

GUIDANCE ON CREW RESOURCE MANAGEMENT (CRM)  
AND NON-TECHNICAL SKILLS TRAINING PROGRAMMES

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## FOREWORD

The analysis of both occupational and process incidents in the energy industry has repeatedly indicated the risks of human error and unsafe or sub-optimal behaviours. In other industrial sectors, one method of addressing this issue has been to identify and then train behaviours that are protective for safety. These are the non-technical skills (thinking, teamwork and personal resource skills) that workers require for safe and efficient performance. In the aviation industry, where this approach has been adopted for the last 30 years, this type of training is called crew resource management (CRM). Recent incidents in the energy sector have demonstrated the need to introduce CRM training for non-technical skills in the energy industries.

This guidance has been developed for anyone who wishes to know more about why and how to implement CRM and non-technical skills training in their organisation. It was commissioned by the Energy Institute's Human and Organisational Factors Committee (HOFCOM) and based on a research report written by Professor Rhona Flin and Jill Wilkinson of the Industrial Psychology Research Centre, University of Aberdeen.

The information in this publication is derived from the scientific and regulatory literature on CRM/ non-technical skills from aviation and other industries. In addition, interviews were conducted with practitioners experienced in delivering CRM programmes, psychologists involved in CRM research and with members of HOFCOM.

The guidance has been structured into topic areas covering the background and rationale for CRM training, followed by recommendations on how to identify the required non-technical skills for a particular job, what should be included in a training course, how to deliver the training, methods of assessment, and organisational 'barriers' to implementing CRM training. Examples of CRM courses are given, and sources of background information and further reading are provided in the bibliography. As such, this publication provides a high level process and good practice guidance for how an organisation can implement CRM.

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Suggested revisions are invited and should be submitted through the Technical Department, Energy Institute, 61 New Cavendish Street, London, W1G 7AR. E: [technical@energyinst.org](mailto:technical@energyinst.org)

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# 1 INTRODUCTION

## 1.1 BACKGROUND AND SCOPE

The systematic analysis of both occupational injuries and major process incidents in the energy industry has repeatedly indicated the risks of human error and unsafe behaviours, as well as systemic organisational failures. The need to examine human factors, as well as technical causes of incidents, has been demonstrated in the explosions at the Texas City refinery (2005), Venezuelan Amuay refinery (2012) and Buncefield oil storage facility (2005), a number of offshore oil and gas sector incidents, and the earthquake-induced incident at Fukushima nuclear power plant (2011).

Human error is ever present and therefore remains a constant risk in all workplaces but can be particularly hazardous in industries working with major accident hazards (MAHs), such as the energy industry. Some industries, most notably aviation, strive to minimise human error by the use of crew resource management (CRM), an approach which identifies and trains non-technical skills (e.g. decision making, teamwork) to improve safety and efficiency. As of 2014 CRM has not been widely adopted in the energy sector, although there have been recent recommendations that it should be introduced.

Commissioned by the EI Human and Organisational Factors Committee (HOFCOM), this publication has three main aims:

1. to provide an introduction to CRM and its core features;
2. to set out the case for the use of CRM in the energy industry; and
3. to provide guidance on how to design and implement a CRM training programme.

The reader should expect to find a brief introduction to CRM and non-technical skills, a summary of the use of CRM in other industries and its benefits (based on current research), as well as a step-by-step process for designing and implementing a CRM programme (which may be familiar to those who have designed and implemented other types of training programmes). The reader should not expect to find in-depth information on the different types of non-technical skills (which are readily available from the resources referenced throughout this publication), nor what course content should be taught in the energy sector. Whilst example course syllabuses are provided, it should be remembered that CRM training should be tailored to each organisation and occupational role.

The content of this publication has been derived from good practice and lessons learnt in industries that have significant experience of developing and delivering CRM (e.g. aviation, marine, nuclear), or are beginning to introduce it (e.g. rail, mining). While CRM can be used in many work settings, the most relevant group for the energy industry is the operational crew working in a safety-critical, dynamic environment (e.g. teams in control rooms, production, drilling, and maintenance), although this type of training can be adapted for any type of team.

## 1.2 WHAT IS CREW RESOURCE MANAGEMENT (CRM)?

'CRM is not ... an abstract management concept; it embraces principles and skills which, if combined with a high degree of technical knowledge and skill, will enable the crew to make best use of all available resources to achieve optimum efficiency in the conduct of operations while at the same time maximising [...] safety' (UK Civil Aviation Authority (CAA), *Crew resource management (CRM) training*).

CRM originated in the aviation sector and refers to a type of behavioural training course introduced by airlines, initially for their pilots but then expanded to include flight crew as well. It focuses on the **non-technical skills** required to execute a flight safely and efficiently, in addition to the technical flying skills. Non-technical skills are cognitive skills such as situation awareness and decision making, as well as social skills for communication, teamwork and leadership. In addition, personal resource skills for managing conditions that can impair performance, such as stress and fatigue, are covered by CRM.

The Human Factors Group of the Royal Aeronautical Society (RAeS) defines the objectives of CRM training as follows:

- 'To enhance crew and management awareness of human factors which could cause or exacerbate incidents which affect [...] safety.
- To enhance knowledge of human factors and develop CRM skills and attitudes which when appropriately applied could extricate an [...] operation from incipient accidents and incidents whether perpetrated by technical or human factors failings.
- To use CRM knowledge, skills and attitudes to conduct and manage [...] operations, and fully integrate these techniques throughout every facet of the organisation culture, so as to prevent the onset of incidents and potential accidents.
- To use these skills to integrate commercially efficient [...] operations with safety.
- To improve the working environment for crews and all those associated with [...] operations'. (RAeS, *Quality crew resource management*)

Despite being born out of the aviation sector, the CRM training concept has since been successfully transferred to other higher risk work settings, such as the fire services, shipping, mining, surgery, and the energy industry.

### 1.2.1 Non-technical skills

Non-technical skills are 'the cognitive, social and personal resource skills that complement technical skills, and contribute to safe and efficient task performance' (Flin et al, 2008). Non-technical skills are especially important in safety-critical occupations.

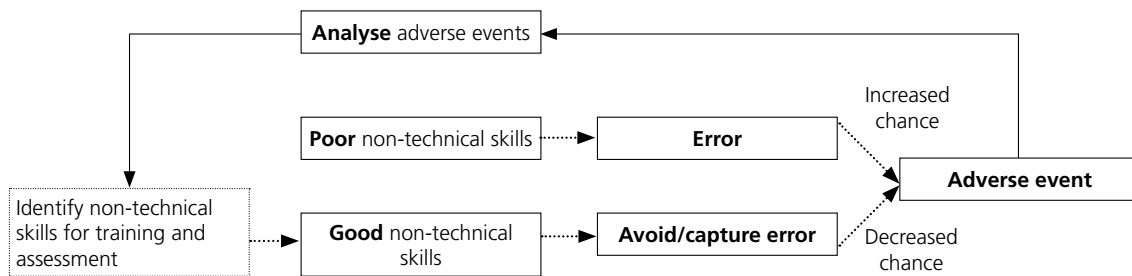
The following non-technical skills are typically taught on a CRM training course, with an emphasis on how these relate to task performance, human errors and organisational safety; however, the precise set of non-technical skills should be customised for the technical tasks, operational conditions and the workplace culture:

- situation awareness;
- decision making/problem solving;
- leadership;
- teamwork;
- communication, and
- managing stress and fatigue.

Detailed descriptions of the six non-technical skills categories are provided in the *Associated non-technical skills (ANTS)* factsheets (New South Wales (NSW) Government website, <http://www.resources.nsw.gov.au/safety/world-leading-ohs/ants>), and in *El Human factors professional development: complete training resource*.

The relationship between non-technical skills and human error and adverse events is illustrated in Figure 1. This shows that deficiencies in non-technical skills (e.g. not thinking ahead, not following procedures, not speaking up when concerned about risks) can increase the chance of human error, which in turn can increase the chance of an adverse event. Good non-technical skills (e.g. high vigilance, effective communication, leaders listening to team members' concerns) can reduce the likelihood of error and so decrease the chance of such an adverse event.





**Figure 1: Relationship between non-technical skills and adverse events<sup>1</sup>**

In essence, non-technical skills help to reduce the incidence of error, to catch errors that have occurred and to respond effectively when a hazardous situation arises. These skills are not new or unfamiliar to most workers: they are essentially what the best practitioners do in order to achieve consistently high performance.

The emphasis in CRM is on training individuals in non-technical skills to work in whatever team is on duty (as membership may change day to day), rather than on training an established team where the same people always work together. This distinction is appropriate for the energy industry, where crew composition can change across shifts and rotations.

### 1.2.2 Distinctive features of CRM training

Compared to training discrete skills such as teamwork or leadership, CRM training covers all the non-technical skills in one course and the teaching material is based on scientific evidence (from studies of attention, decision making, group behaviour etc.) and current safety data (corporate or industry).

The focus is on an individual's behaviour at work rather than on personality. We know that personality influences which behaviours an individual prefers, such as being quiet or talkative, cautious or adventurous. In CRM training, the emphasis is on which behaviours are **safest for the current task**. Sometimes it is best to discuss the procedure for a task; at other times it is necessary to be quiet, to allow a colleague to concentrate.

Key features of CRM training are shown in Box 1.

#### **Box 1: Notable features of CRM training**

CRM training:

- Is based on current analyses of the non-technical skills required for safe and efficient operations and their role in recent adverse events, from company or industry sources (e.g. reporting systems, audits or incident data).
- Is focused on the individual worker in a team setting – workers need 'portable team skills' to use within any team.
- Addresses behaviour in routine operations with the aim of avoiding critical incidents, as well as skills for dealing with a critical event.
- Is not about someone's personality but about his or her behaviour at work.
- Is founded on current scientific research into human performance, with particular relevance to the specific work setting.

<sup>1</sup> Reprinted by permission of Ashgate, from Figure 1.2, in Flin et al. (2008)

It is important to recognise that CRM is more than just a new training course: the ultimate aim of CRM is to improve an organisation's operating culture and safety. Therefore this will take more than a one-off training event or cosmetic changes to existing training that may already address some non-technical skills. It is more correct to think of CRM as a programme rather than a training course.

It should also be noted that, while the CRM training method is part of a human factors approach, it is not equivalent to 'human factors training', which might cover some aspects of non-technical skills, as well as ergonomics, risk management techniques, etc.