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**Safety compliance and safety climate**  
A repeated cross-sectional study in the oil and gas industry

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**Safety compliance and safety climate: A repeated cross-sectional study in the oil and gas industry**

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## **SAFETEC** Presentation outline

- Introduction
  - Safety compliance and accidents
- Safety compliance
  - The relationship between compliance and accidents
- Safety climate
  - The link between safety climate and compliance
- The common features of Safety Climate
  - Safety Competence
  - Safety System
  - Safety Supervision
  - Work pressure
- Method
- Findings
- Discussion

## **SAFETEC** Safety Compliance and accidents

- Violation of procedures
  - One of the most common causal factors of fatal incidents and high potential events in the oil and gas industry (OGP, 2011, 2012, 2013, 2014; Walker et al., 2012)
- Ingredient in high profile accidents
  - Montara (2010)
  - Texas City (2005)
- Compliance with procedures
  - Vital to ensure correct execution of work tasks on safety critical equipment
- Oil and Gas: Highly regulated industry
  - virtually all work operations are governed by rules and procedures. A high level of safety presupposes a high level of compliance

**SAFETEC** Compliance

*the extent to which employees adhere to safety standards, procedures, legal obligations and requirements*

(Masia and Pienaar, 2011: 3)

**SAFETEC** Creating compliance

- Emphasis on conditions that promote compliance rather than violation provoking conditions
- Safety Climate, probably gained the most attention
- In spite of some variation regarding the strength of the causal relationships, safety climate studies indicate that a positive safety climate promotes safety-compliant behaviour (Alper and Karsh, 2009; Clarke, 2006)

“compliance with safety procedures is not a result of mere chance and individual differences, but rather that it is highly influenced by manageable contextual factors”

## SAFETEC Safety Climate

- Safety climate can be defined as a set of perceptions that employees share regarding the priority of safety in their organization (Zohar, 1980)
- Pragmatic view of safety culture, a “snapshot”, indicator etc.
- Multifaceted and cover a broad range of employee perceptions of the priority of safety within the organization
- Perceptions that form the frame of reference for employees about what sort of behaviour is expected, supported and rewarded (Zohar, 2010)
  - employee behaviour will tend to align with these perceived expectations

## SAFETEC A problem with Safety Climate

- Identical measures of safety climate are seldom tested repeatedly over extended periods of time
  - The stability of the identified causal relationships between safety climate and safety compliance has not been subject to testing
- Numerous questionnaire tools
  - Factors vary
  - Items vary
  - Limited testing/validation



- Cross-sectional survey, administered four times within a period of seven years
  - A framework consisting of common features of safety climate
  - Repeated testing of a theoretical model that is held constant over a prolonged time span
  - Increasing the reliability and the predictive validity of the factor structure

## **SAFETEC** The «common features» of Safety Climate

- Safety Competence (1/3)  
The perceived general level of qualifications, skills and knowledge, along with associated aspects such as training, selection and competence standards and assessment
- Safety System (2/3)  
a range of aspects related to the organization's safety management systems, from safety officials and safety committees to safety policies and permit-to-work systems
- Safety Supervision (implicitly or explicitly part of all reviewed questionnaires)  
Satisfaction with supervision or their perceptions of the supervisors' attitudes and behaviours with respect to safety
- Work pressure (?)  
Workload and work pace
- (Risk)

(Flin, R., Mearns, K., O'Connor, P., Bryden, R., 2000. Measuring safety climate: identifying the common features. Safety Science 34, 177-192)

## **SAFETEC** The connection between Safety climate and safety compliance

- Safety Competence
  - Studies indicates that there is a positive causal relationship between safety competence and safety compliance
  - E.g. Kwon and Kim (2013) found that the level of safety knowledge was significantly related to safety compliance
- Safety system
  - positive link between rule clarity, comprehensibility and compliance
  - procedure vagueness found to be negatively related to safety compliance
- Safety Supervision
  - leaders positively affect the level of safety compliance among their subordinates
- Work pressure
  - high job demands and low job resources were negatively related to safety compliance
  - mixed findings about the role of respectively pressure and positive resources in predicting safety compliance
  - Recurring theme in the safety sciences

**SAFETEC** Hypothesis

- Hypothesis 1: Safety competence will positively predict safety compliance
- Hypothesis 2: Safety system will positively predict safety compliance
- Hypothesis 3: Safety supervision will positively predict safety compliance
- Hypothesis 4: Work pressure will negatively predict safety compliance

**SAFETEC** Method

- Repeated Cross-sectional survey among sharp-end workers within the Norwegian oil and gas industry
- Administered every second year within a period of seven years by the Petroleum Safety Authority Norway (PSA)
- Four samples consisted of respondents from operating, contracting and subcontracting companies
  - a total of 464 different enterprises spread over fixed offshore installations, floating offshore installations and onshore petroleum terminals
  - All Offshore and onshore facilities included are located in the Norwegian sector
- Total sample size of 31,350 respondents

## SAFETEC Survey

- Fifteen of the 150 items were used to measure safety climate
  - selected on the basis of safety climate literature (Flin et al., 2000)

Items
Q1 I have received sufficient work environment training
Q2 I have received sufficient safety training
Q3 I know the HSE procedures well
Q4 I think it's easy to find the right steering documentation
Q5 I have easy access to procedures and instructions related to my work
Q6 The HSE procedures are suitable for my work tasks
Q7 I always know which person within the organization to report to
Q8 I prefer not to discuss HSE conditions with my leader (reversed)
Q9 My leader appreciates that I raise topics related to HSE
Q10 My leader is committed to working with HSE on the installation
Q11 The safety deputies' suggestions are taken seriously by the leaders
Q12 Sometimes I am forced to work in a way that threatens safety
Q13 In practice the concern for production precede the concern for HSE
Q14 I experience group pressure which jeopardizes HSE-evaluations
Q15 There are often parallel work operations proceeding that leads to dangerous situations

## SAFETEC Analyses

- Reduce the number of items to a manageable size
  - Uncover the underlying safety climate factor structure
- ↓
- Exploratory Factor Analysis (EFA) / principal component analysis (PCA) with varimax rotation
  - Inspecting the scree plot for a bend point
  - The factor solution that produced the cleanest factor structure, i.e. with no or few item cross-loadings
  - A four-factor solution was tested and this showed satisfactory results, i.e. a simple factor structure with no cross-loadings above .40
  - All alpha scores are equal to or above .70. Thus, the internal consistency and reliability of the factors were considered adequate

## SAFETEC Analyses

- The dependent variable safety compliance was measured by one single item regarding compliance with procedures
  - “*Sometimes I break safety rules to get the job done quickly*”
- Separate hierarchical multiple regression analysis was conducted for each measurement period to test the hypothesized relationship between safety climate and safety compliance
- Each safety climate factor was entered into the model in separate steps
- Control variables
  - Male
  - Leader

## SAFETEC Findings

- H1: On average, safety competence adds about 8% explained variance in safety compliance on average during the four measurement periods when it is added to the regression model
- H2: Safety system was hypothesized to contribute positively to compliance, and support was found for the hypothesis across all four measurement periods. Adds roughly 4% explained variance in safety compliance on average
- H3: Positive effect of safety supervision on safety compliance. Adding safety supervision to the regression model yielded roughly an additional 4% explained variance on average across the four measurement periods
- H4: Adding work pressure to the regression model increased the explained variance by roughly 9% on average across the four time periods

**SAFETEC** Discussion

- Identical measures of safety climate are seldom tested repeatedly over extended periods of time
- A significant theoretical contribution of the present study is that a repeated set of tests of a theoretical model that is held constant over a prolonged time span
- The theoretical model explains a significant proportion of the variation in safety compliance (25,7- 28,5%)
- The stability of the model over time demonstrates that the common features of safety climate, as identified by Flin et al. (2000) and as operationalized in the present study, show high predictive validity in relation to safety compliance.
- The findings indicate that safety compliance can effectively be enhanced by focusing on appropriate leadership practices, the usability of the safety system and the safety competence of employees

**SAFETEC** Practical implications

- Companies seeking to enhance safety compliance should focus on leadership practices that show a clear commitment to safety concerns, on improved accessibility and clarity of safety procedures, and on training that emphasizes increased knowledge of safety issues and safety procedures
- Work pressure is the most important contributor to safety compliance. This means that the organization should focus on the enacted priorities when faced with safety issues that might conflict with production targets

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Safety climate as an indicator for major accident risk: Can we  
use safety climate as an indicator on the plant level?

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Thank you

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