The Corporate quest for zero accidents: A case study into the response to safety transgressions in the industrial sector

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Abstract

Since the 1990s, the idea that accidents should be reduced to zero is gaining growing acclaim in the fields of road safety and occupational safety and health. As most of the literature on this so-called Zero Accident Vision (ZAV) deals exclusively with its application to road safety, which is a public sector responsibility, there is a need to learn more about the way it is implemented by private companies. This paper reports on a case study into the zero accident approach followed by steel company Tata Steel IJmuiden (the Netherlands). The study suggests that private sector advocates of the ZAV, unlike their public sector counterparts, tend to view safety aspirations and economic considerations as mutually reinforcing. However, it is shown that this harmony model does not entirely hold in practice. The findings also highlight another discrepancy. Characteristic of the ZAV is a systems-theoretic focus on identifying root causes of unsafe situations rather than on individual error and blame. Yet employee behavior appears to be a major target for Tata's safety policy and several managers insist on punishing unsafe behavior. Paradoxically, this punitive tendency seems partly stimulated by and at the same time could hinder the very ambition of eradicating all accidents.

Keywords

Occupational safety; Safety management; Safety culture; Zero accidents; Systems theory; Blame

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1. Introduction

It is almost commonplace, today, to say that western societies have become increasingly risk averse (cf. e.g. Burgess, 2011; Douglas & Wildavsky, 1982; Furedi, 2009; Scott, 2000). A specific expression of this development is the growing importance of the so-called Vision Zero or Zero Accident Vision (ZAV), which aspires to a world without severe and fatal accidents, or, in some versions, even without accidents at all. Since being introduced in the 1990s, the ZAV and similar philosophies have been adopted in several countries across different continents (Sherratt, 2014; Swuste, Albrechtsen, & Hovden, 2012; Young, 2014). The ZAV is best known as a (Scandinavian) road safety program, but is also being applied in the field of occupational safety and health (Zwetsloot et al., 2013). A growing number of companies are committing themselves to the pursuit of zero accidents and, in countries such as Finland, Germany and the Netherlands, share best practices in Zero Accident Networks (Partnership for European Research in Occupational Safety and Health, 2014; Zwetsloot et al., 2013).

The rise of the ZAV has not gone unnoticed in the scientific literature. However, most of the available literature deals exclusively with the ZAV in road safety (e.g. Elvebakk & Steiro, 2009; Fahlquist, 2006; Johansson, 2009; Rosencrantz, Edvardsson, & Hansson, 2007). Much less attention has been paid to the implementation of the ZAV as an occupational safety philosophy in the private sectora. Recently, some empirical studies have been published about the ZAV in this rather unknown application area (e.g. Sherratt, 2014; Young, 2014), but there is a need for more research (cf. Zwetsloot et al., 2013).

Two questions are especially worthy of investigation. The first has to do with the ethical content of the ZAV and its alleged neglect of economic laws. In a discussion of the Scandinavian zero accident approach to road safety, Elvik (1999) criticizes the reasoning that the moral unacceptability of traffic fatalities forbids that cost be a barrier to reducing the number of traffic fatalities as far as possible. According to Elvik, the economic law of diminishing marginal returns implies that it would be more reasonable to stop spending extra money on road safety at some point, as this money could save more lives when spent in other ways, such as on health care. Since road safety is traditionally a public sector responsibility and hence not subject to free market considerations such as profit and returns, there is ground to hypothesize that the ZAV's disregard for economic rationality is

typical for its application in the public sector and does not, or to a lesser extent, apply in the private sector. Our question is therefore: How does the ZAV in the private sector relate to economic considerations?

The second question concerns the tension between the zero accident approach and another way of responding to unsafe situations, that is, by punishing those who err or break the rules. The ZAV takes a system approach in which the primary responsibility lies with the designers of a system, not with the system users. Unsafe behavior is perceived as a symptom of underlying problems with the system, at least when not originating in bad intent or gross recklessness, and taking refuge in blaming individuals for such behavior is rejected (Langeland, 2009; Tingvall & Haworth, 1999; Young, 2014). However, blaming individuals for unsafe behavior is a response that has deep roots in western culture and still holds considerable appeal (Dekker, 2012; Dekker & Nyce, 2012). Dekker (2011) even argues that the tendency to criminalize human error, as he calls it, is on the rise. Furthermore, it could be argued that there is an association between a zero accident strategy and a zero tolerance policy (cf. Sherratt, 2014), which would mean that striving for zero accidents provides a sort of intuitive stimulus to blame unsafe behavior of individuals, notwithstanding the ZAV´s explicit rejection of blaming individuals. This begs the empirical question of whether companies that apply the ZAV manage to resist the temptation to criminalize human error on the part of their employees.

This paper contributes to the empirical knowledge on the implementation of the ZAV in the private sector and to answering the two questions outlined above. It does so by presenting and analyzing the results of a case study into the zero accident approach followed by steel multinational Tata Steel on its site in IJmuiden, the Netherlands. The case study consists of semi-structured interviews with more than twenty managers from three different levels, a survey among employees below the level of middle management, and an analysis of relevant company documents.

In the remainder of this section we provide a further introduction into the responses to unsafe situations we just described: the Zero Accident Vision and what we will call, following Dekker (2011), the approach of criminalizing human error. After that, we describe the

methodology of this study in more detail. In the next section, the results are presented. These results are discussed in the last section of the paper, which also contains conclusions.

1.1. Zero Accident Vision

As touched upon before, most of the thinking and writing about the ZAV thus far has taken place within the context of road safety. We briefly discuss the most relevant elements from this body of knowledge and compare these with what is known about the ZAV in the private sector. Furthermore, we take a look at the broader context of the ZAV.

Whitelegg and Haq (2006) characterize the ZAV as ethical in nature, since it refuses to accept lifelong suffering or human death as a result of traffic accidents. This refusal entails an unorthodox allocation of responsibility. Although the role of road users in avoiding traffic accidents is not denied, they are not, like in traditional approaches, deemed primarily or solely responsible for road safety. Instead, the responsibility for safety is skewed toward the designers and administrators of the system, because of their supposed capability to change the parameters of the system so as to achieve the goal of 'zero'. User disobedience, negligence or failure to understand the rules do not reduce the responsibility of the system designers and administrators, but are considered indicators that show where system improvement is needed (Fahlquist, 2006). In Sweden, where the road safety version of the ZAV was first adopted, this distribution of responsibility has been laid down in the following rules:

1. The designers of the system are always ultimately responsible for the level of safety within the entire road transport system.
2. Road users are responsible for following the rules set by the system designers.
3. If road users fail to obey these rules for whatever reason, the system designers are required to take necessary further steps to prevent people from getting injured or killed (cited in Tingvall & Haworth, 1999, p. 2).

An important assumption of the zero accident approach to road safety is that human error cannot entirely be excluded. The road transport system therefore needs to be arranged such that the consequences of human error do not exceed the resilience of the human body (Langeland, 2009; Whitelegg & Haq, 2006). In other words, the road environment ought to

be forgiving of mistakes by road users (Bax, De Jong & Koppenjan, 2010; Tingvall & Haworth, 1999).

Not everyone is convinced that the forgiveness of the system can be raised to the extent necessary to actually reach the goal of zero serious injuries and fatalities. Some authors have argued that the ZAV is no more than an image of a desired future, whose function lies in appealing to those individuals who have the ability to improve things (Elvebakk & Steiro, 2009; Langeland, 2009). However, scientists involved in the ZAV argue that it should not merely be perceived as a representation of a desired future, but as a scientific goal that is set to be achieved (Langeland, 2009; Rosencrantz et al., 2007).

The debate on the character and attainability of the road safety ZAV shows that referring to it in the singular is a bit artificial. As the authors writing about this approach and the countries that have adopted it do not always agree in their interpretations and elaborations, the road safety ZAV has in fact different versions. When we turn to the ZAV in the context of the private sector, it is even more difficult to give a clear description of its content. Thus far, efforts to define the corporate ZAV have been scarce and, due to its application in a large number of companies, its potential for varying interpretations exceeds that of the road safety ZAV.

Notwithstanding these difficulties, attempts to discover the common core of zero accident approaches in the private sector reveal obvious similarities with the ZAV in the road safety context. Like the road safety ZAV, the corporate ZAV is motivated by ethical considerations. Zwetsloot et al. (2013, p. 46) see a connection between the ZAV and the paradigm of Corporate Social Responsibility, and call accident free workplaces ‘the only ethically sustainable safety goal’. Debate about whether the ZAV is to be seen as a concrete target or rather a strategy to raise commitment to safety is also apparent in the literature on the corporate ZAV (Sherratt, 2014; Swuste et al., 2012; Zwetsloot et al., 2013). Furthermore, there is correspondence between the zero accident approaches in both domains with respect to the shift in responsibility toward system designers and administrators. Different authors emphasize that pursuing the corporate ZAV requires leadership of the management of companies and paying attention to systemic causes of accidents rather than to individuals’ actions (Young, 2014; Zwetsloot et al., 2013).

However, there seems to be a difference regarding the scope of the responsibility that system users retain. According to Zwetsloot et al. (2013, p. 45), 'without the personal commitment of every individual person in the company, ZAV cannot be realized'. In the zero accident approach to road safety, system users appear to have been assigned a less crucial role. Although the obligation of road users to follow the rules is explicitly articulated, the success of the ZAV is not made dependent upon the commitment of every road user. Instead, efforts are aimed at designing a road transport system in which even the not-so-committed will cause little or no harm (cf. e.g. Tingvall & Haworth, 1999). There is some logic in this difference between both versions of the ZAV, as it seems easier for the management of a company to promote the commitment of every employee than for the administrators of a road transport system to promote the commitment of every road user (cf. Langeland, 2009).

The observation that system users in the corporate ZAV retain a crucial role would mean that the shift in responsibility toward system designers and administrators in this field is less radical than in the road safety ZAV. From this perspective, it is no coincidence that the principles presented by Zwanikken and Zwetsloot (2012) as the core of the corporate ZAV place much less emphasis on the responsibility of the system designers than the Swedish rules cited above. The principles of Zwanikken and Zwetsloot read as follows:

1. All accidents can be prevented.

2. Every accident is unacceptable.

3. The management proactively advertises that every accident must be prevented.

4. Learning from accidents is considered key to the success of the ZAV (our translation).

Although the ZAV in its different forms dates from the 1990s, it is rooted in a much older way of thinking about human behavior, error and safety, which is referred to as the environmental hypothesis. The environmental hypothesis perceives the actions of an individual in the broader context of the surrounding environment. It can be traced to the work of Crystal Eastman, at the beginning of the twentieth century, who attributed accidents to different environmental factors such as working conditions, high production pressure, fatigue, heat, noise and inexperience (Swuste, Van Gulijk, & Zwaard, 2010). In the

1920s, Lewis Deblois followed up on this line of reasoning and argued that not the worker, but the management is ultimately responsible for a lack of safety. He also perceived accidents to be the result of a sequence of events and argued that they should be investigated as such (Swuste, Van Gulijk, & Zwaard, 2009; Van Gulijk, Swuste, Ale, & Zwaard, 2009).

Reason (2000) refers to the environmental hypothesis as the system approach and highlights the following implications: (1) errors are to be expected, because humans are fallible; (2) errors are to be viewed as consequences rather than causes; (3) human errors highlight traps in the workplace, therefore, not *who* made the mistake is important, but *how and why* this happened and *what* can be done to prevent it.

With its emphasis on the preventability and unacceptability of every accident, the ZAV adds to the tradition of environmental thinking a certain utopian flavor. This addition, the 'zero' element, brings yet another tradition to the attention. According to Zwetsloot et al. (2013), the ZAV is part of a family of 'zero visions'. Some other members of this family are the visions of zero defects, zero wastes, and zero emissions. Interestingly, Zwetsloot et al. argue that these zero visions do not only have ethical kinship, but also have in common that they were initially criticized for being unrealistic or too expensive, while later on business cases proved to be realistic. The zero defects movement, for instance, demonstrated that the costs of low quality were much higher than the costs for generating better quality. By analogy, Zwetsloot et al. suggest that the costs of a lack of safety are higher than the costs connected to the pursuit of zero accidents. This would mean that besides ethical considerations there are good economic reasons for adopting the ZAV.

1.2. Criminalizing human error

The tradition of environmental thinking, with the ZAV as a particular form, can to a certain extent be seen as a correction to an individualized way of dealing with unsafe behavior. The individual hypothesis, as Swuste et al. (2010) call it, has just like the environmental hypothesis a venerable history. In the tradition of the individual hypothesis, accidents were viewed as the result of a poor execution by individual employees of given orders (Guarnieri, 1992). Scientists therefore tried to identify 'susceptible workers', individuals who had an above average chance to be involved in an accident. This line of reasoning resulted in the

first scientific safety theory, the accident proneness theory, which was initiated by the work of Greenwood and Woods in 1919 (De Winter, 2014; Rodgers & Blanchard, 1993; Swuste et al., 2010).

Reason (2000) uses the term person approach to refer to the individual hypothesis. He argues that followers of this approach view errors as moral issues and subscribe to the just world hypothesis, which states that bad things happen to bad people. The person approach is embedded in the idea of free will; human behavior is perceived as a rational, conscious decision making progress. Safety transgressions can therefore be attributed to the individual and punishment poses as an effective way to respond to human error. In this sense, punishment represents the means to the end of preventing human error. So, the approach of criminalizing human error can be considered a manifestation of the person approach or individual hypothesis. According to Dekker (2011), error has come to be viewed as a failure of character. He states that thinking in terms of human error implies negligence (how can there be error without it?). Holding someone accountable for his errors is based on the utilitarian idea that punishing one person will ultimately ensure the safety of the rest of the population (Dekker, 2003). Punishing one to prevent an error or rule transgression, is in accordance to the rational choice paradigm. Proponents of the rational choice theory will argue that punishment is a cost item in the cost-benefit analysis which precedes any rule transgression. In this view, punishment can operate as a measure taken to either deter the offender, or discourage his peers to exhibit similar behavior.

Yet, this is not the only way by which the use of punishment can be explained. Reason (2000) argues that the person approach is based on other grounds as well. Blaming individuals rather than targeting institutions would simply be more emotionally satisfying and seeking to uncouple a worker's unsafe act from institutional responsibility would be in the interest of managers. A broader observation on punishment comes from Garland (1990, 1991), who describes it as a social phenomenon in the context of social life. He writes that although there is no reason to expect an overall positive effect from punishment, it remains an important institution within our society. Rather than a means to an end, Garland argues punishment to be an expressive institution, an emotional response. According to him, punishment lies at the basis of our social order and operates as the ultimate manifestation of her power. This suggests that at a sub-rational level criminalizing human error has a

stronger appeal to people than the systems-oriented approach to human error advocated in the ZAV.

2. Method

2.1. Data collection

As was stated before, the data collection took place at Tata Steel IJmuiden in the Netherlands. Tata Steel IJmuiden is one of several companies in the Netherlands that have publicly committed themselves to the goal of zero occupational accidents (Tata Steel IJmuiden, 2013c; Zero Accidents Network, 2015). The company was selected because of its willingness to grant the researcher access to employees from all levels of the organizational hierarchy.

All data were collected by one researcher, the first author of this paper. The research was carried out from May to July 2013. The main research method involved conducting interviews. Potential respondents were selected by means of *a priori* selection and the snowball method. They were explained the purpose of the study and were invited to participate in a one hour semi-structured interview. The company provided the researcher with the opportunity to start the research by interviewing some of the top executives within the business unit 'Strip Products Mainland Europe' and to descend the hierarchical ladder from there. Subsequent research within the business unit was done within three departments: 'Manufacturing Iron & Steel', 'Manufacturing Rolling & Coating' and 'Engineering & Site Services'. Twenty-five Tata employees were approached to part-take in the research, 23 of them consented to do so. Incidentally, three interviews were conducted with Tata employees who fall outside the hierarchical chain just described. Their selection was the result of the snowball method. Most interviews were recorded with a voice-recorder and subsequently transcribed for further analysis. When recording the interview proved impossible, extensive notes were taken during the interview. As most interviews were in Dutch, the quotations used in this paper were translated to English.

To enable a categorization of the statements that Tata respondents made and to view the acquired information within the right context, the respondents are classified into three groups. The classification of the respondents into either one of these three groups is done in accordance to their position. Group one can be described as 'top management': Individuals

in this group hold an executive position at Tata Steel IJmuiden. Group two is defined as 'senior management': The individuals who belong to this group bear the responsibility for one of the many divisions within the three departments that were mentioned. The third group is classified as 'middle management': Individuals who have been categorized into this group are responsible for a specific part of one of the divisions. They are for example in charge of production or technical maintenance or fulfill a managerial position at a project.

The semi-structured interviews covered various safety related topics: (the interviewee's) general opinion on safety, prevention (measures, perceived obstacles, reach), disciplinary action (nature of transgressions, responding to undesired behavior, use of punitive measures), company culture (acceptable and unacceptable behavior, addressing undesired behavior, safety reports), incidents (definitions), dealing with incidents (responding to, investigating, looking for cause or blame), external influences on safety policy (third parties, regulations, outside contractors on site), vision on safety (returns and investments, future developments, reaching zero, role of disciplinary action).

The second research method adopted is that of a survey. In order to get a better understanding of the way in which the policies created by the managers are experienced on the work floor, a questionnaire was administered among the employees operating below the middle management level. All of these employees work at one of the plants in IJmuiden as either a factory worker, team leader or duty officer. They are subject to the safety policy and are supervised by some of the respondents that were interviewed. The questionnaire focused on the topic of safety commitment, safety regulations and deviation from the rules. Seven divisions were approached and asked for permission to distribute the questionnaire. Three of these divisions authorized the request. After consulting with the responsible managers, the number of questionnaires that could be distributed was agreed upon. The respondents of each division were selected at random. The vast majority was approached via e-mail, a small number by paper questionnaire. A week after the first e-mail, those respondents who had not yet filled out the questionnaire, received a second e-mail to remind them of the pending request. After another two weeks, the non-responders received a final reminder and were given a full month to grant this request. In the end, a total number of 197 invitations were sent, 64 of these questionnaires were returned, setting the average response at 32%. The vast majority (79.7%) of these participants has been

working for Tata Steel for over five years, but no more than 10. Nearly 44% holds a managerial function.

The questionnaire consisted of 53 multiple choice questions. Apart from the introductory questions, it had a response scale which consisted of five categories: 'agree', 'slightly agree', 'neutral', 'slightly disagree', and 'disagree'. Respondents were asked to respond to various statements regarding their own behavior, observed behavior of colleagues and regarding the company's safety policy. For example: 'I always report unsafe situations', 'My colleagues follow all safety procedures as closely as possible', 'The investigation of a safety incident serves to identify the cause of the incident' (full questionnaire available on request).

The third research method was a content analysis. The analysis involved public documents such as annual reports, sustainability reports, the company websites and documents attained via respondents (e.g. material used for informing and training employees in the field of safety).

2.2. Data analysis

The analysis of the interview data (559 pages of transcripts and notes) roughly took place in two phases. In the initial coding phase (Charmaz, 2014), raw research data were labeled using informant terms, concepts, and terms from everyday life. For example, managers tried to explain the occurrence of unsafe behavior. Some of the codes used to label their explanations were: 'short-cut (production pressure)', 'short-cut (laziness)', 'craftsmanship', 'resistance to rules', 'occupational blindness'.

The large number of codes that emerged during the initial phase was assembled and reduced to a more manageable number of themes in the phase of focused coding (Charmaz, 2014). The aforementioned codes, for example, were assigned to the theme 'employee attitude and behavior'. We then also started going back and forth between the data, concepts, themes and the literature to make sense of the larger picture. The actual coding was undertaken by the first author and discussed with the second author during several meetings.

Tata Steel IJmuiden

Tata Steel Limited was established in 1907 and is part of Tata Group which consists of over 100 companies in different business sectors. Tata Steel is among the top ten global steelmakers in the world and is the second largest steel company in Europe. The company has named 'excellence in health and safety' a key business imperative (Tata Steel Limited, 2013a, p. 44). Tata Steel Limited has manufacturing operations in 26 countries and is commercially present in over 50 countries. The larger production facilities are situated in countries such as India, Thailand, Singapore, China and Australia, but also on the European continent, namely in the UK and the Netherlands. The part of the company that is operating in Europe formerly went by the name 'Corus' (Tata Steel Limited, 2013b). Data collection for this paper has been carried out at one specific European location: Tata Steel IJmuiden, in the Netherlands.

Tata Steel employs 11,000 people in the Netherlands. The vast majority of employees work in IJmuiden (about 9,000), but the company also operates in other locations, such as Maastricht, Oosterhout, Nieuwegein and Moerdijk. The industrial complex in IJmuiden is situated north of the North Sea Canal, it covers about 750 hectares of land and is within the territory of the municipalities of Beverwijk, Velsen and Heemskerk. The IJmuiden location features its own port and thus stands in direct connection to the North Sea (Tata Steel IJmuiden, 2011a, 2013a). It produced 6,6 million tons of crude steel during the financial year 2012-2013 (Tata Steel Limited, 2013a, p. 60). The steel that is produced in IJmuiden is used for different purposes, for example the automotive, construction and packaging industry. The IJmuiden location is home to a number of business units, such as 'Strip Products', 'Packaging Steel' and 'Research, Development & Technology'.

On its website, Tata Steel IJmuiden insists that safety is of top priority. This statement is supported by the aspiration of having no more than zero accidents. The slogan that is used to spread this message reads: 'We do it safe, or we don't do it at all' (Tata Steel IJmuiden, 2013c). Furthermore, the company states that its focus on safety does not end with the well-being of its own employees but also includes the well-being of external employees, such as firm personnel working on the Tata premises. Working on the industrial site implies being in a risk environment and according to the company's philosophy, it is Tata's responsibility to constitute a working environment that allows employees to reach their retirement in good health (Tata Steel IJmuiden, 2013d).

3. Results

In this section, we present the findings of our case study. First, we describe the considerations of Tata Steel's managers in pursuing zero accidents. Second, we discuss the managers' view on the role of employee attitude and behavior in the occurance and prevention of accidents. Next, we outline the responsibilities of managers and employees in dealing with unsafe situations, both proactively and reactively. The section ends with an identification of punitive elements in the company's policy in action.

3.1. Pursuing zero

The top management at Tata Steel IJmuiden indicates that it pursues a uniform safety policy across its site. The overarching goal that it has set for the organization is zero Lost Time Injuries (LTI: an occurrence that minimally results in lost time from work for one day or shift). This coincides with the first three corporate ZAV principles, which designate accidents as preventable and unacceptable (Zwanikken & Zwetsloot, 2012). Furthermore, the top management indicates that it attests to the common-cause hypothesis, which states that pathways of near-misses are similar to pathways of actual accidents (cf. Wright & Van der Schaaf, 2004). Therefore, the pursuit of zero involves a broader effort. It does not just cover LTI related incidents, but any unsafe situation is regarded as unacceptable.

The top managers state that the objective of zero LTI has not been imposed upon the organization from the outside, but is based on an intrinsic conviction. The interviews show that this conviction is mainly driven by two considerations. The first consideration is ethical in nature: Providing workers with a safe environment is seen as an essential condition of employment by the top management as well as the senior and middle management. The management therefore argues zero to be the only possible ambition a company can set for itself; setting the bar at one or more accidents is considered inexplicable. The ethical character of this consideration is clearly reflected in the following statements:

> I think we owe it to our people and I owe it to my conscience (senior manager).

> Man is the most fragile thing we have, so it's good that's what we put emphasis on (middle manager).

The second consideration has an economic basis. Zero LTI means one avoids all the costs involved with the occurrence of occupational injuries. However, this is only part of the consideration. Several managers also point out that the achievement of zero requires a high degree of what they refer to as 'process control'. They argue that successful safety management is intertwined with controlling for other factors, such as efficiency and product quality. Therefore, rather than an item of expense, safety is regarded as an investment. As a top manager puts it:

> It also yields money, because you can only work safely if you attain a certain degree of organization in your work, which does not only pay off in safety, but also in efficiency and effectiveness and quality, and a safe factory is a neat and tidy factory, and in a neat and tidy factory you make more good products and you make them right the first time. It is about overall efficiency.

There have been discussions about whether or not the ZAV is an attainable goal in practice. Most managers at Tata deny this to be the case. They perceive the zero as something that can never be permanently achieved, although some underscore that the zero can be held for extended periods of time. More importantly, not the goal, but the commitment to the goal is considered the most important factor in pursuing the ZAV:

> I'm not concerned about whether or not it is feasible; what's important is that we do everything we can to get there (senior manager).

3.2. Influencing attitude and behavior

The top management of Tata Steel makes two important assumptions about its employees. First of all, employees are perceived to be individuals who intrinsically want to work in a safe manner. The second assumption follows from the first one: If a safety incident does transpire, its occurrence was not the intention of the employee(s) involved. This is not to say that employee behavior does not contribute to an incident, but the contribution is seen as merely a direct cause and not the underlying root cause to the incident. It serves as evidence that the management has not succeeded in conveying their safety message well enough, or failed to design an optimal system. According to one top manager, an in-depth investigation into an accident will reveal 'in 100% of all cases' management related root

causes. This leads him to the conclusion that if the management had done a proper job, there would have been no root causes and therefore no direct causes either.

Notwithstanding the focus on root causes, the management of Tata addresses direct causes as well. Managers throughout the organization designate employee attitude and behavior as the most important direct causes to a lack of safety. The following quotes illustrate the importance attributed to these factors:

> All accidents are for 98% related to attitude and behavior (…), that is what we see (top manager).

> Ninety-nine percent of occupational safety has to do with behavior, and behavior can be influenced (senior manager).

As a consequence, preventive programs at Tata are characterized by a strong focus upon employee attitude and behavior. Yet, none of the respondents gave a clear definition of what these concepts were supposed to mean and most of them used 'attitude and behavior' as a singular concept. Despite the absence of a clear operationalization, attitude and behavior are targeted for the purpose of improving risk-awareness and the degree of ownership among employees. Employees are to become more conscious of the risks they take as stronger risk-awareness would enable them to 'sense' when (undesirable) risks are being taken. A senior manager gives this example:

> If I'm not wearing a helmet, immediately a sixth sense is telling you something is wrong.

Ownership is described as a display of employee responsibility and involvement in the company, which is expected to improve the willingness of employees to proactively cooperate with changes. As with the topic of process control, ownership on the part of employees is alleged to contribute to safety but also to yield other benefits:

> The more ownership grows, not just of safety but also when it's about installations and the well-being of workers, the more you see those things as a common interest, the better it gets (…). Knowledge, the level of responsibility, ownership should be raised. Then, safety, production performance, environmental performance will all head in the right direction (senior manager).

The importance that the interviewed managers attach to a sense of ownership within the company makes clear that their acceptance of responsibility for a safe working environment is not meant to inhibit workers from taking responsibility. On the contrary, the management wants all workers to incorporate safety fully into their daily practices. So, while the company's safety policy is focused on the functioning of the system as a whole, the worker as user and part of the system also receives a lot of attention. In order to come closer to the challenging goal of zero LTI it is deemed vital that every individual worker joins the effort. In the words of a top manager:

> Take responsibility yourself, nothing is easier than to say: someone in charge should do something about this.

3.3. Responsibilities in proactive safety management

The influencing of attitude and behavior at Tata Steel IJmuiden occurs in two stages: the proactive and the reactive stage (prior or in response to a safety incident). Each stage involves certain responsibilities for both the manager as system designer (top-down) and the workers as system user (bottom-up). This approach, as explained by Tata's managers, is depicted in Figure 1.

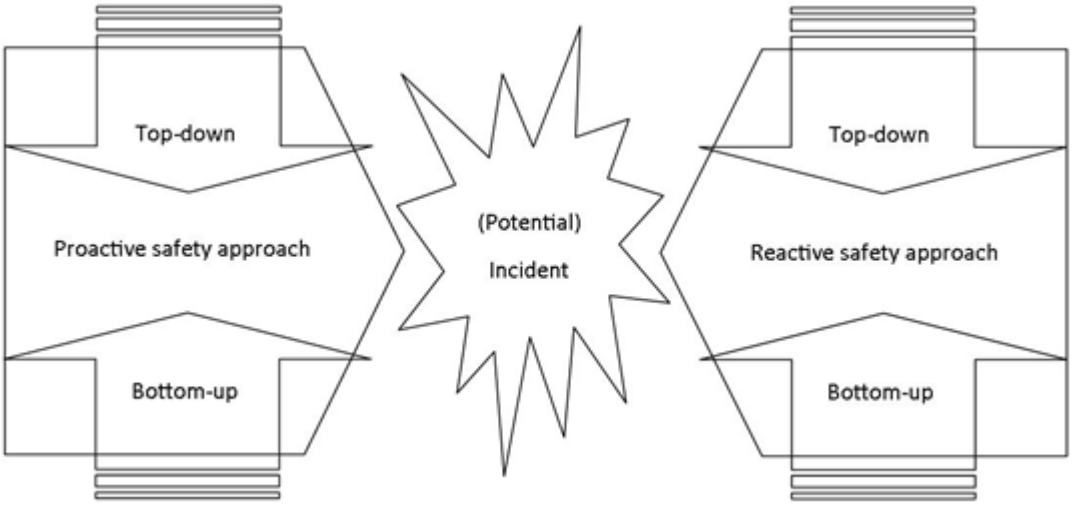

Figure 1: Safety management responsibilities

As regards the proactive management of safety at Tata Steel, the management responsibilities can be grouped into three activities: non-verbal as well as verbal communication and the allocation of resources. Conveying the safety message in a non-

verbal way is considered important. It is also referred to as 'demonstrated leadership' and is meant to show employees that the management does not just preach the safety message, but also exhibits the proper behavior. The simplest example is showing exemplary safety behavior. Through it, norms become known, whereas by not setting the right example, the safety message is considered lost. The following quote from a middle manager illustrates this:

> It has to do with yourself as well. There is my helmet, I always wear ear protection. It is about showcasing the safety message. I believe that as a manager, you have that responsibility (middle manager).

Another example of non-verbal responsibilities involves the (management) safety inspection rounds: the obligation top and senior managers throughout the company have bestowed upon themselves to visit the workplace to convey the safety message, supervise work safety and engage in dialogues with workers on the topic of safety. By performing these tasks themselves rather than delegating them, the management demonstrates its involvement in safety.

The safety message is also radiated through verbal communication. Managers consider it important to explain or discuss the need for rules that are unclear to workers and value learning why rules sometimes encounter resistance. Workers are informed about safety regulations, but also reminded of them prior to the start of an assignment. Other examples are: informing workers about safety expectations, showing involvement in daily problems and supervision. The diverse functions of this kind of interaction – getting insight into the employees' perspectives as well as conveying a message - are reflected in these two quotations:

> We want employees to engage in a discussion with us, so we can understand which dilemmas they are facing (top manager).

> We properly explain something the first time, then we keep repeating and confirming what we have told them. All of it is meant to prevent having to asking someone after an incident: 'didn't you know about….?' (middle manager).

A third element in the top-down responsibilities involves the provision of resources. Resources are a prerequisite to starting work safely. They can take different forms: physical

(Personal Protective Equipment (PPE), fences or walkways), technical (safety engineering), providing risk- and safety related information (e.g. tool boxes), mandating risk analysis and providing the tools for it (e.g. Risk Identification & Evaluation and work permits). Another manifestation of resources is the investment in employee training and education. Tata Steel IJmuiden is engaged in deploying a long-term program called 'Safety Teams' where all production and maintenance employees undergo a training that takes up four full-time weeks and which is fully dedicated to bringing attention to and getting people involved in safety. A more abstract manifestation of resources that should not be left unmentioned is 'time'. It is highlighted as a resource on its own since it is part of the tools employees are provided with so as to do their work safely. In the words of a middle manager:

> What we emphasize is: take your time, don't rush things, it's not worth it.

Although the management is primarily responsible for safety, workers are also expected to take their bottom-up responsibilities seriously. The most obvious responsibility is 'abide by the rules', but workers are also expected to use the safety equipment that is made available to them, point out possible ways to improve safety, not give production priority over safety, and assess risky situations prior to the commencement of their assignment. Finally, several managers mention that they value employees who discuss rules that come across as unworkable, as this would allow managers to re-explain certain rules and create support or to make necessary adjustments.

Importantly, the interviews reveal that in practice workers regularly disregard the instruction to take their time and prioritize safety over production goals, and that this is condoned in certain circumstances by at least some managers. Various middle managers talk about employees who perform or finish a task too hastily. One explanation the managers offer for this behavior (besides laziness, stress and frustration) is the 'felt tension' between safety and production goals, introduced when one is under time pressure. As a result, unsafe situations occur because employees deliberately violate the rules to get the job done quickly, or because they hastily start a job without assessing the risks involved. It is important to note that this argument contains the assumption that people would not violate the rules if the pressure to produce is absent. Moreover, the term 'felt tension' is specifically used by the managers, since most of them deny that they contribute to retaining such an

attitude or behavior in any way. Instead, they declare that they consistently convey the message that safety always comes first.

Although this may hold true for daily production, some of the project managers and maintenance managers who deal with standstills paint a different picture. One of them tells that safety and production are weighted against one another: Safety requires time, while such delays are undesirable with regard to the timely completion of work. Another middle manager states that when maintenance proceedings during a standstill suffer delays, workers use all means necessary to make up for lost time, thereby taking extra risks. Because of this trade-off, one middle manager observes, behavior that is normally considered unsafe, is condoned during standstills. A similar remark is made by another middle manager, who declares that production targets do overrule safety procedures at times:

> We're in a dilemma. Basically, we need to regulate safety, but as the time pressure increases, well…

Finally, a middle manager describes a project he has worked on recently, where certain essential safety measures were deliberately not taken to prevent the unplanned downtime of a factory.

The finding that safety is not always given priority over production goals is supported by the results of the survey among employees below middle management level. In order to assess compliance with the safety standards in daily work practice, we asked respondents to respond to 12 statements (questions 24-35, Cronbach's $\alpha = .901$), for example: 'I always work safely', 'my colleagues always work safely', 'I always report unsafe situations', 'I follow all safety procedures as closely as possible'. Table 1 shows that according to a large majority of the respondents (88.1%) work practices at Tata Steel IJmuiden comply with the safety standards. Only 2.9% indicate that safety is of minor importance in their daily work. However, when asked about reasons to violate safety standards (questions 41-47, Cronbach's $\alpha = .847$), more than one fifth (21.3%) of the respondents indicate that the urge to complete their work faster, or personal convenience may well be a reason for them to violate safety standards. Finally, we presented respondents with six statements that served to elicit their view on whether production goals or production pressure may negatively

affect safety (questions 48-53, Cronbach's α = .861). Some of the statements read as follows: 'Safety and production are at odds with each other', 'A higher production comes at the expense of safety', 'Safety is important, but it is actually production that comes in first place'. While a majority (54.5%) reject the suggestion that production may negatively affect safety, a substantial percentage of respondents (34.8%) agree.

Table 1: Safety in practice (n=64)

Construct	Agree (%)	Slightly Agree (%)	No Opinion (%)	Slightly Disagree (%)	Disagree (%)	N/A (%)
Compliance with safety standards	50.4	37.7	8.9	1.9	1.0	0
Violation of safety standards	6.5	14.8	10.6	12.7	48.6	6.8
Production affects safety	13.0	21.8	10.3	14.5	40.0	1.8

Thus, while most respondents indicate that their work practice complies with safety standards, the picture becomes less clear when respondents are confronted with statements concerning possible reasons for the violation of safety standards. Production pressure seems to be a strong motivator to deviate from the conviction to work safe.

3.4. Responsibilities in reactive safety management

The reactive stage involves the top-down and bottom-up responsibilities after a safety incident has occurred. Tata's safety management in this stage is principally devoted to learning from accidents and other incidents in order to improve the safety level, and so reflects the fourth corporate ZAV principle (Zwanikken & Zwetsloot, 2012). From the interview data and document analysis, three types of responses can be perceived: the submission of a safety report, the response to a violation of safety procedures and the 'systematic in-depth investigation' of an accident (in Dutch abbreviated as SDO). Safety reports are required for a range of incidents, they include every incident that results in an injury as well as certain near-misses and a loss of containment (Tata Steel IJmuiden, 2013b). An in-depth investigation is mandatory for every situation where an employee has suffered a work related injury (Tata Steel IJmuiden, 2011b), but, as several managers indicate, may also be carried out in case of near-misses or otherwise dangerous situations. Because such situations are more ambiguous than accidents, managers can decide for themselves if an investigation is useful.

Several top-down responsibilities are involved in the submission of a safety report. Safety reports are considered an opportunity to learn, offering the chance to prevent possible accidents from occurring. The management of Tata Steel therefore encourages employees to make such reports and makes sure that the act of reporting is as effortless as possible:

> We have a reporting system, which has been made easily accessible. We tell everyone, if you encounter safety related incidents […] make a report, because we can learn from it and it provides us with the opportunity to check if adequate measures are in place (middle manager).

The management takes responsibility for providing follow-up on reports, communicating this follow-up to the reporter and creating an 'open culture'. It is necessary for the success of this instrument that employees do not fear the act of reporting, which is why punitive action in response to a safety report is considered undesirable.

When managers observe an employee violating safety procedures, a so-called '1-2-3-policy' should be used. This three-step approach is designed to stop the unsafe behavior from occurring. At step one, the behavior of an employee is addressed and the supervising manager explains what kind of behavior is or is not expected and why. At this moment, the employee gets the chance to explain his actions. Step one allows for reciprocal influence: Both the worker and manager are offered an insight into a different perspective. If an employee persists with the undesired behavior, step two follows. At this stage, the manager has to make sure that the employee has understood what is expected of him and why. The second step also involves an official warning. If the employee still fails to change his behavior, an intervention is used (step three) to ensure that the behavior stops. Examples of an intervention are additional training or allocating an employee to a different task.

The occurrence of an accident mandates managers at Tata Steel to investigate what has happened. As indicated before, this is done by means of an SDO: a five-phase investigation with the ultimate aim of facilitating improvement by detection of root causes, which are believed to be influenced by management decisions and omissions. An SDO needs to be completed and reported on within 21 days of the accident. SDO investigation teams should consist of at least a manager (chair), a safety expert, a technical expert, and also the employees that were involved in and witnessed the accident (Tata Steel IJmuiden, 2014).

The first phase of the investigation is called the 'injury phase'; during this phase the impacts and effects of the accident are evaluated. The second step is called the 'emergence phase'. It outlines the context of the situation and requires the investigator to describe what exactly happened. Phase three examines the 'direct causes', it investigates which of the acts that were performed eventually led to the accident. It also describes other circumstances that played a role in the sequence of events. The fourth phase is about investigating 'root causes'. Root causes are defined as the causes of the direct causes which led to the accident, and are divided into personal, work-related and organizational root causes. Phase five is the final phase. During this last step in the investigation, root causes are traced back to management causes (Tata Steel IJmuiden, 2011b). The interviewed managers underline that looking for someone to blame does not belong to the objectives of an SDO. Rather, they see apportioning blame during or after the SDO-process as a threat, since fear of a possible sanction might impair employees' willingness to talk openly about what happened.

The bottom-up responsibilities are tied to the top-down responsibilities. Employees are expected to take immediate measures to eliminate existing danger, make safety reports, address unsafe behavior by co-workers, incorporate the feedback received after being subject to the 1-2-3-policy and cooperate with accident investigations.

3.5. Punitive responses to unsafe behavior

Despite the fact that Tata's managers acknowledge that blaming employees may have adverse effects on the process of learning from safety incidents, many of them believe that punishing unsafe behavior must have a place in Tata's safety policy. They ascribe punishment various functions, which may be related: affirmation and enforcement of the transgressed rule(s) and prevention. This is illustrated more or less explicitly by the following set of quotations:

> Punishment and reward, you try to find an appropriate balance between the two of them (top-manager).
>
> Punishment enforces our safety standards (senior-manager).
>
> Omitting a punitive response poses a risk (senior-manager).
>
> The safety policy cannot be allowed to become a paper tiger (middle-manager).

> Punishment acts as a preventive measure (middle-manager).

No wonder, then, that several managers deviate from the formal reactive procedures and respond to safety incidents in ways that fit the paradigm of criminalizing human error, namely by punishing employees when deemed appropriate. We have found no indications that the appropriateness of a sanction is determined on the basis of a clear distinction between 'honest mistakes' and bad intent or gross recklessness (cf. Dekker, 2012).

Our data reveal three different manifestations of punishment:

1. Applying the 1-2-3-policy as a sanction policy;

2. Responding in accordance to a zero tolerance policy;

3. Disciplinary action in response to an accident, prior to an SDO.

First, the aforementioned 1-2-3-procedure appears to be interpreted and used by some senior and middle managers not as a mere safety policy, but as a sanction policy. In this case, the 1-2-3-policy is used as a disciplinary reaction to unsafe behavior which builds up in punitive intensity: (1) verbal warning, (2) written warning, (3) disciplinary action (punishment). Managers who characterize the 1-2-3-policy in this way expect punishment to have a preventive effect.

> You are giving off a signal [by punishing], ensuring that he will not show that kind of behavior ever again (middle manager).

To be sure, the difference between the purely safety-oriented 1-2-3-policy and its punitive aberration may seem subtle. While punishment has no explicit role in the former, at least some of its safety-oriented measures, like assigning someone to another task, could be experienced as punitive. The different place of punishment in both versions of the 1-2-3-policy is probably best characterized as unintended side-effect versus means to the goal of safety.

Some of the senior and middle managers indicate that on their worksite, they use a different policy altogether. This so-called zero-tolerance policy involves the direct imposition of sanctions in response to observed unsafe behavior, possibly resulting in the suspension or dismissal of the employee in question. Mostly outside contractors are

confronted with this kind of policy, possibly because they are easier to dismiss. Proponents of this policy argue that employees already received enough information, explanations and resources to be aware of the safety standards. They consider the 1-2-3-policy an unnecessary lengthy process and argue it proves too difficult to implement in practice, whereas they find the zero-tolerance policy to be clear and consistent.

> The power of a zero-tolerance policy is that it clearly indicates: we take this seriously (senior manager).

Finally, a large number of senior and middle managers state that they use disciplinary action in response to the occurrence of an accident. The managers realize that such a response would possibly counteract the learning effect of an SDO and therefore impose punitive measures after a short investigation into direct causes that precedes any SDO. A middle manager explains this course of events as follows:

> Prior to an SDO, we look at the question of blame. You can't do that at any other time, it would diminish the power of an SDO. (…) We do it this way to ensure maximum disclosure [during the SDO itself].

The results from the survey confirm that employees are not subject to a uniform safety policy and that practice sometimes deviates in a punitive way from formal policy. When asked which safety policy applies in their department, 57.8% of the respondents indicate that they are subject to the 1-2-3-policy (answer options did not differentiate between safety and sanction variants), 15% indicate it to be a zero-tolerance policy and 23.4% of the respondents have chosen the answer option 'other'. About half of the third group (11.7%) have further elaborated on their answer. Some of these respondents state that the policy depends on the situation and the kind of safety violation, others write that they are not aware of the safety policy that is currently being applied.

4. Discussion and conclusion

4.1. Zero Accident Vision and economic rationality

The data show that the ideas that characterize the ZAV have permeated safety thinking and safety management at Tata Steel IJmuiden. Respondents paint a picture of an organization whose management accepts ultimate responsibility for occupational safety. Prevention plays a crucial role and is visible in both the proactive stage (ensuring safety) and reactive

stage (learning from incidents and making improvements to the system). As regards the debate on whether prevention will actually lead to zero accidents, Tata's managers subscribe to the view that this is not a consistently attainable target, but is worth striving for because of its function in raising the commitment to safety and because every less ambitious goal is deemed ethically unacceptable. This interpretation of 'zero' as a necessary albeit utopic goal also features in the papers of Zwetsloot et al. (2013) and Sherratt (2014) on the corporate ZAV. The ethical consideration recurs in statements from managers at other companies, such as oil company Shell, whose head of Health, Safety and Environment in 1991 called the pursuit of zero accidents 'the only responsible policy' (cited in Adams, 1995, p.16).

Another concurrence between the findings of this study and the paper of Zwetsloot et al. (2013) is that the pursuit of zero accidents is not only based on ethical grounds, but also motivated by economic reasons. According to the management of Tata Steel IJmuiden, investing in safety will pay off in two ways: first, through the prevention of costs involved in injuries that classify as an LTI or worse, and second, through improved 'process control', which will have a positive impact on other elements of the production process as well.

We can now answer the first question posed in the introduction of this paper: How does the ZAV in the private sector relate to economic considerations? Our study shows that managers at Tata Steel IJmuiden do not subscribe to the view of an opposition between safety aspirations and economic considerations that appears in elaborations of the road safety ZAV, but foster the belief that safety and economy reinforce each other. We suppose that the idea of a 'win-win' is characteristic for the corporate ZAV in general, because Zwetsloot et al.'s (2013) paper on the corporate ZAV takes the same idea and because for companies it seems the most attractive way of defining the relationship between the two rationalities. By stating that there is harmony or even synergy, ZAV-dedicated companies save themselves the need to formally choose between their commitment to high safety standards and their main goal of making profit.

Private businesses distinguish themselves from the public sector not only by their profit-making considerations. Another important difference is that businesses, due to their less comprehensive and heterogeneous character, do not have to choose between as many life-

saving opportunities as exist in the public sector. This means that the private sector not only has stronger inducement, but also less difficulty to reconcile safety and economy than the public sector. Elaborating on the latter distinction, it can be observed that Elvik's (1999) criticism of the ZAV's alleged neglect of economic laws loses much of its validity in a private sector context. Whereas invoking the economic law of diminishing marginal returns exposes a serious problem on the part of the ZAV in the public sector (why investing so much in pursuing 'zero' in one subsector and not in another?), this problem does not occur to the same extent with the ZAV in the private sector.

Of course, this is not to deny that the economic law cited does apply in the private sector and begs the question whether spending as much money as necessary for reducing the number of occupational accidents to zero is possible without impairing the economic viability of companies. Furthermore, there is reason to question the corporate ZAV's picture of a harmonious relationship between the rationalities of economy and safety. Our findings about the tension between meeting production targets and adherence to safety rules show that the harmony model does not entirely hold in practice, and that under certain conditions economic motives may prevail over safe behavior (cf. Han, Saba, Lee, Mohamed, & Peña-Mora, 2014). Further research is needed to determine whether and to what extent pursuing zero accidents and sound economic policy are actually compatible or even mutually reinforcing.

4.2. Zero Accident Vision and criminalizing human error

In section 4.1, we pointed to our finding that Tata's management takes final responsibility for occupational safety. Managers argue that any lack of safety can ultimately be traced back to root causes and management decisions. This is in accordance with the environmental hypothesis or system approach to safety. However, the acknowledgement of final responsibility does not equate to waiving employee responsibility. Quite the contrary: in agreement with Zwetsloot et al. (2013), the management of Tata feels that safety can only be reached if both the management and employees are involved in safety. So, the articulation of the ambitious goal of zero accidents is not only meant to make the managers committed to safety, but the workers as well.

In fact, Tata's occupational safety policy revolves largely around increasing the sense of 'ownership' among employees and influencing their behavior. Our data show that the managers' responsibility for improving the system is to a large extent interpreted as improving the safety performance of the system users. Some managers justify the focus on employee attitude and behavior by referring to the idea that this factor plays a role in 98% or 99% of all accidents (which are percentages with more rhetorical appeal than substantiated accuracy, cf. Swuste et al., 2010; Thomas, 2013). Although this may appear contradictory to the professed conviction that any accident ('100% of all cases') can be traced back to management related root causes, both claims may go together. If one assumes that every accident has direct causes as well as root causes, it is perfectly possible to maintain that the behavior of system users is almost always one of the triggers (direct causes) that actualize the accident potential related to the system design (root causes) (cf. De Winter, 2014). Acknowledging the role of human error in the realm of direct causes need not be at odds with the system approach of the ZAV. But the balance is delicate: Placing heavy emphasis on human error as a target for safety policy does not fit well with the systems-theoretic focus on root causes (cf. Reiman & Rollenhagen, 2014).

This friction is clearly visible in Tata's safety policy. Influencing human behavior has such a crucial place in it, that it cannot be characterized as genuinely systems-oriented. Both in the proactive and the reactive stage of the company's safety management, there is actually a struggle for domination going on between the system approach and the person approach. The former has the momentum, but the latter is tough and continues to appeal to common sense. The influence of the person approach is most structurally felt in the proactive phase of safety management. As highlighted before, raising the commitment of employees and giving them the tools and training to do their work safely is Tata's main strategy in this phase. Little consideration is given to the systems-theoretic notion that such measures cannot fully eradicate human error. As a consequence, the management appears to make less effort to increase the forgiveness of the system than one would expect of a systems-oriented safety policy.

Things are somewhat different in the reactive phase of Tata's safety management. The design of procedures in this phase is evidently determined by the principles of the system approach. Whether it comes to the submission of safety reports, the 1-2-3-policy or the SDO

method for investigating accidents, their formal aim is learning from unsafe situations in order to advance a safer work environment. Since an optimal learning process requires employees who are willing to actively report unsafe situations and fully cooperate with accident investigations, fostering an open culture where cooperation is not hindered by fear of punishment is deemed essential.

This may lead to the conclusion that the person approach has no formal place in Tata's reactive safety policy. Yet, in practice it has gained a foothold in the form of sanction-oriented deviations from and additions to the policy. As we have shown in the results section, the 1-2-3-policy is used by some senior and middle managers as a program for stepwise disciplinary action, and sometimes even suspended in favor of a zero tolerance policy. Moreover, accidents may be responded to not only by an SDO, but also by a trajectory focused on the question of blame.

Although managers defend their punitive response by pointing to its function in enforcing norm compliance, it obviously violates basic principles of the system approach and, more specifically, the ZAV. In its disciplinary form, the 1-2-3-procedure ceases to be a learning tool. Applying zero tolerance in response to unsafe behavior is even less compatible with the aim of learning. As regards the policy followed after an accident, managers' adherence to the idea of an open culture appears to be half-hearted and their belief that punishing employees will not interfere with an SDO because sanctions are imposed before an SDO is started, must be considered naïve. The act of punishment still takes place in response to the same accident or near-miss, stands in direct contrast to the ideas that underlie the SDO methodology and is likely to discourage openness in general.

Taking refuge in disciplinary action in response to either incidents or merely unsafe behavior also conflicts with the assumption the company makes about its employees' intrinsic willingness to work in a safe manner. If this assumption is taken seriously, every unsafe act that does not originate in bad intent or gross recklessness should be considered unintentional and/or induced by circumstances beyond an employee's control, and punishing unintended behavior seems irrational and unnecessary. In the cases that an employee who displayed unsafe behavior not already understands by himself that he made an error, conveying this message is possible by other means than a sanction.

Of course, distinguishing between unsafe behavior that is unintentional and behavior that is driven by bad intent or gross recklessness may be a difficult and to a certain extent subjective task. That does not mean, however, that attempts to draw such a line will prove futile (cf. Dekker, 2012).

The foregoing discussion allows us to tentatively answer the second question we asked in the introduction of this paper: Do companies that apply the ZAV manage to resist the temptation to criminalize human error on the part of their employees? We have shown that the company we investigated, Tata Steel IJmuiden, does not spare the rod in responding to unsafe behavior of employees. Notwithstanding the company's endorsement of the idea of an open environment where unsafe situations are traced down to their root causes, the managers also pay considerable attention to direct causes and evidently criminalize individual safety transgressions, without making a clear distinction between honest mistakes and bad intent or gross recklessness. This punitive tendency is difficult, if not impossible, to reconcile with a proper application of the systems-oriented ZAV. From a systems-theoretic point of view, it would be advisable to entirely get rid of sanction-based elements in the response to unsafe behavior that is unintentional, as these could hinder the pursuit of zero accidents.

At the same time, we realize that it may prove difficult to follow this advice, since, paradoxically, incentives to punish unsafe behavior seem in part related to the ZAV itself. In the first place, the very ambition of eradicating all accidents possibly contributes to a reduced tolerance of behavior which endangers the realization of this ambition (cf. Dimitrova, 2014). As referred to earlier, Sherratt (2014) points in this direction by articulating a connection between the zero accident approach and the application of zero tolerance. Thus, using the metaphor introduced by Zwetsloot et al. (2013), 'zero tolerance' could be seen as another member of the family of 'zero visions'. Although our study cannot fully substantiate the presumption that the pursuit of zero accidents nurtures an intolerant attitude toward unsafe behavior, it provides some indications, such as the finding that several of the interviewed Tata managers consider punishing safety transgressions as a requirement rather than an obstacle for achieving the company's safety ambitions.

Second, the interpretation of the ZAV as dependent on 'the personal commitment of every individual person in the company' (Zwetsloot et al., 2013, p. 45) easily has the effect of adopting elements of the person approach, including the temptation to criminalize human error. It is a small step from emphasizing the importance of everyone's personal commitment to holding employees accountable who do not live up to this expectation.

These considerations warrant further inquiry into the way companies that have adopted the ZAV deal with human error. Ideally, a large number of ZAV-dedicated companies would be investigated in order to give more empirically grounded insight into the relationship between ZAV and criminalizing human error. Such investigation could also provide clarity as to whether there are companies that actually apply the ZAV without punishing human error.

There is one final observation to make. Even if a company explicitly excludes punishment from its reactive repertoire, it is possible that safety measures with no punitive aim are nevertheless experienced by employees as punitive measures. In other words: determining whether or not a company's safety policy contains punitive elements is to a certain extent a subjective matter. This can be illustrated with Tata's 1-2-3-policy. The three steps of the original version of this policy increase in force, but merely with the purpose of securing safety. When talking does not change the unsafe behavior of an employee, certain compulsory measures may be taken to ensure that the behavior stops. We mentioned the examples of additional training and assignment to another task. While these interventions are not meant as punitive measures, they could well be perceived as such. This is confirmed by Mullen's (2004) finding that being assigned to alternative work may be experienced by employees as the loss of a desired position.

The question then arises whether safety measures that are inadvertently punitive can, like genuinely punitive measures, negatively affect employees' willingness to cooperate with incident investigations and report unsafe situations. If so, it would pose a serious problem for systems-thinking in general and the ZAV more specifically. Therefore, this is another subject that deserves attention in future research.

4.3. Limitations

This study has its limitations. First, we investigated only one company. More research is necessary in order to establish to what extent our findings on the corporate ZAV hold for other ZAV-dedicated companies.

A second limitation is that we could interview just managers, not workers. Although we got some insight in the perspective of workers by means of the survey, we gained no in-depth understanding of their experiences and beliefs. As the interviews with managers, who have some interest in preserving a favorable image of Tata's safety policy, already revealed several discrepancies between formal policy and policy in action, it is possible that interviews with workers would have made the picture a bit messier. Also, they might have provided first-hand accounts of how the policy works out in practice and what working safely in an environment full of risks actually looks like.

Third, the survey has a limited sample size and response rate, as only three of the seven divisions approached allowed distributing a questionnaire, the responsible managers tried to confine the number of questionnaires to be distributed as far as possible, and no more than 32% of the questionnaires were returned. This can be explained by survey fatigue (as managers told the first author), by managers who did not want (too much) labor costs spent on filling out questionnaires, and by the fact that conditions in a steel company are not favorable for answering a questionnaire, especially as regards workers.

Fourth, we focused on Tata's occupational safety and health policy, and paid no specific attention to process safety. Our finding that improving employee attitude and behavior has a crucial place in the company's safety policy and in the pursuit of zero accidents must be understood against this background. It does not discount the fact that the company obviously also employs a variety of safety measures focused on the operation and maintenance of installations and equipment.

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