

The human factor

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Dublin, October 2006

1 Background and aims

As a result of the Allgemeine Eisenbahngesetz [General Railways Act] of 1993, railways in Germany are obliged to construct their systems and vehicles to be safe and to maintain them in a safe condition. In order to live up to this requirement of the Act, attempts have been made from time immemorial to draw appropriate conclusions from dangerous incidents and so eliminate weaknesses. Compared with other means of transport, railway accidents are thus relatively improbable; when they do occur, however, the damage can still assume considerable proportions.

In spite of the extensive and costly technical facilities which monitor human actions on the railway system, human error is often found to have been the cause of an accident.

Around 90% of all Deutsche Bahn's accidents can be attributed to human failings. Although rail transport enjoys a very high safety level, there is still scope for further improvement in this respect.

Human behaviour and human failings are the most commonly underestimated and neglected cause of irregularities in rail operations.

Deutsche Bahn has therefore resolved to devote more attention to the human factor in future, and to make it a major emphasis of the forthcoming safety programme which will replace the currently running programme in 2008.

2 The 'Investigation of railway-specific human error' project

Under the auspices of the 2003 safety programme, Deutsche Bahn had already initiated a project for the investigation of railway-specific human error.

The essential phases of this project were as follows:

- Processing of safety-relevant findings coming from other industries and other railways, and presentation of the state of present day knowledge and practice in relation to the human factor
- Stocktaking with reference to the role of human error at Deutsche Bahn
- Implementation of recommendations for intervention with a view to minimising human error in the form of short term, medium term and long term measures.

ζ How accidents arise

It is frequently assumed that nothing can be done to prevent human failings as the cause of accidents. This point of view is based on the idea that complex technical systems are fundamentally safe, and need to be protected from unreliable people, by punishing the person (e.g. after an accident) or replacing him (e.g. by introducing automation). The main emphasis of investigation, in analysing an accident, is still often on the question of what has happened. The investigation is terminated as soon as the error has been identified.

The modern way of looking at things sees human errors as being symptoms of problems within the system. The human errors in question are not coincidental, but are rather systematically linked to the properties of the system as a whole.

Human actions in complex systems are subject to many different factors.

- ζ Organisational environment

- ζ Organisation
- ζ Groups
- ζ Technology
- ζ Human beings

While some of these factors have a direct effect on human actions in the production process, other factors have a more indirect influence. Factors that are further removed, in both spatial and temporal terms, from the production process and the point where accidents happen have been rarely referred to in Deutsche Bahn's analysis of accidents in the past.

The probability that an accident will occur is very slight. Only when several factors gather, can an accident take place.

Typical 'holes' are:

- ζ a less than optimal design of the man to machine interface
- ζ a less than optimal allocation of tasks to human beings (e.g. the monotonous activity of supervision)
- ζ Management parameters that tend to favour unsafe behaviour (e.g. leaving decisions, in cases of conflict, to the wrong management level).

ζ **Situation report – a first stocktaking on the theme of human failure at Deutsche Bahn**

A first stocktaking on the theme of human factors at Deutsche Bahn was carried out with the assistance of an external firm (MTO GmbH in Berlin, Professor Wilpert).

The investigation came to the following conclusions:

Questions considered

The following questions were central to the investigation:

1. What understanding of human failure is dominant at Deutsche Bahn?
What originating causes are posited for human error?
2. What measures are already in place to reduce the risk of human failings? Are there mechanisms for learning from experience and for the encouragement of organisational learning within Deutsche Bahn?

Conclusions

In comparison with other industrial areas, Deutsche Bahn has an admirable system of personnel selection in operational and safety-critical fields (e.g. railway vehicle drivers, traffic superintendents etc.). It also has an excellent framework of training and further training.

On the technical plane, Deutsche Bahn's high technological standards are responsible for a very high level of safety. Major investments have been made for the prevention of speed limit violations and the overshooting of stop signals. These technical facilities can prevent a situation where human error leads to an accident.

Technology and automation are used to monitor and control human actions on the system, and to bridge over any gaps that may arise. Automation is less used to support human beings in their actions and decisions. Little regard has been paid to the fact hitherto that human flexibility and human capabilities can make an important contribution when technology breaks down.

The increasing degree of automation presents the operator with new challenges. Here we may refer to the loss of manual capabilities when operating under automated conditions, for instance, or to the phenomenon that people find it difficult, when the automated system malfunctions, to switch out of their passive supervisory role, find out what is going on and then intervene with all possible speed. So it is also the case that relatively little knowledge of human factors goes into the development, design and

evaluation of automated systems. The idea prevails that it is possible to prevent human failings by means of automation. The possibility that human error may occur even in the design and layout of the system is however ignored.

Recommendations

Following this first stocktaking on the theme of human factors at Deutsche Bahn it has become clear that

1. there are already human-factor-related activities in place at Deutsche Bahn
2. better use should be made of these activities
3. these activities need to be modified to some extent

It follows that coordination is needed in order to make the human influencing factors that are found in the interaction between human beings and technology at Deutsche Bahn accessible and beneficial for the persons responsible throughout the DB Group.

3 Corporate culture / safety culture

The normal behaviour of employees is determined by the social norms and rituals to be found in the company.

As tried and tested modes of behaviour come to be established gradually in the course of years or even decades, corporate cultures come into being in the form of accepted scales of value and thinking patterns. The corporate culture determines how the company is perceived by the employees and so what one is allowed or not allowed to do.

ζ What do we understand by the term 'safety culture'?

The safety culture of a company, as an aspect of the corporate culture generally, was first used as a term on any scale following the Chernobyl accident – by the International Nuclear Safety Advisory Group (INSAG). This group defined safety culture as

“the totality of features and modes of behaviour in organisations and individuals which have the effect that safety principles are given the priority that befits their importance” (INSAG 1991).

At Deutsche Bahn we understand this as implying

“the understanding and behaviour of our employees on all levels of the company with reference to the safety of railway operations, and the endeavour to improve these and to learn from our mistakes”.

This starts right at the top of the company, and extends as far as the individual employee at his or her given workstation. It applies not only to those who have to carry out actions that have safety implications, but also to those whose job it is to ensure that only appropriately trained employees, in adequate number and with suitable equipment, will be used and to those whose task is just to provide the resources and finances to make this possible.

We all contribute to the safety culture of the company – management, executives, team leaders and employees.

ζ By what marks can a good safety culture be recognised?

A good safety culture is characterised by six key aspects. These were defined by the International Atomic Energy Authority in 2002.

1. obligation of top management to guarantee safety and ensure that safety standards continue to be maintained
2. application of the rulebook
3. taking of conservative decisions
4. well established reporting culture at the level of the employee for the reporting of safety-relevant incidents
5. rejection of any actions and conditions that are unsafe
6. learning organisation

ζ **What is a good safety culture like?**

A good safety culture is distinguished by four properties:

1. positive reporting ethos
2. safety culture is appropriate and confidence-inspiring
3. safety culture must respond flexibly
4. learning safety culture

ζ **How can we improve our safety culture?**

Without doubt we will have improved our safety culture if we succeed in reducing the number of accidents and keeping them to the lowest possible level.

4 Programmes for the improvement of safety culture

This year we have begun, on the instructions of management, to develop a programme for DB Group executives at the highest level. This 'Safety and Risk Management' programme is designed to improve the sensitivity of executives in relation to safety and risk management issues in their given area of responsibility.

A similar programme will be developed at Deutsche Bahn next year for all new staff members coming from other companies, direct new hires and junior executives. This comprehensive programme will link safety themes more closely with rail operations, and so create an understanding of the complexity of the rail system network, as well as raising awareness of the responsibility that every individual member of staff has for safety in his or her allotted area.

So as to have regard to the aspect of learning from accidents and dangerous incidents, we are also planning to add a new element to the further training courses taken by our operating personnel. accidents analysis

Sources:

A. Hinzen, dissertation on 'Der Einfluss des menschlichen Fehlers auf die Sicherheit der Eisenbahn' ['The effects of human error on railway safety'], Rheinisch-Westfälische Technische Hochschule Aachen [RWTH Aachen University of Technology], 1993.