The influence of leadership on the prevention of safety incidents: on risk reduction, leadership, safety principles and practices

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The idea that the future is unpredictable, is undermined every day by the ease with which the past is explained.

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9 Retrospective views

9.1 The view of incident investigators

A group of 18 professional incident investigators reviewed 19 different investigation reports of major incidents distributed over six business sectors (tank storage, hospitals, the oil and gas industry, rail infrastructure and the process industry). No professional incident investigator meeting our selection requirements (competence and professional experience) could be identified for the general infrastructure sector. The 'Other' business sector was considered too non-specific for use in this review. Each investigator reviewed an investigation report[1] selected from their own occupational history. These analyses were conducted in the period between August 2017 and January 2019. The investigators were asked to scrutinise these reports regarding: a) the risk reduction phases that were compromised, and through which major incidents could occur, and b) the leadership orientations of the leaders who were instrumental in causing the major incident under review. The request was accompanied by detailed guidelines for conducting this review. These guidelines are presented in Appendix 15.2.

The investigators were asked to judge the extent to which the risk reduction phases contributed to the events with a score from 0–5 (0=no contribution, 5=high contribution). Their judgements resulted in the following scores per risk reduction phase: Recognition 204, Ability 185, Motivation 156, Courage 151, Action 178. These scores show that the investigators consider the Recognition (of risks) as the risk reduction phase contributing most to the causes of these 19 major incidents. This main contributor is followed by Ability (to intervene) and (remedial) Action. Motivation (to intervene and Courage (to intervene) were considered the least important contributing factors.

The investigators identified 64 leaders who contributed to the causes of these 19 events. The investigators were asked to judge the applicable leadership orientation of each contributing leader with a score of 0–5 (0=no contribution, 5=high contribution). Their judgements resulted in the following total scores per leadership orientation: Task 256, Relation 158 and Self 164. These scores show that the investigators considered

1 One investigator provided two reviews.

Task-oriented leaders as most instrumental in the causation of the major incidents under review.

We conclude that the reviews of 19 major incidents by 18 professional incident investigators suggest that recognition of risks is the least controlled risk reduction phase, and that Task-oriented leaders are most instrumental in causing major incidents.

9.2 The view of risk analysis experts

Risk reduction starts with the recognition of risks. In that respect, recognition is considered of paramount importance to a successful risk reduction process. In the previous section we reported that the professional incident investigators consulted consider Recognition the most compromised risk reduction phase. This suggests that there is often a lack of understanding regarding safety risks, or that they are ignored, which contributes seriously to the occurrence of major incidents. Based on this observation we considered it useful to obtain multiple independent opinions with respect to understanding, underestimating or ignoring safety risks in organisations. The business sector in which (the control of) major hazards is recognised as part of day-to-day operations was chosen as the most applicable sector on which to focus. We therefore invited five different risk analysis experts with extensive expertise in the field of risk analyses in 'major hazard' (BRZO) organisations for interview. These experts were selected on the basis of their individual experience in the field of risk analysis. Four of the five interviewees have used numerous safety risk analysis methods as part of their occupational practice for several years, and one interviewee has extensive experience reviewing risk analyses in major hazard organisations, from a governmental position.

The experts were individually interviewed in a semi-structured way according to a predetermined conversation guide. These interviews focused on the role of risk identification and assessment in the prevention of safety incidents. The interviews were guided using the following questions: Do you have knowledge of how organisations deal with risks? What can you tell us about this? Do people in the workplace know the safety risks? Are their supervisors aware of the risks in the workplace? Is this the same for management? What is your experience with corrective actions when risks are identified? Where are the problems? Do you have examples of incidents in the processes where you yourself were involved in the risk inventory/analysis? If so, was there a relationship/no relationship between the identified risks and the incidents? These questions served as guidance, and were posed if and when they were considered applicable in order to obtain as much information as possible from the different interviewees, without disturbing the natural flow of the interviews.

The following is a summary of the most salient topics in the interviews.

Barriers hampering the influence of risk identification/analysis

The interviewees did not paint a positive picture about the influence of risk analyses in major hazard organisations. According to these experts, risk analysis suffers from some

inherent difficulties, such as the required combination of creativity and technological expertise in one person, the limited imagination of people combined with the invisibility of complex risk scenarios,[2] the unpredictability of human error,[3] the subjective nature of risk assessment, the potential operational restrictions caused by the identification of design flaws, and the complex communication process required to ensure that operational staff are informed about the identified risks and aware of how to deal with them in their practice.

The interviewees noted several barriers affecting the quality of risk analysis processes. We summarise these barriers as: team composition (number, expertise, mix, hierarchy), validity of documentation (e.g. P&ID), time constraints (insufficient time allocated to investigate unexpected findings), loss of data (due to malfunctioning ICT), incompatible interests (competition and distrust between departments/organisations),[4] loss of momentum (no periodical analyses, or monitoring the influence of preventive measures during operations), driven by compliance[5] (certification, license to operate), commercial influence (suppliers hiding information), limited scope (methods used don't cover all risks), application (differentiation between standard operations and start-up/shut-down, maintenance),[6] and language barriers.[7] An important barrier with operational implications for risk analyses is the lack of unambiguous international norms for process risks, which prevents the objective evaluation of safety risks, and the acceptance of risk analysis reports by the different parties involved.[8]

In summary, the experts we interviewed to obtain their views on the influence of the risk analysis practice in major hazard organisations, suggested that the identification and assessment of safety risks is a subjective and incomplete process. Common practice does not produce a reliable representation of all potential safety risks. Organisations pretend that they have tackled all risks, but experts wonder whether it is possible to identify and analyse all risks.[9] Many risk analyses are performed in an inadequate manner, but the reports comply with governmental regulations. Leaders live in an illusionary world, believing that their operations are safe.[10, 11] It should not therefore be surprising when major incidents occur as a result of unrecognised risks.[12]

2 Perrow (1999).
3 Groeneweg (1992), p. 22.
4 Beck (1986), p. 6.
5 Kluin (2014).
6 Reason (1997), pp. 85–104.
7 Lindhout and Ale (2009).
8 Fischhoff and Lichtenstein (1984), pp. 61–63.
9 Pasman (2015), pp. 168–171.
10 Motet and Bieder (2017).
11 Beck (1986), p. 28–32.
12 Taleb (2010).

Risk awareness of operating staff

The experts were pessimistic about risk awareness at work floor level. One expert suggested that people in operations do know the safety risks, but also that there is a trend of *Normalisation of deviation*, meaning that certain deviations from safe practices have become the normal way of working. The other four experts explained that, for various reasons, the operating staff's knowledge of risks is insufficient. A lack of information communicated from risk analysis teams to operating staff seems to be an important reason.

Risk awareness by leaders

The answers to the question of whether supervisors are aware of the safety risks are also a cause for concern. Reasons include a lack of information, poor communication, or that risk analysis is considered 'owned' by technical departments. The experts are clear that operational leaders lack knowledge about the major hazards.

9.3 The view of the Dutch Safety Board

Summary

When a safety incident is considered to have a potentially major impact, the Dutch Safety Board may decide to investigate its causes.[13] The scope of investigations is not limited to one particular sector or activity, but involves organisations of different types, in different domains. Where leadership is mentioned in a board's reports as a contributing factor, this often refers to leaders at different levels in the organisation's hierarchy, from chairpersons and CEOs to shift leaders at work floor level. Once the board's investigation reports have been published, the leaders of the organisations concerned are under the spotlights of the (inter-)national press, other media, peers, principals, clients, authorities, and so on.[14, 15, 16, 17, 18, 19] Public communication by these sources regarding a lack of leadership as one of the causes of a safety incident puts these leaders in very uncomfortable positions, and may affect the reputations of the organisations they lead.

Twelve investigation reports by the Dutch Safety Board (*Onderzoeksraad voor Veiligheid*) into safety incidents in the Netherlands were analysed as part of this research. This stage of the research was introduced after we considered the results of the reviews with the incident investigators, who suggested that insufficient recognition of risks is in an important reason for major incidents. This suggestion was the reason for investigating the role played by the recognition of safety risks. The board has investigated many (potential) major incidents since its founding, in many different business sectors.

13 Rijkswet Onderzoeksraad voor veiligheid (2004).
14 Onderzoeksraad voor Veiligheid (2007).
15 Onderzoeksraad voor Veiligheid (2008a).
16 Onderzoeksraad voor Veiligheid (2008b).
17 Onderzoeksraad voor Veiligheid (2012).
18 Onderzoeksraad voor Veiligheid (2013c).
19 Onderzoeksraad voor Veiligheid (2015).

In this section we present a selection of major incidents which have occurred in the business sectors considered by this research, and which were investigated by the board. The investigation reports considered were selected according to the following selection criteria: 1) the variety of the specific domains; and 2) their relatively high community impact. Our analysis included the tank storage, hospital, rail infrastructure and general infrastructure sectors, the process industry, and the oil and gas industry. The 'Other' category was not considered as it does not represent a specific area of investigation. We focused on the board's reporting of the role of risk awareness and risk assessment as contributors to these incidents in our review.

Tank storage

Report #1: This investigation was conducted due to an environmental spill caused by the rupture of a storage tank bottom. Concerning the cause of the spill, the board concluded that: "… it was known that the technical state of the tank exceeded the acceptance criteria of EEMUA 159 and one was aware of the risks involved. Nevertheless, based on the argument that the Licence to Operate did not require the tank quality to be tested according to these EEMUA 159 criteria, the organisation did not act upon that awareness", and "… due to the lack of historical information about the construction of the tank, the organisation was not able to use the knowledge of the weak tank support and the safety risks involved."

Report #2: This investigation was conducted due to an uncontrolled situation at the tank storage farm, creating increased safety risks for employees. Concerning the cause of this uncontrolled situation, the board concluded that: "…the company had no complete insight into its primary processes, installations and the safety risks involved", "… as there was no way to conduct an effective hazard identification process, there was no complete picture of the major risks", "… the risk identification of process safety risks was performed in an insufficient way", "… the risk identification of hazardous substances is insufficient and inadequate", and "… many of potential incident risks have not been assessed in the HAZOP-study…".

Hospitals

Report #3: This investigation was conducted due to the deaths of several patients after or while undergoing weight-loss surgery. Concerning the cause of these deaths, the board concluded that driven by the aspiration of innovation, "none of the parties involved viewed the introduction of bariatric surgery as an innovation of care provided that introduced particular risks for patients…", "none of the parties involved with the hospital displayed awareness of the risks of bariatric surgery, its complex forms in particular", and "…insight into the interrelated risks was largely absent…"

Report #4: This report by the board was prompted by the identification of high mortality rates after heart surgery. Concerning the cause of this mortality, the board concluded

that: … "the managerial activities related to risk analysis and learning from incidents in the hospital were not aimed at (having) an inventory of risks in the primary business process. Rather, the Board of Directors focused on external risks and threats to the primary business process, such as competition from other hospitals.

Process industry

Report #5: This report concerns the investigation of an event comprising two severe explosions, followed by a large fire. Two employees were seriously injured in these incidents, and an immense amount of damage was caused to assets. Debris was retrieved at a distance of around 800 metres from the place where the explosion took place. The blast was heard 20 kilometres from the plant. A very large local fire generated considerable amounts of smoke. Concerning the cause of this incident, the board concluded that: "… the company failed to identify and control the risks associated with the plant modifications and with the execution of chemical processes …", that "… earlier modifications did not always lead to a new risk analysis. The subject chemical reaction failed to be identified as a result…", that "… work instructions were inadequate, which was not identified, creating risks that Shell Moerdijk failed to control…", that "… the company failed to recognise that the subject process, involving a reactor vessel containing ethylbenzene and this catalyst, is always dangerous to work with in itself…", and that "… various signals concerning the risks that arose failed to be recognised and dealt with as such."

Report #6: This investigation was prompted by four serious safety incidents at a multi-company chemical site. One of these incidents caused fatal injury. The majority of the technical assets on this site were old (> 40 years in service). Concerning the factors of causation in these incidents, the board reported the following general findings: "… the inspection and maintenance of installations is inadequate…", "…work instructions are inadequately used…", "… there is insufficient learning from incidents", "… flawed risk identification…", "… flawed risk assessment", and "… insufficient awareness of process parameters…" Based on these findings the board concluded that: "These factors involve weaknesses in the control of process safety and indicate a lack of systematic research into possible improvements in the control of process safety in the chemical installations as a whole."

Oil and Gas industry

Report #7: This investigation was due to the explosion of a natural gas condensate tank, resulting in two fatalities, one seriously injured person and severe material damage. Concerning the cause of this explosion, the board concluded that: "…The officials for the client and the contractors involved insufficiently identified the process safety risks. The process safety risks that were identified were underestimated and the safety measures planned were insufficiently executed."

Report #8: This investigation was due to earthquakes caused by the exploration of natu-

ral gas, resulting in severe damage to many buildings in the area. Concerning the cause of these earthquakes, the board concluded that: "…the parties involved did not regard earthquakes as a safety concern for the citizens of Groningen", "… the parties concerned deemed the safety risk to the population negligible, and thus disregarded the uncertainties surrounding this risk assessment."

Rail infrastructure

Report #9: This investigation was due to a rail grinding train on a transfer journey colliding with a building (shop), resulting in severe material damage. Concerning the cause of this collision, the board concluded that: …" the companies involved did not adequately map the risks involved in this type of journey…", "… the companies were not aware of some of the risks of transfer journeys and limited themselves to other risks as described in legislation…", and "…the companies involved did not sufficiently recognise the specific safety risks of transfer journeys…"

Report #10: This investigation was due to a collision between a train and a mobile lifting platform, resulting in the death of the train driver, three slightly injured people and severe material damage. Concerning the cause of this collision, the board concluded that "…risk assessments do not include the risk of trains colliding with heavy vehicles…", "… the risk of crossing the rails was assessed too optimistically by the driver of the vehicle…", and "… road managers are not adequately safety aware of this type of risks…."

General infrastructure

Report #11: This report was based on an incident in which two barge-based cranes toppled while lifting a bridge deck (187 tons dead weight), causing serious equipment damage (the bridge deck and total loss of both cranes, among other assets), and the destruction of houses and shops. Concerning the cause of this incident, the board concluded that: "None of the parties involved realised that lifting the bridge section entailed risks to the environment and for citizens." "None of the parties realised that for this reason there were potentially serious consequences for local residents." "All parties involved had a blind spot for the safety of the surrounding area during the preparation and implementation of the bridge renovation."

Report #12: This investigation was conducted due to multiple incidents (suffocation) related to carbon monoxide, causing between 5 and 10 fatalities, and some hundreds injured people per annum, plus an unidentified number (estimated at 3 to 5 times these numbers) of fatalities not formally related to carbon monoxide. Concerning the cause of these incidents the board concludes that: "… the hazard of carbon monoxide is an underestimated problem." "The board identifies gaps in the system that must provide guarantees for the supply of safe products (combustion installations and carbon monoxide detectors) and the services provided by expert installers. The Netherlands is lagging behind compared to neighbouring countries."

9.4 Summary

Based on the conclusions of the Dutch Safety Board regarding the causes of major incidents as presented above, we suggest that all reviewed incidents could have been prevented if the safety risks had been identified and risk management mechanisms had been in place and functional. The reports by the Dutch Safety Board offer proof that seemingly safe operations still may contain weaknesses where the management of safety risks is concerned. Society does not take these potential unsafe situations for granted and therefore many organisations risk the loss of public reputation. This is considered a serious business risk, and so organisations, voluntarily or as required by law, put much effort into the development of better, more effective risk management philosophies, methods and practices.

Whether there will actually be a major incident and its potential maximum severity has much to do with the specific context which allows the devastating energy to be available, how this availability develops in a specific form of loss of control, and what coincidental influences stimulate the trigger for an event to occur. Dekker refers to this process as "Drifting into failure."[20] Even when that failure has materialised and the damaging energy has managed to become uncontrolled, the outcome of the event remains uncertain. Groeneweg refers to this situation as the "irreducible unpredictability and disorder of the outcomes."[21] Uncertainty is thus an inescapable factor that must be taken into account where it concerns the predictability of major incidents and the ability to identify, assess and manage the risks by taking the right preventive decisions.[22, 23, 24, 25, 26, 27] In that respect Pasman argues: "Incident scenarios can be very diverse and therefore difficult to predict, at least with respect to details about how an event will initiate, develop, its likelihood and what influences it will have."[28]

The incident reviews referred to in this chapter demonstrate the confidence of members of organisations that their primary processes were safe at the time they decided to operate them, but this confidence is based on individual perceptions about the absence of potentially dangerous threats, and/or the likelihood that these threats will develop into a major incident. In that illusory certainty, all people involved, whether leaders vis-à-vis their followers, doctors vis-à-vis their patients, train drivers vis-à-vis their passengers, and so on, are convinced about the acceptability of the level of safety in their area of

20 Dekker (2011)
21 Groeneweg (1992)
22 Fischhoff and Lichtenstein (1984)
23 Dekker (2011)
24 Perrow (1999)
25 Groeneweg (1992)
26 Reason (1997)
27 Van Asselt (2000)
28 Pasman (2015), p. 28.

responsibility, or in their positions as potential victims of safety incidents.[29] Often, they are right, but sometimes they are proved very wrong.

The next and final chapter presents the final conclusions of this research, including recommendations for fostering Process-oriented leadership. This chapter also explains the applicable limitations of this research, and makes proposals for further research.

29 Motet and Bieder (2017)