

Safety gets real

Sylvius Hartwig examines the importance of the human factor



THE past five decades have seen a remarkable change in the pattern of industrial safety in Western industrial countries. This is particularly true for plants of the process industry. Whereas in the 1960s, accidents, disasters and malfunctions were mostly attributed to technical failures, the human factor has become increasingly important as a cause for accidents. People often assume that the change is only relative, that technological improvements have led to fewer failures, thereby increasing the relative importance of the human factor. However, this is not true: the human factor has become more important in its own right. Simple errors such as operators pressing the wrong buttons in plants have become almost neglectable – most errors must now be attributed to a number of ongoing structural changes in industry. They include:

- the rapidly-increasing complexity of industrial structures;
- the increasing importance of

- communication, which depends heavily on the human factor;
- automation and related regulations;
- the lack of foresight of automation strategies;
- increased splitting up of production lines;
- growing specialisation; and
- the drastic change of social structures.

At the same time, the importance of the human factor has increased in a different way. People are a source of safety and a key factor relied on in the prevention of accidents and disasters not only in process-industry plants, but also in our society in general.

To illustrate this trend, the declining importance of technical causes for failures over the last 50 years is shown in Figure 1. The graph line is an average function and a summarised illustration of over hundreds of thousands of event and accident data taken from evaluations by Hollnagel (1998), Hartwig (2005) and Lieb (2005) which are based on a number of studies in various Western industrial countries.

industry reaction

Over the last couple of years, it has become clear that the human factor cannot be neglected. However, many managers are not aware of the facts and even refuse to acknowledge that the human factor is responsible for more than 90% of all accidents today, especially as the distinction between technical and human causes can be unclear questions concerning the definition of technical causes on the one hand and human causes on the other hand. The data in Figure 1 are based on an assessment of the companies involved with regard to the definition of the causes.

How does industry deal with the situation described above? Figure 2 is taken from a European enterprise with well over 100,000 employees. It shows the distribution of the number of safety programmes at the end of the 1990s, distinguishing between technical and human causes. The chart merely shows how the number of programmes was distributed between both areas; it does not show the investments. Despite that limitation, the number of programmes allocated to human causes is in significant contrast to its importance. The conclusion is that businesses are uncomfortable with this situation and do not want to acknowledge it. This is also an impression I gained in many companies that I worked with.

In the field of industrial safety, the

human factor is an issue which is hard to tackle; it requires sensitivity and realism. Public discussions and publicly fought-out disputes between management and staff show that, in Germany at least, realism is often lacking. A couple of years ago, I dealt with a German company which had to drastically change its administrative structure while avoiding large-scale redundancies. This resulted in a rise of accidents of 20% per thousand employees over the following years. Apparently, neither the internal communication structures affected by the reorganisation, nor the grown social structures, which are very relevant to safety, were noticed or taken into account. They just did not exist for the upper management, a disastrous attitude.

industrial thinking

In large parts of the industry there is a tendency to ignore the often excellent skills of employees in coping with situations in which failures occur. The inherent constraints resulting from the characteristic human traits and the development of our intellectual capabilities over millions of years are ignored in the same way. This is surprising, as our knowledge of these has greatly increased in recent years.

Large parts of the industry make the mistake of treating people as computers which may be laboriously programmed, and not as human beings which have creative capabilities but also constraints. Political arguments over pay and jobs show that many industrial leaders have a mechanistic view of the world which has little to do with reality: companies, plants and facilities are bought and sold like bricks in a hardware store, with the target of creating new buildings (ie companies) at the fastest possible pace. Experience and investigation clearly show that buying and selling plants seriously affects the staff involved and therefore safety, and also their appreciation of the company. This occasionally even leads to situations where employees are unaware of who the current owner of the plant is. The employees' identification, loyalty and emotional attachment are greatly affected, as much as their pride in their own work.

This impact on loyalty is highly relevant in terms of safety, and especially security.

insider sabotage

On the one hand, a declining loyalty results in arguments that are suppressed by

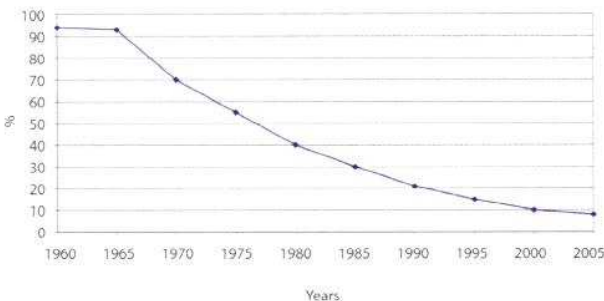


Figure 1: Course of time dependence of technical causes for accidents from 1960 to 2005 based on data from Hollnagel, Hartwig and Lieb. The graph line is an average function and a synopsis of approx 200,000 accidents and events

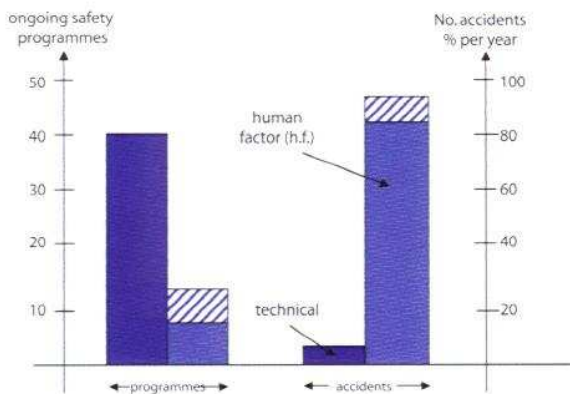


Figure 2: The distribution line of different accident causes and the number of safety programmes for technical and human factor accidents; the difference between the number of safety programmes and the importance of real accidents is striking.

employers for fear of negative publicity. On the other hand, employees avoid open conflict for fear of repression. Especially for the process industry, this is a security problem that may – and does – to some extent result in insider sabotage. In one of our data collections on malfunctions and accidents, we concluded that 8–9% of all events were caused by insider sabotage, as shown in Figure 3.

In general, I find that wide areas of the organisation planning of facilities management often only have a rather limited idea of the reality and the capabilities of their employees. The diction of the plant management regarding the requirements for both the company and the employees, if anything, reminds one of the specifications for a computer rather than of communication with human beings. This diction rather seems to be based on the “Yes-No” or “If-Then” code of a computer than on the characteristics of a living human language; and the same is true for codified regulations. This way of communication is based on a rather limited appreciation of man.

Safety today has little to do with implementing technology. This is particularly true for highly automated processes and plants. Most technical factors are dealt with during planning and construction of a plant and, to a lesser extent, while starting the facility. Human factors, however, play an important role throughout a plant’s operating life. They are strongly affected by the changing industrial culture, ie the demands of our achievement-oriented society and how these demands comply with our predetermined physiological, psychological and intrinsic social capabilities. By nature, we are equipped with intellectual and emotional-intellectual capabilities we cannot merely govern, but have to deal with in a responsible way.

emotional intelligence

Humans do not only have a rational, but also an emotional intelligence. A considerable part of our actions is determined by the latter, even in the field of technology, and this is also the case with process-industry operators. In the history of man, emotional intelligence developed long before rational intelligence and is, for our good, genetically codified. Especially when safety is concerned, we cannot pretend that this is not true – although a major part of the current IT and managerial thinking are based on exactly that.

The following example might help to understand the difference between emotional and rational intelligence: You meet a beautiful woman and you decide at first glance that you want to take

her out for dinner – then your decision was based on emotional intelligence. However, if you are going to make her fill in a questionnaire with 100 questions and evaluate the different answers before making the decision, then your rational intelligence has taken the lead.

This example clearly describes the purpose of emotional intelligence: Genetically encoded knowledge enables one to make decisions incredibly fast. That may save your life. In the second case, the woman might have gone off with a colleague of yours while you were still working on the questionnaire! Our managerial and industrial culture has hardly taken into account that emotional intelligence does exist and that it can be very beneficial to safety. Ignoring the importance of the emotional internal structure of humans and, accordingly, that of employees and their instinctive patterns of behaviour causes considerable stress and hence most likely health problems. Table 1 gives an overview of some research on the dimensions of stress-related health problems.

This stress is not merely a problem in its own right and a factor contributing to costs; it is also a major problem with regard to safety. It is mostly those people working under the highest stress levels that have the highest amount of responsibility and consequently the greatest freedom of decision, which inevitably also implies the greatest chance of making the wrong decisions – which may lead to severe safety problems. The dimensions of stress-related health problems are an indication for the dimensions of possible safety problems. At least in Germany, this is an unacceptable point of view both within the industry and within the government and its agencies. These institutions prefer regulating technical issues because they seem easier to handle.

conclusions

The human factor plays a decisive role with regard to our safety and security, but is often not acknowledged, neither by the public nor by the industry nor the government. The resulting costs for our society are very high indeed. The disregard of the human factor has led to an industrial and economic culture which is hostile to safety. We will not be able to maintain this culture in the long run because of the economic and social costs. Changes are not only advisable, but necessary but the resistance to change can be considerable.

Managers urgently need to find more innovative ways of handling of safety issues, and factor human nature into their safety-culture. tce

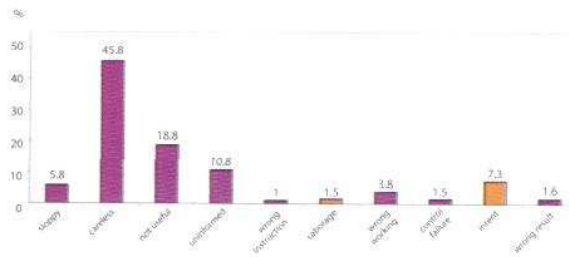


Figure 3: Human actions as cause of failure, based on nearly 2000 events; insider sabotage amounts nearly to 9% (sabotage plus intent)

At present, one third of European employees suffers from lack of appreciation (Johannes Sigrist, 2005)

Appreciation means: money; human acknowledgement; development of the job / working conditions

80% of companies don't know the sources of stress in the company although the law for the safety of works (1996) makes this obligatory. It is widely assumed that stress is an individual problem. (Hans-Böckler Stiftung, 2006)

Long-term studies show that employees without appreciation suffer from continuous stress. Consequence: they are two times more likely to suffer from heart attack or depression (Johannes Siegrist, Düsseldorf University 2005).

24% of employees in Germany are under such high levels of stress caused by lack of time and demands that they don't believe that they'll be able to work until retirement age (65 years).

59% of German employees fear for their job or position (Initiative Arbeitsqualität 2006).

10% of employees are the result of psychosomatic illness; mostly depression caused by continuous stress at work (DAK 2006).

Work-related stress costs US companies \$200b/y (National Safety Council, 1995).

60% of absences from work are caused by stress (Copper & Payne, 1988).

The Californian Institute of Work found that stress-related costs rose by 700% from 1979–1988 (Lehner 1997).

75% of all Americans describe their job as causing considerable stress, 25% suffer from stress every day, 20% have given up their job because of stress (Heartmath Center 2001).

A nationwide study in the US showed that employees suffering from stress and depression miss 16 working days per year, whereas the average only misses four days (NYB, 1990).

Examinations on 46,000 employees showed that untreated stress and depression are the most expensive risks with regard to treatment costs and 2–4 times more expensive than smoking, obesity or lack of exercise (Goetzal, 1998).

Table 1: The economical damage of stress

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