

1 **Title** **Towards the integration of human factors root causes**

2
3 **Abstract**

4
5 This paper describes a project carried out on behalf of the Health and Safety Executive
6 (HSE) and an industry partner to gain a deeper understanding of how psychological ill-
7 health (e.g. anxiety or depression) or state of mind (e.g. feeling anxious, feeling sad,
8 feeling angry) could affect safety at work. The aim of this project was to obtain evidence
9 from incident reports that would illustrate the ways in which psychological ill-health and
10 state of mind could affect safety at work, and to identify some practical implications for
11 industry on reducing the risks associated with such cases.

12
13 A key part of the project was an analysis of incidents from our industry partner's incident
14 database and a publicly available aviation accident database was conducted to gain an
15 insight into the mechanisms at work that could lead to someone experiencing symptoms
16 of psychological ill-health behaving in an unsafe manner. As is often the case with the
17 output on incident investigations, the analyst is at the mercy of original investigator's
18 data gathering, and in many cases detailed information on state of mind or psychological
19 ill-health had to be inferred. To help add depth to the analysis, a series of interviews with
20 those who had investigated or had been directly involved in incidents where someone's
21 state of mind had been contributory or causal were conducted.

22
23 The analysis of incidents and interviews with those involved suggested that there may be
24 some overlap between the root causes of incidents, factors that could shape a person's
25 performance, and potential sources of stress at work. Further analysis suggested that this
26 overlap was in fact significant, and had clear implications for the way that stress risk
27 assessment and incident investigations are conducted in most organisations. In particular,
28 this research has suggested that a more integrated approach to the analysis of human
29 factors risks and human factors causes of incidents has great potential in more proactively
30 identifying potential accident causes and potential sources of stress.

31
32 **Keywords:** Human factors; safety, stress, anxiety, depression, human error, human
33 performance

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41 **INTRODUCTION**

42
43 This paper describes one aspect of a recent project jointly funded by the UK Health and
44 Safety Executive (HSE) and an industry partner from the petrochemical industry. The
45 project set out to identify how psychological ill-health (stress, anxiety, depression) could
46 affect safety performance at work.

1 A key part of the work was to review incident reports and interview people who had been
2 involved in incidents to determine whether or not there was any evidence to suggest that
3 psychological ill-health could affect safety performance, and to identify the implications
4 of the outcome of this research for industry.

5
6 There has been a great deal of research into the affect of psychological ill-health on
7 performance, and such research provides strong evidence for the negative impact on
8 performance of clinical depression and anxiety. However, people suffering from such
9 conditions tend to withdraw from work, either voluntarily or on the advice of their doctor.
10 In such cases, there is limited opportunity for them to affect safety performance in the
11 workplace directly (although their absence may impact on the workload of others in the
12 team). Those who remain at work often control their symptoms using prescribed
13 medication. This complicates matters, since the side-effects of medication can also affect
14 performance, and it becomes impossible to distinguish between the effect of the condition
15 being treated, and the treatment for the condition.

16
17 Stronger evidence was found for the impact of 'frame of mind' on safety performance. In
18 this context, 'frame of mind' was defined as the way that a person thinks or feels at a
19 particular point in time (e.g. feeling anxious but not actually experiencing clinical
20 anxiety). It was found that there was evidence to suggest 'frame of mind' could be linked
21 to safety performance, and that 'frames of mind' could be causal or contributory to
22 people having accidents at work.

23
24 Previous papers on this research by the same authors have gone into more depth on the
25 way in which psychological health and frames of mind affect safety performance, and the
26 implications of this for industry. In this paper, however, the authors will focus on the
27 implications for incident and accident investigations themselves.

28 29 **LACK OF INFORMATION ON PSYCHOLOGICAL ILL-HEALTH IN** 30 **INVESTIGATIONS**

31
32 When incident and accident investigations were reviewed during the course of this
33 research project, it was very rare to come across a case where psychological ill-health had
34 been cited as contributing to or causing an incident or accident. There are many possible
35 explanations for this, which include the stigma associated with psychological ill-health
36 leading to those involved withholding such information, or equally the fear of the
37 potential consequences of admitting to suffering from psychological ill-health.

38
39 Another possibility is that incident investigators do not have the training and tools to
40 investigate psychological health, and therefore psychological ill-health tends not be
41 recorded as a root cause of incidents or accidents. Many organisations do have the tools
42 and skills to analyse cases psychological ill-health, but quite often these skills and tools
43 fall within the purview of the Human Resources or Occupational Health departments
44 rather than with the incident investigation teams, and hence such analyses do not get
45 incorporated into incident investigations.

46

1 **ROOT CAUSES, SOURCES OF STRESS AND PERFORMANCE SHAPING**
2 **FACTORS**

3
4 How closely related are the conditions at work that can lead to people suffering from
5 psychological ill-health, the root causes of accidents and the conditions that can lead to
6 people making errors?

7
8 To answer this question, a comprehensive review was conducted of frameworks and
9 models used by the HSE and the industry partner to identify the degree of overlap
10 between stressors (the conditions that can cause stress at work), root causes and
11 performance shaping factors (conditions that can lead to people making errors).

12
13 The following steps were taken to perform these analyses:

- 14
15 1. Define a list of stressors to be considered;
16 2. Compare stressors and root causes of incidents;
17 3. Compare stressors and performance shaping factors;
18 4. Summarise the comparison
19

20 ***Stressors***

21
22 To ensure that the research was as comprehensive as possible, it was necessary to identify
23 a comprehensive set of work-related stressors from the range of frameworks available.
24 The HSE's Stress Risk Factors were used as the starting point, and compared with the
25 HSE's Indicator Tool, Cox's (1993) framework of stressors, and the industry partner's
26 own Stress Risk Assessment tool.

27
28 This comparison revealed a high degree of overlap between these frameworks and
29 models, but also some differences, indicating a need to expand the HSE's stress risk
30 factors for the purpose of this research.

31
32 The final list of stressors under consideration were therefore:

- 33
34 – Demands;
35 – Control;
36 – Training;
37 – Support;
38 – Role;
39 – Relationships;
40 – Change;
41 – Communications (not about change).
42
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44

1 ***Stressors and Root Causes of Incidents***

2
3 The industry partner in this research used a rigorous system of root cause analysis to
4 investigate its incidents, and an analysis was performed to determine the extent to which
5 this investigation tool included causes that could also be considered stressors.

6
7 The root cause analysis tool included both system causes (e.g. conditions of work and
8 working practices) and immediate causes of incidents. Only the system causes of
9 accidents were included in this analysis, as these covered both personal and job factors,
10 and were therefore the most relevant causes to this research. The following table shows
11 the results of the mapping between system causes of incidents and stressors, and it can be
12 seen that there is a significant overlap between the sources of stress at work, and the
13 causes of incidents.

14

Stressor Categories	System Causes of Incidents	
	Personal Factors	Job Factors
Demand	X	
Control		
Training	X	X
Support		X
Role		X
Relationships		
Change		
Communications		X

15
16 The main areas of overlap are further described below:

- 17
- 18 – Role ambiguity: (e.g. being unclear about role/ responsibilities);
 - 19 – Communications: (e.g. not having adequate information about the job/ task or
20 poor communications between teams/ individuals etc);
 - 21 – Workload: (e.g. having too many tasks to do);
 - 22 – Training: (e.g. not being adequately trained to do the task).
- 23

24 ***Stressors and Performance Shaping Factors***

25 Performance shaping factors are conditions that can affect how well a person performs
26 when carrying out a task. They include factors external to the person (e.g. workload,
27 equipment design, environmental conditions) as well as factors internal to the person (e.g.
28 interpersonal relationships, fatigue). Performance shaping factors are considered when
29 analysing the underlying causes of human error, and hence potential causes of incidents.

30

1 It was therefore considered important as part of this project, to determine whether any of
2 these potential human performance influences could also act as potential sources of
3 stress.

4
5 There are many different human error analysis methods available, but this project focused
6 on the tool used by the industry partner, which used 8 categories of performance shaping
7 factors, namely:

- 8
- 9 – Task factors (e.g. number of tasks, workload);
- 10 – Communication factors (e.g. quality of communication);
- 11 – Procedures and documentation (e.g. clarity of procedures, complexity of procedures);
- 12 – Ambient environment (e.g. noise, lighting, etc.);
- 13 – Training and experience (e.g. recency of training, quality of training);
- 14 – Human machine interaction (e.g. workplace layout, equipment design);
- 15 – Personal factors (e.g. domestic issues, fitness);
- 16 – Social and team factors (e.g. supervision, allocation of responsibility).

17
18 An analysis of these factors against the list of stressors revealed that there were several
19 types of performance shaping factors that could also represent a source of stress, as well
20 as an influence of human performance. In particular, the following stressors were
21 highlighted as having the greatest overlap with performance shaping factors:

- 22
- 23 – Demands: closely related to task factors and environmental factors;
- 24 – Communications: closely related to communication factors, especially
25 communications about the job or task;
- 26 – Training: poor training quality or training that is not recent.

27
28 Other stressors also overlapped partially with performance shaping factors:

- 29
- 30 – Change: performance shaping factors around procedural changes relate well to this,
31 but performance shaping factors did not cover broader organisational change;
- 32 – Support: performance shaping factors cover poor supervision, but do not cover
33 support more generally.

34
35 This analysis therefore suggested that if an investigation identified that the types of
36 performance shaping factors listed above may have influenced the likelihood of someone
37 making an error, then that performance shaping factor may also be acting as a source of
38 stress, and this should be investigated in relation to the incident, and more generally if the
39 presence of the performance shaping factor is likely to persist. Conversely, if a stress risk
40 assessment identified the presence of the aforementioned stressors, then consideration
41 should be given to whether or not their presence could also lead to human errors, and
42 mitigating actions taken as appropriate.

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1 ***Conclusions***

2
3 The analyses reported above identified significant overlaps between stressors,
4 performance shaping factors and the root causes of accidents. This means that there are
5 some characteristics of work and the working environment that could lead to
6 psychological ill-health, human error or an incident or accident. This is particularly true
7 of the following:

- 8
- 9 – Demands: high levels of workload or task complexity;
- 10 – Role: role ambiguity or conflict;
- 11 – Support: lack of support and encouragement from line management;
- 12 – Training: inadequate or ineffective training and skill development;
- 13 – Communications: lack of or inadequate communication of information.

14
15 As already discussed in the introduction to this paper, there was little evidence uncovered
16 during the research of cases where psychological ill-health had been cited as causal or
17 contributory to incidents or accidents. A number of possible reasons for this exist,
18 including non-reporting of the condition by those involved due to the stigma of
19 psychological ill-health or fear of the consequences of doing so. There is also the
20 possibility that investigators in general are ill-equipped to identify symptoms of
21 psychological ill-health or to investigate the underlying causes of such conditions. Given
22 the close interrelationships between root causes, performance shaping factors and
23 stressors, if the latter is even partially true, then there is a case to expand the level of
24 competence in considering the role of psychological ill-health in incident causation for
25 investigation teams.

26
27 Root cause analysis tools such as the one used by the industry partner in this research
28 project do include categories of root causes covering psychological ill-health. Therefore,
29 if the psychological health of an individual is implicated in an incident, there would be a
30 natural tendency for the analysis to stop at the point of identifying psychological ill-
31 health as a root cause, rather than conduct further analysis to see if any characteristics of
32 the job, organisation or working environment had caused the identified psychological ill-
33 health. Again, this suggests the need for a more integrated approach to incident
34 investigation and the analysis of psychological ill-health.

35 ***Implications for Safety***

36
37 The main implication for safety of this research is that significant benefits could be
38 achieved by adopting a more integrated approach to incident investigation and the
39 analysis and prevention of psychological ill-health at work. This would involve an
40 increased understanding of the sources of psychological ill-health within incident
41 investigation teams, with the potential to increase the effectiveness of accident
42 prevention. For example:
43

- 1 – Information already exists (for example in the HSE’s management standards) on how
2 to reduce the impact of potential stressors at work, and this information could also be
3 applied to reducing the potential for human error and accidents.
4
- 5 – If incident investigators used a greater understanding of the causes of psychological
6 ill-health during investigations, they would be able to identify the likely causes of
7 psychological ill-health when it is relevant to the investigation, which in turn would
8 allow better recommendations to be made, which could be fed into the results of
9 stress risk assessments.
10
- 11 – Opportunities also exist to use the outputs from stress risk assessments to identify
12 potential influences on human performance, and root causes of incidents. If such an
13 assessment identified a series of stressors that could also cause incidents, then
14 mitigating action could be taken to reduce the likelihood of an accident.
15

16 Achieving the aforementioned would require training and education of incident
17 investigators to impart the understanding of psychological ill-health necessary to be able
18 to ask the right questions, in the right way, during investigations to enable a thorough
19 analysis of the situation and produce appropriate and effective recommendations. It is
20 also likely that those involved in stress risk assessment would need to have an enhanced
21 understanding of the incident investigation process in order that they could effectively
22 feed their findings into the process.
23

24 Some organisations have already embarked on programmes of training for incident
25 investigators to provide them with enhanced skills and tools to enable a more thorough
26 analysis of the human factors aspects of incidents. The kind of skills required to consider
27 aspects of psychological health in incident investigations could be a natural extension of
28 such training.