Crew resource management for teams in the offshore oil industry

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Introduction

The notion that effective teamwork is an essential component of organizational performance has now pervaded British management practice, and teams, of different types and varying degrees of competence, can be found in abundance from the shopfloor to the boardroom. Team training in British industry also appears in a myriad forms ranging from militaristic outward-bound courses to psychodynamic analysis of individual and group functioning. It is likely that some of this training is ineffective because courses are usually generic rather than domain specific and consequently they are not designed to identify or tackle the precise teamwork factors which are critical for a given set of operating conditions[1].

The offshore oil industry has traditionally functioned with a teamwork culture and many operations are managed by crews, shifts and groups working together. This article describes a particular type of operational philosophy and team training called crew resource management (CRM) which was developed by the aviation industry for flight deck crews but which is now being used in other domains, such as in merchant navy ships (e.g. Braathens-SAFE) and hospital operating theatres[2]. The CRM training approach has been adapted for use in industrial settings such as nuclear plants[3] and offshore oil installations, particularly in control rooms and emergency command centres. In essence, CRM involves enhancing team members' understanding of human performance, in particular the social and cognitive aspects of effective teamwork and good decision making. This training is designed to reduce operational errors which could cause an accident, and to give crews additional skills to deal with problems if they are faced with an emergency. In this article, the origins of CRM will be outlined, followed by two examples of CRM-type training being used by a major North Sea oil company.

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What is CRM?

The term cockpit resource management (now crew resource management) was first used in 1977 by American aviation psychologist John Lauber, who defined it as "using all the available resources – information, equipment, and people – to achieve safe and efficient flight operations"[4, p. 20]. By 1980, many of the international airlines had become interested in human factors issues and had introduced training in flight-crew co-ordination. There were several reasons for this; for example, statistics on aircraft accidents from the National Transportation Safety Board showed that 73 per cent of losses were due to flight crew failures rather than technical problems[5]. Moreover, investigations by NASA in the 1970s using accident analyses, pilot interviews and simulator observations had confirmed the need for non-technical training which would focus on pilots' leadership, command, decision making, communication and teamwork. This type of research continues today, for example at the Crew Factors Group at NASA Ames, and their findings are fed back into training and operations partly through the medium of CRM to improve decision making and crew performance[6].

CRM is now widely used by the international aviation industry, typically taking the form of three-day training courses and subsequent monitoring of CRM skills during simulator flights (line-oriented flight training – LOFT): "LOFT provides the organization with a means of creating conditions requiring the practice of effective crew co-ordination to resolve complex emergency situations. It is also the instrument for reinforcing and evaluating the concepts learned in the CRM classroom"[7, p. xxi]. In the UK, human factors training and examination are required for a flight crew licence, and CRM training is an annual CAA requirement for commercial pilots.

What do CRM courses include? There is no standard CRM course, but the CAA issued an information circular[8] which suggested a syllabus for a three-day course. This syllabus was neither exhaustive nor compulsory and individual operators designed their own courses, with the CAA issuing approval on inspection. Rick Thomas[9], a British Airways training captain, explained that their programme covers six main topic areas: choosing behaviour, communications, decision taking, feedback, medical and self-awareness. During the BA course, a variety of delivery techniques are used: lectures, video, exercises, as well as a peer assessment questionnaire called "Cockpit 2000". Simulator flights are used to allow crews to develop and practise their team skills, having trained flight crew trainers to observe and evaluate a crew's performance as a team. For a full account of the development of CRM and current research see Wiener et al.[7]; details of CRM programmes in companies such as Lufthansa can be found in Johnston et al.[10].

CRM for offshore control room operators' emergency response training

Our first awareness that CRM could be adapted for offshore installations was in 1992 when we became involved in human factors training which was part of a

four-day programme of offshore control room operator competence assessments and emergency response training. The assessments were being carried out in an onshore simulator facility and the company had decided to intersperse these scenarios and feedback sessions with four specially designed training modules. The trainers had already looked at one of the CRM courses being used by a commercial airline and, with regard to their standard of competence for CROs, they had decided that the most relevant elements to incorporate into their training programme would be modules on communication, decision making, stress and assertiveness.

In the airlines, the content of the CRM courses has been based on research findings from the aviation psychologists (such as NASA) and the expertise of experienced pilots. In this case, a similar approach was adopted; we drew on relevant psychological research (although very little had been carried out offshore) and the expertise of the trainers who had considerable experience in control room operations. Our remit was to design the training packages for the trainers to deliver. The development phase therefore consisted of the initial design of the materials followed by an extensive redesign in order to tailor the presentations and exercises to meet the trainers' exacting standards of validity and applicability to the offshore control room. (This was a time-consuming and challenging exercise for all involved but one which was justified by the feedback received by the trainers from the CROs as the courses progressed. The trainers were also able to refine the modules further on the basis of this feedback.) The module content as initially prepared was briefly as follows:

- *Decision making.* The objectives of this module were that participants would be able to recognize the essential differences between decision making under normal operating conditions and in an emergency; and, in addition, that they would be able to identify the factors which hinder or help decision making under stress in the control room and would know how to apply the latter if required. A working memory model was used with specific exercises to demonstrate information- processing limitations under normal conditions. One of the naturalistic decision-making models, recognition-primed decision making (RPD)[11] was used as a framework for understanding and discussing decision making in high pressure situations.
- *Communication.* This module covered the basic communication process, barriers to effective communication and awareness of strengths and weaknesses in personal communication skills. Exercises highlighted the importance of feedback and listening skills, the role of non-verbal communication and effective communication techniques. An actual offshore incident involving a communication problem was also presented and discussed.
- *Assertiveness.* This module began by defining what was meant by assertiveness, why it was relevant to CROs, how it differed from passive and aggressive styles of behaviour and the signs that indicate each

mode. The impact of different behaviour styles on oneself and on others was discussed. (This covered similar ground to the British Airways "Choosing Behaviour" module[9].) Exercises were used to allow role playing of different styles of behaviour in control room situations which would merit an assertive response from the CRO, such as, "You have a major process upset and you receive the second phone call from the Toolpusher to say that he wants fresh water immediately. What do you say to the Toolpusher?". Participants were encouraged to discuss situations they had experienced in relation to different styles of behaviour and their outcome.

- *Stress.* The stress module was designed to improve understanding of the causes and effects of stress, recognition of the signs of stress, and the ability to cope with the effects of stress. A balance model was used to explain the psychological and physiological process of stress[12] and particular emphasis was placed on sources of stress in an offshore emergency and, in particular, in the control room. Personal experiences of stress and resulting effects were discussed, and then available coping strategies were considered.

This was not a full CRM course but the underlying philosophy was very similar, with human factors modules being designed by psychologists and subject experts together, but being delivered by the latter in conjunction with a programme of simulator assessments. The course content covered standard CRM topics although the materials were adapted for the environment and operations of the production platform control room. The teaching methods included lectures as well as exercises and discussion of personal experiences relating to the topic areas. In the longer term such courses can be developed and refined by incorporating operational experience, incident analyses and research findings from control room studies.

CRM for offshore installations managers and their emergency response teams

Last year we had the opportunity to work on a second application of the CRM approach with offshore installations managers (OIMs) and their teams who were undergoing emergency response team training in a high-fidelity offshore control room simulator facility. We were again asked to design training modules which would be used in between scenarios and debrief sessions. By this time we were drawing on a much richer vein of research material and expertise, having completed a study of OIMs' crisis management[13], having examined command training in other organizations[14] and having visited British Airways and NASA Ames to learn more of CRM research and practice. We subsequently attended a meeting in January 1993, when Shell Expro invited several members of the British Airways CRM flight-crew training team to their office in Aberdeen to brief one of their operational training groups on the CRM approach. In addition, we were able to discuss CRM developments with other

psychologists at the European Aviation Psychology Conference in March 1994[10] and with the other researchers working on emergency decision making at the Naturalistic Decision Making Conference in June 1994[15]. Two of our psychologists had joined the British CRM group (affiliated to the Royal Aeronautical Society), which meets several times a year to discuss current CRM philosophy and practice.

On this basis, we were aware of a number of elements which appeared to be particularly critical for effective team performance in emergency command centres and which were applicable for an offshore platform. These elements included understanding of team roles, communications, group decision making/problem solving, assertiveness, team attitudes, stress management and shared mental models[16,17]. Working closely with the trainers we were able to design materials to introduce these topics, to suggest scenario modifications which would allow these facets of team performance to be tested and to discuss these issues with the team in the feedback sessions. Our aim was not only to help the team under training to improve its performance, but also to teach individual crew members team skills for whatever team they find themselves in when they are summoned to the Emergency Control Centre (ECC). Details of three of these elements are given below.

Team attitudes

Our behaviour is governed to a significant degree by the attitudes we hold, and any attempt to change behaviour should begin with an attempt to identify underlying attitudes and beliefs relevant to the behaviours in question. Research carried out by aviation psychologists showed clearly that pilot attitudes were a predictor of their behaviour on the flight deck and one of the objectives of CRM is to produce attitude change where required. In fact measuring attitudes before and after CRM training is one of the techniques used for evaluating its effectiveness[18]. The scale most commonly used with pilots is the Cockpit Management Attitudes Questionnaire (CMAQ)[19]. The CMAQ contains 25 attitude items covering a range of issues regarding crew co-ordination, communication, role definitions and personal capabilities under stress which revealed substantial variability in attitudes among pilots. This scale is composed of three factor-analytically derived dimensions: communication and co-ordination; command responsibility; and recognition of stressor effects.

The CMAQ has been used in a number of research studies as well as CRM evaluation. It has also been adapted for use with other occupations where crew co-ordination is important, such as nuclear power plant control room operators[3]. As no research of this kind had been carried out with offshore crews, we adapted the CMAQ with reference to Harrington's nuclear industry version and substituting offshore terms where appropriate. This scale is called the Offshore ER Team Attitudes Questionnaire[20] and it contains 25 attitude items in a Likert format dealing with command

responsibility, team co-ordination and personal performance. Some sample items are:

- Team members should avoid disagreeing with each other because conflicts create tension and reduce team effectiveness.
- OIMs should leave technical matters to other members of the team.
- Team members should not question the decisions or actions of the OIM except where they threaten the safety of the platform.

Respondents are asked to indicate whether they agree or disagree with each item on a five-point scale and the questionnaire takes about ten minutes to complete. This scale is still under development but we have administered it at the start of two training courses to a sample of 33 subjects. To date it has only been used for feedback of the group results and discussion of topic areas particularly where team members do not show general agreement on specific items. This has generated a lively discussion and has facilitated the introduction of the human factors training packages during the course. Our intention is to develop this instrument to be used for both training and course evaluation with offshore and emergency services teams.

Roles and responsibilities

Models of team performance generally emphasize that members of high performing crews have a clear understanding not only of their own roles and responsibilities but also of the role demands of other team members. For an offshore emergency response organization this is particularly critical as team members will be assigned roles that probably will not correspond with their everyday duties (e.g. muster checker, board writer, on-scene commander). Where platforms have small crews then it is possible for an individual's role to change if the incident escalates. One exercise was developed which involved groups of three outlining their own roles in the ECC team and the roles of the other members. This allows an assessment of role clarity and reveals any unwarranted assumptions which are being held about the roles and duties of other team members.

Assertiveness

The need for assertive behaviour in more junior team members has been sharply highlighted in aviation accident analysis and simulator observations which revealed the reluctance of co-pilots to challenge captains' authority even when they had made a poor decision or an actual error. This was compounded by an attitude held by some captains that it was not the co-pilot's place to question their decisions. The need for assertive behaviour is greatest where team members are not of equivalent status and the more junior or lower status members do not feel comfortable questioning the instructions of the leader. Research shows clearly that high performing (low error) crews have a climate of openness and trust where team leaders are receptive to alternative views and

team members are not afraid to express them. Our experience of watching many offshore ECC teams is that this is as relevant on a platform as it is on a flight deck. The training package involves a video which gives an excellent demonstration of the need for assertiveness in operational conditions and a review of material on this topic covered earlier on the control room operators' (CRO's) course.

Team decision making

Our main research interest is the area of OIM and team decision making[21,22] and we use a group decision making exercise which highlights the need for team members to share and review incoming information in order to build a picture of the problem at hand. We review the types of decision making that may be appropriate with particular reference to the recognition-primed decision-making model (discussed above) which is introduced on the CRO course. An outline process of decision making is discussed and if necessary refined as the result of group discussion, and we have begun to chart communication networks and the concept of the shared mental model with the help of course participants (see Figure 1).

OIM and ECC team decision-making research

We are currently preparing a new research project which will examine how OIMs and their offshore ECC teams take decisions in simulated emergency conditions. Our intention is to gain a better understanding of why some teams perform better at crisis management than others and to improve the methods for training OIMs and teams to function effectively under high-pressure situations. To do this we will be studying OIMs and their teams facing crisis scenarios in offshore simulators. Our method will be loosely based on the

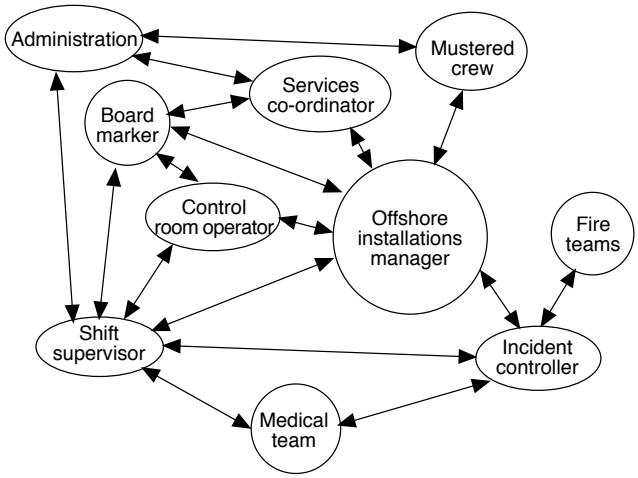

Figure 1.
Sharing the "big picture"

approach which has been adopted by psychologists at NASA in their studies of airline crews. One of the main aims of this project is to identify the processes by which offshore emergency command teams assess situations and reach a shared understanding of aspects of the scenario they face. Orasanu[6] stressed the importance of "shared problem models" in dealing with emergencies. The implication is that a crew which shares the same understanding of the nature of a problem is more likely to generate a workable solution. Orasanu emphasized that the basis for shared problem models is effective communication among team members, and her research has shown that active crews which communicate more efficiently make fewer operational errors. CRM training is one way to assess and improve these team co-ordination and leadership skills.

Conclusion

Our experience suggests that CRM training can be successfully tailored for offshore teams which have responsibilities for managing emergency response procedures. While CRM training was initially designed to reduce operational errors and improve emergency response performance in aircraft crews, companies using this method have reported significant benefits for normal operational performance. In the offshore oil and gas industry, properly designed CRM training may have a wider application than just emergency response situations; it could also be used to enhance safety and improve productivity in a range of tasks where teamwork is important.

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