety culture at each subsidiary and highlight specific perceived strengths and shortcoming in Safety Culture. A second section of the article discusses how maturity models can be a legitimate tool despite some inherent limitations underlined by part of the safety science research community, alongside a consideration of some common critique of the safety culture construct. The article gives an illustration of how practitioners can use maturity models and how the results support the development of improvement plans that integrate key risk themes to drive effective & sustainable enhancement. We also argue from a safety practitioner's point of view that using maturity models give the opportunity to drive stakeholders' ownership and commitment that may be eventually more important that the maturity score or rank.

The paper provides elements for a better understanding of how underpinnings of maturity models articulate with assessment of safety culture and explore their methodological properties to show how some theoretical weaknesses can paradoxically become competitive advantages in the practical implementation of safety improvement approaches.

Keywords: Safety Culture, Maturity Models, Safety Performance.

1. Introduction

The concept of organizational culture was introduced as *"the way we do things around here"* (Bower, 1966). This concept extends beyond shared practices to include common ways of thinking (e.g. mindset) and a normative dimension (Schein, 2010), defining not only *"how we do things"* but also *"how we are expected to do things"* (Berg & Wilderom, 2004). Its use in the field of safety under the term safety culture has been widely disseminated for around thirty years (Iftadi, 2023). The concept of safety culture has gained immense prominence in recent years, recognizing its pivotal role in mitigating workplace risks and fostering a safe and healthy environment. (Wiegmann & al, 2004 ; Kalteh & al., 2021). A strong safety culture goes beyond mere compliance with regulations; it permeates all levels of an organization, creating a shared commitment to safety values, behaviors, and outcomes (Ayob, 2022). These models encompass various aspects of safety culture, including leadership commitment, communication, hazard identification, risk assessment, and employee involvement. Popular models include: *"The Bradley Curve™"* by dss+, *"The Safety Culture Ladder"* by the Health and Safety Executive (HSE), *"The Safety Culture Assessment Tool* (SCAT)" by the American Society of Safety Professionals (ASSP). Indeed, Safety culture maturity models provide a structured framework for organizations to assess their current safety culture maturity and identify pathways towards continuous improvement (Laine & al., 2022).

2. Methods

This article presents the results of a comprehensive HSE Review conducted through four subsidiaries of an oil and gas company to provide insights and recommendations to enhance the current HSE culture and system. The analysis was carried out for one subsidiary in North America, one subsidiary in the Middle East and two in Western Europe. It involved reviewing more than 600 documents, conducting over 100 interviews, spending about 130 hours on field visits to evaluate the effectiveness of HSE system implementation, and gathering input from more than 1,500 participants in a safety climate survey. The methodology relies on one hand, on a Safety Culture Maturity framework to analyze perceptions at different levels of the organization, and on the other hand, on expert judgment following field observations and interactions with workforce and management across all subsidiaries.

2.1. Data collection

The HSE review was conducted through a combination of methods: (1) Document Review and Data Analysis: Over 600 documents related to HSE policies, procedures, and performance data were reviewed for each subsidiary (i.e. A wide array of HSE documents were reviewed, including but not limited to HSE policy, standards, and procedure, risk assessment and actions closure report, standard operating procedure, in field review of work permits, maintenance records, incident reports, training materials, audit reports); (2) Interviews: More than 100 interviews and focus groups were conducted with employees at various levels, including executive leadership, management, supervisors, and frontline workers; (3) Field Visits: Approximately 130 hours were spent conducting field visits to evaluate the effectiveness of HSE system implementation; (4) Safety Climate Survey: Over 1500 employees participated in a safety climate survey designed to assess perceptions of safety culture across the organization and to compare relative safety culture perception between directorates, departments and organizational levels within a company. Questions assessing the perception of safety culture are split into three areas (leadership, structure and process).

	North america	Middle east	Europe 1	Europe 2
Safety survey participants	400+	250+	800+	91
Documents reviewed	200+	200+	200+	70+
People interviewed	30+	30+	60+	20+
Menhours spent on the field	30+	30+	45+	20+
Focus area	6	7	5	4
Actions to be implemented	68	69	63	57

Table 1. Summary of data collection.

Then, a Safety Culture Maturity Model (i.e *"The Bradley Curve™"* in this study) was employed to analyze the data collected from these sources. This model assessed various elements of safety culture, including leadership commitment, communication, training, and risk management, across different organizational levels. In a mature safety culture,

characterized by the interdependent stage, safety becomes genuinely sustainable, with injury rates nearing zero (Cooper, 2000). Individuals feel empowered to take necessary actions to ensure their safety while working. They actively support and challenge one another in this endeavor. Decisions regarding safety are made at the appropriate organizational levels, and individuals adhere to these decisions (Guldenmund, 2000). Furthermore, the organization experiences significant transformative business advantages, including enhanced quality, productivity, a beneficial influence on society, and improved overall business performance.

2.2. Theorical framework

The Safety Culture Maturity Model is structured along different stages of development:

(1) *Reactive stage:* People do not take responsibility and believe incidents will happen.

(2) *Dependent stage*: People view safety as complying with rules. Incidents rates decrease;

(3) *Independent stage*: People have a personal value for Safety, take responsibility and believe they can make a difference with actions. Incidents reduce further;

(4) *Interdependent stage:* Teams feel ownership and responsibility for safety culture and performance. The number of incidents is low enough to be no longer a valuable indicator for action.

A fairly common criticism of detractors of the use of safety maturity models is the lack of theoretical foundation of the models (Flin, 2007; Reiman and Rollenhagen, 2014, Filho & Waterson, 2018). More precisely, some point out the lack of articulation of the models with mainstream theories of safety science (e.g. *High Reliability Organization* (Weick & Sutcliffe, 2007), *Normal Accident Theory* (Perrow, 1984)). However, from a more operational perspective, safety maturity models call upon several essential dimensions shaping the role of a safety professional (Van Wassenhove & al. 2022), namely Leadership, Communication and Commitment. In a sense, it appears that the merits of the use of safety models stem from the following three axioms: (1) Strong and visible leadership is essential for creating a safe work environment. Effective leaders must demonstrate a genuine commitment to safety, actively communicate safety values, and hold themselves and others accountable for safe practices. (2) Open communication is paramount for fostering a culture of trust and transparency. (Foussard & al., 2022). Transparent communication channels allow for effective sharing of safety information, concerns, and best practices. (3) Engaging employees in safety initiatives is crucial for building a shared sense of ownership and responsibility (Amalberti, 2013). Effective employee engagement strategies include empowering employees to participate in decision-making, providing safety training, and recognizing and rewarding safe behavior.

3. Results

The overall results indicated both perceived strengths and gaps in the current safety culture across the four subsidiaries.

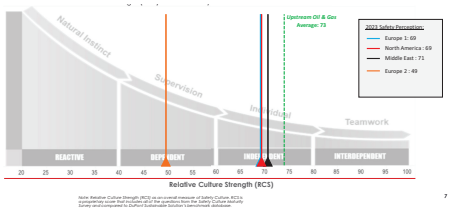

Fig. 1. Results of the Safety Climate Survey.

The perceptions of the employees in *North America, Middle East* and *Europe 1* are all close overall, with the *Europe 2* significantly lower (fig.1). The scores of the different framework elements are homogeneous with each subsidiary Companies, with however certain exceptions. The perception resulting from field visits completes the panorama. The experts' opinion is consistent with the survey, but nevertheless marks more important requirements (Fig.2). The quality and effectiveness of initiatives can be judged more harshly when an external point of view is taken from a global perspective.

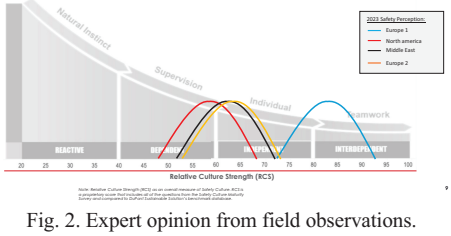

Fig. 2. Expert opinion from field observations.

Overall, the perception of the organization's Structure is consistently regarded as effective whereas the perception of the Leadership framework element also appears to be consistently the largest area of improvement (Fig 3).

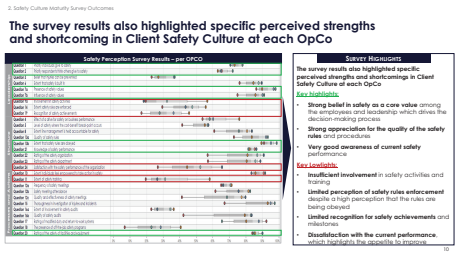

Fig. 3. highlighted specific perceived strengths and shortcoming.

3.1. Perceived Strengths

All subsidiaries under review have exhibited a commendable level of leadership commitment to HSE principles. This commitment is characterized by the establishment of clear, measurable goals and expectations that are communicated effectively across all organizational levels. Leadership engagement is not merely a top-down directive; rather, it encompasses a holistic approach where leaders actively participate in HSE initiatives, thereby reinforcing the importance of safety as a core organizational value. The articulation of HSE goals is not limited to mere statements of intent; it involves the integration of these objectives into the strategic planning processes of the subsidiaries. Leaders have taken proactive steps to ensure that HSE considerations are embedded in decision-making frameworks, thereby aligning operational practices with the overarching mission of promoting a safe and environmentally responsible workplace. Regular assessments of HSE performance against established benchmarks further illustrate the leadership's commitment to continuous improvement in safety standards.

A critical component of effective HSE management is the implementation of comprehensive training programs. The subsidiaries have developed training curricula that are not only extensive but also regularly updated to reflect the latest industry standards, regulatory requirements, and emerging best practices. These training programs are designed to equip employees with the necessary skills and knowledge to identify hazards, understand safety protocols, and respond effectively to emergencies. Moreover, the training initiatives are tailored to meet the diverse needs of the workforce, ensuring that all employees, regardless of their role or level within the organization, receive appropriate HSE training. This inclusivity fosters a sense of shared responsibility for safety among all employees, thereby enhancing the overall safety culture within the organization. In addition to training, effective communication channels play a crucial role in disseminating safety information. The subsidiaries have established multiple platforms for communication, including regular safety meetings, newsletters, and digital communication tools. These channels facilitate the timely sharing of critical safety updates, lessons learned from incidents, and best practices.

Feedback mechanisms are also in place, allowing employees to voice concerns and suggestions regarding HSE matters, which further enhances the communication loop and promotes a culture of openness and transparency. Robust risk management processes are essential for identifying, assessing, and mitigating potential hazards within the workplace. Each subsidiary prized itself in the efforts and improvement to implement comprehensive safety systems. This involves the systematic identification of high-risk activities and systems along with the evaluation of associated risks. A proactive approach enables the organization to prioritize safety measures and allocate resources effectively to address the most significant risks. The risk management framework encompasses a variety of methodologies, including qualitative and quantitative risk assessments, which facilitate a thorough understanding of potential hazards. Following the evaluation of risks, appropriate preventive and mitigation measures are developed and implemented. These measures may include engineering controls, administrative policies, and personal protective equipment (PPE) to minimize exposure to identified hazards. Furthermore, the subsidiaries engage in regular reviews of their risk management practices to ensure that they remain effective and relevant in the face of changing operational conditions and regulatory landscapes. This iterative process of risk assessment and mitigation not only enhances workplace safety but also contributes to the overall resilience of the organization in managing unforeseen challenges.

3.2. Perceived Shortcomings

Despite variabilities between the subsidiaries, 5 key themes were consistently perceived as shortcomings at varying degrees:

1. the alignment of perceptions between management and frontline workers,
2. the existence of comprehensive and up-to-date process hazard analysis studies,
3. the consistent application of the management of change process, particularly in degraded or temporary situations,
4. the oversight of contractors, and
5. the utilization of data analytics for identifying safety and process safety trends.

The alignment of perceptions between management and frontline workers is crucial for fostering a robust safety culture. However, a significant perception gap has been observed between these two groups regarding the effectiveness of existing safety processes and the prevalence of unsafe behaviors within the workplace. Management often perceives safety protocols as effective and adequately enforced, while frontline workers frequently report a contrasting view, indicating that these processes may not be sufficiently robust or consistently applied in practice. This disparity can lead to a lack of trust in management's commitment to safety and may result in frontline workers feeling undervalued and unheard. The perception gap can be attributed to several factors, including differences in experience, exposure to hazards, and the nature of daily tasks performed by frontline workers compared to those in managerial positions. For instance, while management may rely on metrics and reports that suggest compliance with safety protocols, frontline workers may witness firsthand the challenges and barriers that impede adherence to these protocols. This disconnect can foster an environment where unsafe behaviors are normalized, as workers may feel compelled to prioritize productivity over safety, especially in high-pressure situations where meeting production targets is emphasized. To bridge this perception gap, it is essential for organizations to actively seek input from frontline workers regarding safety processes, see the reality of the operations and activities by themselves in the operating facilities and to create forums for open dialogue. Regular safety meetings, anonymous surveys, and focus groups can facilitate communication and provide valuable insights into the realities of the workplace. By acknowledging and addressing the concerns of frontline workers, management can enhance trust and collaboration, ultimately leading to a more cohesive approach to safety.

Another critical issue highlighted was the insufficient set of process hazards analysis studies for the facilities, despite their ages and various changes conducted over time. Process hazard analysis is an essential component of process safety management in the oil and gas industry. This is illustrated by the numerous examples in the oil and gas industry where the inadequateness of process hazard analysis was shown to be a strong factor that led to major incidents (Kletz, 1994 ; Hopkins, 2008). Such study provides a systematic methodology to analyze process design, associated risks and evaluate the adequateness of existing safeguards or recommend new ones as relevant. Furthermore, in instances where process hazards analysis existed, the studies remained largely a one-off task instead of being operationalized. When utilized to their full potential, process hazard analysis integrates into routine processes to address the complexity and risks associated with the operations. In particular, they provide critical personnel the basis for developing their understanding of major risks, associated barrier, and their respective roles in managing those. Existing process hazard analysis also provide a real-time framework to evaluate and assist the decision-making process to face common operational challenges. One of those common challenges is the potential deferment of maintenance or inspection activities of equipment, for example due resources constraints, logistical delays, or other priorities.

Another common shortcoming highlighted with the operations was the lack of clear guidelines to define and apply the management of change process. This specifically involved developing a shared understanding among subsidiaries and across departments, regarding the definition of change, the requirements for risk assessment and interim controls implementation, and the process for eventual hierarchical escalation. This has led to the capture of multiple degraded safety conditions in the operations with insufficient or ineffective controls in place. Management of Change is a fundamental pillar of process safety, ensuring that modifications to equipment and process, whether permanent or temporary, are thoroughly documented and risk-evaluated before approval and implementation. The oversight of this process has led to some of the most striking examples of major process safety incidents such as the Flixborough disaster in 1974 (HMSO,1975) and the Bhopal disaster in 1984. Shrivastava, P. (1992).

In addition, variable standards to manage contracting companies were implemented across the subsidiaries. In the most remote locations, this shortcoming was escalated by the limited availability of qualified contracting companies in the operating areas. This led to multiple situations during the assessment whereby significant contractor risk exposure was observed. Fostering a strong relationship while full oversight of contractors is essential to strengthening the organization overall operational performance. (Deming, 1986). From a safety standpoint, contractors often perform highly specialized or high-risk activities in high-pressure environments (equipment breakdown, plant shutdown). These activities expose the contractors and employees alike to significant risks as illustrated by the Milford Haven Refinery Explosion in 1994 (HSE, 1997) and the LyondellBasell Refinery Explosion (2019). An organization must ensure that all its contractors work seamlessly through its existing systems and processes. It starts by selecting qualified and competent contractors for the activities to be performed. Since contractors often lack in-depth knowledge of site-specific hazards and safety processes, they require an onboarding and training program equivalent to those followed by permanent

employees in similar roles. It is also essential to communicate clearly (for example via pre-job safety briefing) and maintain oversight during the execution of high-risk activities.

Lastly, the limited utilization of data analysis for identifying trends and implementing targeted improvement initiatives represents a recurring observation within the organization. Effective data analysis is essential for understanding safety performance, identifying areas for improvement, and developing evidence-based strategies to mitigate risks. However, the underutilization of data can hinder the organization's ability to make informed decisions regarding safety practices and to proactively address emerging issues. Organizations often collect a wealth of data related to safety incidents, near misses, and compliance metrics; however, without a systematic approach to data analysis, this information may remain untapped. The failure to analyze data can result in missed opportunities for identifying patterns and trends that could inform targeted interventions. For example, a thorough analysis of incident reports may reveal common factors contributing to accidents, such as specific tasks, equipment, or environmental conditions. By identifying these trends, organizations can implement targeted training programs, modify work processes, or invest in new safety technologies to address the root causes of unsafe behaviors. Moreover, the integration of data analytics into safety management systems can enhance the organization's ability to monitor safety performance in real time. Predictive analytics can be employed to forecast potential safety risks based on historical data, enabling organizations to take proactive measures before incidents occur. By leveraging data analysis as a tool for continuous improvement, organizations can create a more dynamic and responsive safety culture that prioritizes prevention and risk mitigation.

4. Discussion

Implementation and confrontation with the reality on the field requires to acknowledges the challenges and limitations associated with implementing safety culture maturity models. First, assessments often rely on subjective evaluations by experts' despites application of consistent assessment frameworks, leading to potential bias in the interpretation of results. Then, the accuracy and reliability of data collected through surveys and audits can be influenced by various factors, including employee perceptions, willingness to provide honest feedback, and operational variability or preparation at the time of the assessment. Finally, cultural context implies that different industries and organizational cultures may require adjustments and adaptations to the models to ensure their effectiveness. From an academic perspective, the robustness of the safety culture concept is subject to several limitations (Stackhouse and Stewart, 2016). The safety culture construct itself has also been subject to scrutiny. Some researchs suggest that the focus on safety culture can inadvertently shift responsibility for safety away from individual workers and management (Filho and Waterson, 2018; O'Donovan & al., 2019). However, this paper argues that a well-implemented Safety Culture Maturity Model can effectively address these concerns by promoting shared responsibility, emphasizing individual accountability, and encouraging proactive safety behaviors. Furthermore, the involvement of employees, including leadership, during the entire assessment process enables the co-development and a robust commitment to priority improvement recommendations, and thus stronger safety performance in the future organization.

It can be argued that maturity models frameworks can be overly simplistic, potentially neglecting the nuanced and complex nature of safety culture. Safety culture is inherently multifaceted, influenced by a myriad of factors including organizational structure, employee behavior, leadership styles, and external regulatory environments. As a result, the classification into distinct levels may not capture the complex dynamics that exist within an organization (Rasmussen, 1997). If the approach is limited to simply identifying specific criteria, such as the presence of safety policies or training programs, classification may overlook critical elements such as the actual implementation of those policies, employee engagement in safety practices, and the underlying attitudes and beliefs that shape safety behaviors (Van Wassenhove & al., 2022). As a result, organizations may mistakenly believe that they have reached a higher level of safety culture maturity, when in reality, they may still be struggling with significant cultural challenges that require attention.

Moreover, the emphasis on achieving a higher 'maturity level' can inadvertently shift the focus away from fostering genuine cultural change. Organizations may become preoccupied with meeting the criteria set forth in the maturity model, prioritizing the attainment of a specific level over the meaningful transformation of their safety culture. This can lead to a checkbox mentality, where organizations implement superficial changes to meet model requirements without addressing the deeper issues that contribute to unsafe behaviors and practices. As a result, the potential for sustainable improvement in safety culture may be compromised, as organizations may not fully engage with the underlying factors that drive safety performance. Despite these limitations, the study validates the

practical value of maturity models for practitioners. Maturity models provide a structured approach for identifying specific areas for improvement and setting realistic targets that align with organizational goals. By utilizing a maturity model, organizations can systematically assess their current safety culture, identify gaps, and prioritize actions that will lead to meaningful enhancements in safety performance. The insights can be instrumental in developing targeted improvement plans that integrate key risk themes. By aligning improvement initiatives with the findings from the assessment, organizations can foster sustainable enhancements in HSE performance that are tailored to their unique context and challenges. Furthermore, maturity models serve as a valuable tool for benchmarking against industry standards or best practices motivating organizations to strive for higher safety culture maturity levels, ultimately driving continuous improvement in safety practices.

Finaly, a key advantage is the potential to drive ownership and commitment processes within organizations. By involving employees at all levels, including leadership, in the assessment and improvement process, a sense of collective responsibility for safety can be cultivated. The dual nature (i.e. implementation of safety barriers and construction of a shared representation of the system) of risk management practices is the pillar of the effectiveness of risk analysis methods (Foussard & al., 2014). This ownership fosters a culture of accountability, where employees recognize their role in contributing to a safe working environment. Moreover, involving employees in the maturity model assessment process can enhance communication and collaboration across different levels of the organization. Employees can share their perspectives on safety practices, identify challenges they face, and contribute ideas for improvement. This collaborative approach not only empowers employees but also helps to bridge the perception gap that often exists between management and frontline workers regarding safety culture. By fostering open dialogue and collaboration, organizations can create a more inclusive safety culture that values the input and experiences of all employees. The commitment to safety that arises from this ownership is likely to lead to more effective and sustainable improvements in safety culture. (Otitolaiye & al., 2021). When employees feel invested in the safety initiatives of their organization, they are more likely to adhere to safety protocols, report unsafe behaviors, and actively participate in safety training and programs. This increased engagement can result in a positive feedback loop (Foussard & al., 2023) where improved safety culture leads to enhanced safety performance, further reinforcing the commitment to safety among employees.

5. Conclusion

The paper provides elements for a better understanding of how underpinnings of maturity models articulate with assessment of safety culture and explore their methodological properties to show how some theoretical weaknesses can paradoxically become competitive advantages in the practical implementation of safety improvement approaches. Rather than perceiving their relative theoretical simplicity as a weakness, the flexibility of maturity models gives them a healing effectiveness. They allow practitioners to put the subjects on the table in an efficient and formalized way. Their simplicity allows for rapid appropriation by all the actors from the front-line workers to the corporate management. They are a valuable asset that allows a structured dialogue at the interface between management and operations. As the commercial pressure inherent to any industrial activity remains the essential driver of organizations' strategies, the interest of maturity models is to bring and carry safety topics, not by subordinating them, but by integrating them into daily operational practices. Similar to Weber's *ideal-types* (Weber, 1971) that allow one to think about the sociology of organizations, the degrees of maturity are supports for the guidance of organized action. They allow the formalization of tailor-made recommendations adapted to the demanding context of the oil & gas industry. It is illusory to believe that it would be a faithful and exhaustive description of reality, but that is not their vocation. They are what a model should be: a simplified representation of a system, a support for thought and a guide for action. Finally, they take on their full meaning from a philosophical perspective that devalues *"good and evil"* in favor of *"better or worse"* (De Spinoza, 2005). Thus, the journey will count more than the destination, the effectiveness of the approach is based more on the work, talent and sincerity of the protagonists than on the intrinsic quality of the tools.

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