

SAFE COMMUNICATION AT SHIFT HANDOVER: SETTING AND IMPLEMENTING STANDARDS

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This paper describes the planning and implementation of a site-wide initiative to improve shift handover communication methods and practice in a UK oil refinery. A model of effective shift handover communication was derived from the psychology of effective communication, shift handover communication research in UK and French safety-critical process industries, analysis of industrial accidents and best industry practice. This model was used to assess current practice in a large oil refinery and make measurable improvements. We describe the process and outcomes of the initiative.

Key Words

Safety - Shiftwork - Shift Handover - Communication - Structured Logs

INTRODUCTION

Shift handover is regarded as important in many shift-working occupations. Discontinuity of tasks and personnel give rise to risk of non-transmission or miscommunication of critical information⁽¹⁾. The importance of shift handover is confirmed by a number of recent industrial accidents^(2,3) where failures of communication or misunderstanding at shift handover have been identified as causal or contributory factors.

Available guidelines^(4,5,6) do not specify measures to be taken to ensure effective communication at shift handover or standards against which current practice should be assessed. It is from this relatively low knowledge-base that industry endeavours to improve current practice.

THE PROBLEM

This paper describes a collaborative project undertaken during 1994/95 to assess and improve current shift handover practice in a large UK oil refinery. The refinery stabilises in excess of one million barrels per stream day of crude oil. The refinery complex includes three crude and four upgrade units, supported by water, road, rail and pipeline modal dispatch infrastructure. In the late 1980's the refinery adopted the then ICLI-developed ISRS management system as a vehicle

to achieve continued improvement in safety performance. A 5-shift continental rota system with a 35-day shift cycle is in operation.

The project was initiated to address concern about current shift handover practice. Whilst there had not been any specific incidents where failures of communication at shift handover had been a causal or contributory factor, management had noted potential for improvement within this site "core" activity.

The project was conducted in three phases. Phase 1 involved a review of current practices employed, within representative areas of the refinery, with recommendations being made. Phase 2 was a pilot scheme involving the implementation of review recommendations in one particular process area. Phase 3 involved implementation of the recommendations refinery-wide. Before describing the project, relevant theory and empirical research will be reviewed, thus providing an overview of the topic and setting the scene for the present study. Readers who are mainly interested in the practical aspects of the initiative should proceed to the project section of this paper.

HOW TO COMMUNICATE EFFECTIVELY AT SHIFT HANDOVER:- **THE RELEVANT LITERATURE**

Despite its importance, shift handover communication has received little attention in the human factors literature. There is only one known published account of how shift handover is conducted⁽¹⁰⁾. Shift handover is regarded as problematic under certain conditions. The UK Health and Safety Executive places particular emphasis on the importance of shift handover during abnormal plant conditions⁽⁴⁾. Handover is also viewed as problematic following a lengthy absence from work⁽⁷⁾. Nuclear power plant operators reported that such handovers become more difficult the longer the incoming operator has been absent⁽⁸⁾. Moreover, experienced process staff view handing over of process control responsibilities to inexperienced staff as problematic⁽⁹⁾.

Current guidance on shift handover

The UK Health and Safety Executive's guidance on human factors in industrial safety⁽⁴⁾ recognises the importance of shift handover and asks managers to consider "what arrangements (e.g. written logs, formal handover procedures) are there for conveying information between shifts on matters such as maintenance in progress, plant out of service, process abnormalities?". Similarly, human factors guidelines for nuclear power generation stations recommend that "proper (shift) turnover methods" be incorporated to ensure that the next shift has received and understands the current operating status of all plant systems and equipment⁽⁵⁾. Guidance on reducing human error in process operations suggest provision of logs or report sheets for transmission of important information⁽⁶⁾. These guidelines do not however recommend how to specify the relevant ***content*** of shift handover communication or the ***process*** by which such information should be transmitted at shift handover. Specifically, ***what*** verbal and written information should be included and ***how*** should this be communicated effectively? Before addressing these questions, it would be useful to

clarify the distinctions between 'information', 'knowledge' and 'understanding' as these terms will be used extensively.

Information, knowledge and understanding: definitions

Information theory analyses information flow in terms of a system whose purpose is to transmit information between separate locations⁽¹¹⁾. Information source and destination are linked by a channel. Information from the source must be encoded in a form suitable for decoding at the destination. System performance is limited by channel capacity, transmission rate and noise. According to information theory, information is transmitted when reduction in uncertainty regarding the content of the transmitted message results. This definition is related to the commonplace definition of information; namely data which increases knowledge and thereby reduces uncertainty.

Information channels have been categorised in terms of their richness⁽¹²⁾. Face-to-face communication is the richest channel for information. It provides immediate feedback thus allowing understanding to be checked and corrected. It is argued that face-to-face communication is most effective for mitigating ambiguity and creating shared understanding. In contrast, written information is lower in richness, lacking the capacity for rapid feedback.

Knowledge can be defined as the body of information possessed by an individual. Two types of knowledge can be distinguished: procedural and declarative⁽¹³⁾. Procedural knowledge refers to practical operational knowledge about how to do something. Such knowledge may be implicit and difficult to verbalise. Declarative knowledge consists of facts about the world which are accessible consciously.

The notion of achieving understanding or comprehension via communication relates to the use of information from a dialogue, in combination with existing knowledge, to arrive at a shared meaning⁽¹⁴⁾. In their attempt to reach shared understanding, dialogue participants must each assess the mental world or mental state of their conversational counterpart to determine what information is required to achieve understanding.

Having distinguished between information, knowledge and understanding, we now return to the notion of "effective communication" of information.

"Effective" communication and miscommunication

Appeals for "effective" communication within organisations are common. Effectiveness of communication can, arguably, only be defined with reference to a particular context. Shift handover has been defined as being an activity directed towards the goal of achieving understanding. An effective handover is therefore free from miscommunication or misunderstanding.

Rather than viewing failures of communication as deviations from effective communication, some conversation analysts maintain that miscommunication is a normal feature of dialogue⁽¹⁵⁾. Shift handover, a conversation with a purpose, is no exception. Misunderstandings have been observed occurring during shift handover communication^(7,10). Analyses of natural conversation and shift handover communication have revealed that participants continually repair potential and actual misunderstandings as the dialogue proceeds^(7,10,16).

Many writers on organisational communication have been accused of referring to communication in terms of the conduit metaphor⁽¹⁷⁾, which conceptualises and refers to communication in terms which ignore the reality of human communication. Much of the English language refers metaphorically to communication, as if it involved the use of a pipeline or conduit to transfer thoughts and feelings between individuals. The metaphor implies that speakers and writers insert thoughts or feelings into words, which are then extracted unproblematically by listeners or readers.

The conduit metaphor runs counter to four basic facts about human communication. First, communication does not involve the transfer of meanings from one person to another. Rather, the listener or reader creates meaning in his or her mind. Second, anything is a potential message, intended or not. Third, the message received is the only one that counts. The sum of these three facts is that, in contrast to the implicit message of the conduit metaphor, unintentional meaning is likely and potential miscommunication is the norm. Consequently, communication requires effort by ***both*** parties to avoid miscommunication.

The final basic fact is the need for some degree of ***repetition*** of communication to ensure comprehension. Two types of repetition are distinguished: intra-message and extra-message. The former refers to repetition within the message, the latter to repetition over more than one channel, e.g. verbal and written. However, the price of repetition is effort on the part of the communicator.

Seen from the perspective of the conduit metaphor, communication is relatively easy and unproblematic. The conduit metaphor fosters a view of communication in which the recipient is largely passive. This is a dangerous view to hold, particularly when great risk is attached to miscommunication. Acceptance of the inadequacy of this view, however, leads to the conclusion that effort should be expended to 1) ensure repetition, 2) emphasise the importance of feedback to check understanding and 3) improve the communication skills of organisational members.

Feedback

Shift handover communication is a task-oriented interaction occurring between two or more individuals. Talk of "conveying information" via "procedures" implies a unidirectional flow and neglects the importance of mutual interaction. Interpersonal communication involves a ***circular*** rather than ***linear*** pattern of interaction⁽¹⁸⁾. Person A communicates with person B, who in turn communicates with person A, a phenomenon known as feedback.

Experimental evidence gained from studies of social interaction in small groups has highlighted the essential contribution of feedback to ensuring accurate communication⁽¹⁹⁾. Increased feedback is associated with greater accuracy of, and confidence in, communication. Greater accuracy is

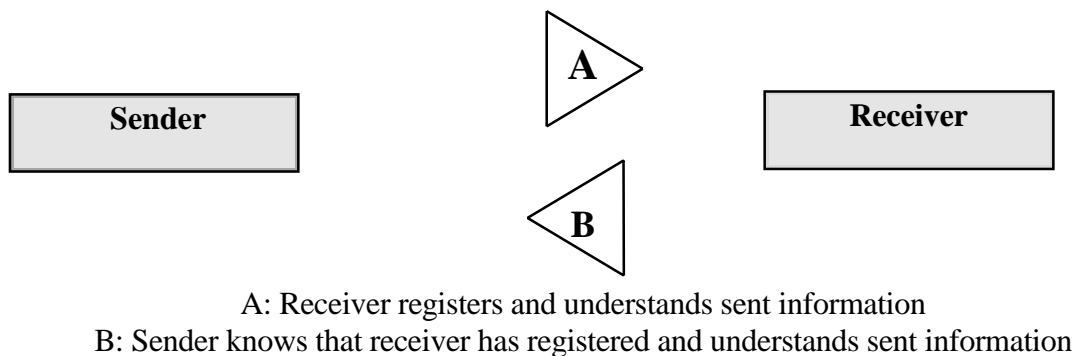
obtained at the expense of time taken. The role of feedback in accurate communication has also been emphasised in a recent cognitive theory of reliable communication ⁽²⁰⁾. This theory also provides a possible explanation of why shift handover communication may be problematic under certain conditions.

The theory is based on an analysis of accidents and the concept of mental models. A mental model is the internal mental representation held by an individual,. In the current context this would be a mental model of the refinery plant they are responsible for operating. According to this theory, there are two factors to be considered when assessing the likely reliability of communications.

First, there is the mental model held by those attempting to communicate with each other. When their mental models are largely compatible (e.g. under stable plant conditions, between experienced operators or when both handover participants have been on duty for a number of consecutive shifts) communication is unlikely to be problematic. In other words, shared understanding aids communication. However, where the respective mental models are not compatible (e.g. under abnormal plant conditions, following a long absence from work or between experienced and inexperienced workers) the role of communication becomes crucial in enabling the differing models to be aligned. The second factor identified as holding the key to effective communication is feedback. Under normal conditions, with shared mental models or shared understanding, largely one-way transmission of information can prove adequate. Shared models enable assumptions to be made about the meaning of the information conveyed. It is not necessary for the receiver of the information to feed back their understanding as the sender's meaning is implicit.

Under abnormal conditions, where the mental models are not compatible, feedback becomes important for both the sender and receiver. Feedback enables a) the receiver to confirm they have received, correctly interpreted and have understood the message and b) the sender to confirm that the communication has been successfully transmitted and clarify any misunderstandings. Figure 1 - The "ideal communication cycle" illustrates this point.

Figure 1. Ideal Communication Cycle



WHAT TO COMMUNICATE AT SHIFT HANDOVER:-
THE RELEVANT LITERATURE

Studies of process control operators' work indicate they indeed use an internal "mental model" of the process they control ⁽⁹⁾. Many shift workers, when completing their shift, endeavour to

anticipate the information required by their relief ⁽⁷⁾. They effectively take the perspective of their relief, asking themselves “what information does my relief need to update their ‘mental model’ of the workplace so they can do their work safely and effectively?”. They may be supported in doing so by a structured log for gathering pre-determined relevant information.

Summary of literature review

The literature review has identified potential indicators of effective, safe and reliable shift handover communication. The literature suggests the following questions should be posed as a means of assessing and improving current standards:-

What does examination of the organisation’s procedures and guidelines suggest about how the organisation views communication? Is it viewed in terms of the (inadequate) conduit metaphor? Specifically, is shift handover referred to as an unproblematic one-way process requiring minimal effort on the part of the sender or receiver? Or is it referred to as a two-way, interactive, potentially problematic process requiring effort by both parties? Is there evidence of a requirement for repetition of communication at handover, for example; written **and** verbal communication?

Does shift handover communication occur face-to-face? Is this required practice? Are handovers interactive in nature, using this rich communication medium to provide immediate feedback and check understanding? Accepting that miscommunication is inevitable, effort needs to be expended by participants to identify and repair misunderstandings. This may be particularly important where shared understanding is likely to be lacking, for example due to abnormal plant status, inexperienced staff or following a lengthy absence from work.

Have the information needs of each post been assessed? Has a reliable system been devised for capturing this information?. Although there are likely to be categories of information required which are common to many industries, failure to consider the needs of each post-holder may mean relevant information is omitted.

THE PROJECT

Phase 1 - Review

The purpose of the review was to examine current practice and make recommendations for improvement, thereby ensuring comprehensive, accurate and safe communication at shift handover. At the outset it was decided to aim for maximum involvement of personnel affected by any changes in current practice. Use of survey research and feedback methodology was identified as the most appropriate way of introducing change⁽²¹⁾. Personnel were fully involved in the process of data collection to ensure ownership and the results were fed back to them for comment. Information generated was used as baseline data and to guide implementation of Phase 2 of the project.

The review gathered information on current shift handover procedures and practice by focusing on one typical area of the refinery. A structured approach with several data collection methods was used to examine current policies, procedures, documentation and work behaviour. Information sources included:-

- Shift patterns
- Procedures
- Log books
- Training programmes and materials
- Investigation reports into recent incidents
- Observation of shift handovers
- Interviews with personnel at different levels of the organisation.

Procedures were examined to determine how they fitted with the standards previously described. Specifically, was communication described in terms of the “conduit metaphor”?

Some team leaders had designed structured logs, which specified the essential information needed at the start of a shift. However, most shift log books were found to be unstructured A4 ruled desk diary type format. In the absence of guidance on what information should be included, style and content varied between individuals. Log book content was largely historical, with little proactive content indicating what *should* or *might* happen in the future. There was no *specific* reference to safety issues.

A training programme for new recruits included shift handover, with a requirement that trainees perform a minimum of six supervised log book entries and shift handovers. However, at the time of the review there was no agreed standard against which to assess the adequacy of trainees’ knowledge or behaviour.

One shift was randomly selected for study and briefings were held for all staff. These briefings were particularly important and provided an opportunity to fully explain both background and methodology. Those present were invited to volunteer to take part. Participation involved complete willingness to be closely observed giving and receiving a shift handover, as well as

subsequently being interviewed about their performance. The project was initially greeted with some scepticism. However, when it became clear that solutions were not being imposed, hesitancy gave way to full participation.

A sample of fifteen shift operator handovers were observed. The purpose of the observation was to determine the presence, or absence, of safe behaviours indicative of effective communication, derived from previous research⁽⁷⁾. Namely whether

- time was set aside to prepare for the handover
- the handover was conducted face-to-face
- the handover was free from distractions
- the person giving the handover
 - gave an overview of the handover content
 - made a positive statement of safety issues
 - talked through log items
 - summarised the handover at the end
- feedback was preset/absent
- the person receiving the handover took notes

- In the case of handovers given following a ten-day absence
 - whether there was evidence of additional preparation
 - whether a historical overview of events was given.

None of the handovers observed had all of the safe behaviours present. Most operators set aside time to prepare for handover, but in 20% of the handovers observed, there was no evidence of collation of information or making of notes in preparation for handover. Some operators carried a notebook during their shift and use this to note important points to be communicated at shift change. Many operators prepared a summary of events when handing over to personnel returning after a ten-day absence. All handovers were conducted face-to-face, although many were not conducted free from distractions or interruptions, due to other handovers being conducted nearby simultaneously.

In all but one of the handovers observed, active participation by the incoming member of staff was present. Absence of active feedback does not mean miscommunication or misunderstanding has occurred. Rather, its presence makes it less likely that miscommunication or misunderstanding has occurred. Only one of the personnel observed took notes during the handover. Whilst taking notes was apparently not common practice, some operators report used a pocket notebook which allowed them to refer to their notes whilst on the plant and check that they had taken important actions. Following handover, all incoming personnel read back through previous logs to check their understanding of recent events was accurate. Length of handover ranged from 1 to 11 minutes.

Whilst there was no evidence that miscommunication or misunderstanding occurred in any of the handovers observed, scope for improvement was identified. The most obvious area for improvement was the verbal handover.

Semi-structured interviews were conducted with a sample of 23 managerial and experienced operational personnel. The interviews focused on establishing:-

- Information requirements at the start of a shift to ensure continuity for safe and effective working
- Examples of effective and ineffective communication behaviours in preparation for, during and after shift handover.
- Perceived responsibility for safe communication at shift handover

Interview data was used, in conjunction with existing log book content, to derive a set of mandatory and discretionary categories of key information for inclusion in structured log books throughout the refinery.

Mandatory categories: “safety”, “maintenance & technical problems”, “work outstanding”, “comments/remarks” and “signatures of log book authors” are now included in *every* log book. **Discretionary categories:** “environmental matters”, “plant conditions”, “production & quality”, “personnel issues”, “external events”, “actions taken during shift” and “routine duties” are included in a structured log book only where this type of information is required for a particular post.

Data derived from critical incident interviewing ⁽²²⁾ was used, in conjunction with data from previous research ⁽⁷⁾, to draft a set of behavioural best practice guidelines for conducting effective shift handovers. These guidelines have since been used for training of new staff, developing experienced staff and have been made available to operational personnel by incorporating them into the design of structured log books.

The main recommendations of the review were to (1) implement a pilot scheme of structured logs in one area of the refinery, (2) introduce induction and refresher training on safe communication at shift handover and (3) following the pilot project, introduce structured logs site-wide.

Following completion of the review, the results and draft recommendations were outlined to participants during group feedback sessions and their comments invited. The proposals to introduce structured log books to all areas and include shift handover as a topic within training, for both experienced and new operators, were well received. The shift handover guidelines were deemed useful and sensible, most significantly for training new operators. The key categories of information and a prototype structured log were circulated and were accepted as being a good way forward and useful for all staff concerned. The only proviso placed upon their successful introduction was that all shifts should be involved in the design of structured logs for each post.

Structured logs were generally thought of as useful memory aids on information to be included in a handover. They were deemed useful for cutting down on unnecessary detail and ensuring that only relevant information was passed between shifts. An added advantage was the ability to see at a glance where specific information was on each page.

Phase 2 - Pilot Project - Structured logs

A senior process operator and process engineer were appointed to co-ordinate the pilot project. All shifts in the area of the refinery where the review had been conducted were briefed on the pilot project and the reasons for the initiative. Each post-holder was issued with briefing notes inviting comments on optimum log format and content for their post. This information was then collated and used to produce draft log books for each post. The draft logs were reviewed prior to issue to assess their conformity to minimum guidelines on effective information design⁽²³⁾ and a number of minor amendments were made. They were then issued for use.

Following several weeks in use, the draft log books were audited to determine how they were being used in practice and to examine the nature of any comments or suggestions for improvement made by post-holders. Comments sheets had been included at the back of each draft log book for this purpose.

Several improvements resulting from the introduction of structured logs were visible. More information on maintenance and technical problems was being recorded, safety issues were being flagged up and timings of events were being recorded more consistently. Furthermore, the information contained in the logs was easier to access and read. The comments and suggestions on the draft logs were used to update their design.

The experience of completing the pilot project suggested that site-wide implementation should proceed as follows:-

1. Each area nominate a team leader and operator to own the implementation plan.
2. Nominees attend half-day seminar to be briefed on project and plan implementation in their area.
3. Group meetings to be held in each area with post-holders, who would be invited to contribute to design of their own logs.
4. Review draft logs prior to issue.
5. Trial draft logs, invite comments and revise as appropriate.
6. Each area to complete post-implementation review after 3 months, using questionnaire used to evaluate the Phase 2 pilot scheme.

Phase 2 - Pilot Project - Training

The behavioural guidelines derived from Phase 1 were used to design an interactive training session which focused on the importance of establishing a two-way dialogue and attending to written, verbal and non-verbal communication at handover. This three-hour session used behavioural observation and feedback⁽²⁴⁾ to emphasise the training message. Delegates split into groups of three and assumed each of three roles; giving a handover, receiving a handover and observing.

This training programme was well received by apprentices. The format and content has been modified for experienced personnel to stimulate discussion and debate, whilst emphasising

general points about effective communication. A rolling programme of refresher training will continue for the foreseeable time.

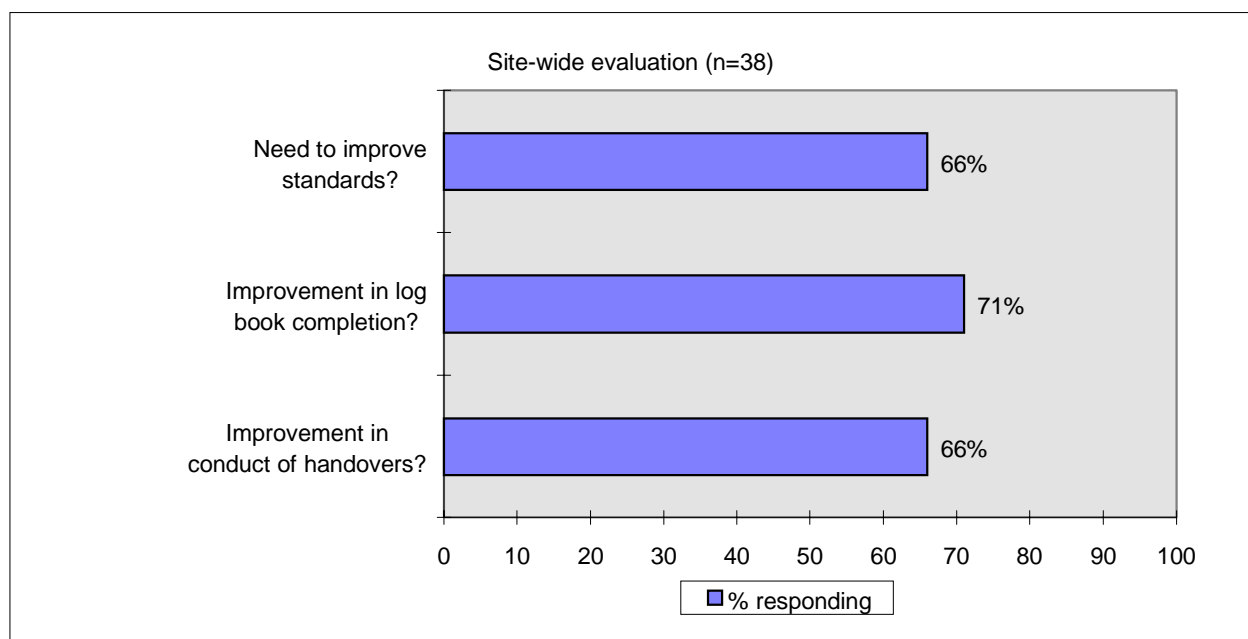
Phase 3 - Implementation refinery-wide.

Implementation of structured logs refinery-wide is now complete. Structured logs have been designed by post-holders for approximately 55 posts. Each refinery area has evaluated implementation in their local area and the results are described below.

Approximately 3 months after introduction of structured logs, a representative sample of 38 personnel involved in and affected by the scheme were interviewed. The purpose of the interviews was to gain their views on the project's effectiveness and how it had been implemented.

Interviews focused on whether, in their opinion, a) there had been a need to improve standards of communication at shift handover; b) the introduction of structured logs had improved how log books were completed; c) the introduction of structured logs had improved the way handovers were conducted. The results of this survey are shown in Figure 3 below.

Figure 3: Site-wide Evaluation



Sixty-six percent of the people interviewed felt there *had* been a need to improve standards of shift handover prior to the pilot project. Relevant information had often been lost, missed or not recorded.

Seventy-one percent believed that introduction of structured logs had led to improvements in how log books *were completed*. Typical comments were:-

“...more continuity between shifts”
“.. it has led to me focusing on what I am actually doing”
“.. (equipment) out of action are now listed and handed over verbally”
“...marked increase in amount of information passed down the line”
“..it has stimulated more interest in the handover and how it has been passed on”.

Sixty-six percent believed that introduction of structured logs had led to improvements in how handovers *were conducted*. Comments included:-

“.. there is more information for the person coming in..”
“.. you are referring to the book more. People talk through the book in a structured way..”
“.. what happens now is that major problems are pointed out - it is highlighted more”
“..safety issues are (being recorded and discussed) now”
“.. we both go over and look at the book and talk through it now”.

Opinions on the structured log designed for each post were sought and comments for improvement invited. A number of minor changes were still required and were actioned. The handover guidelines, printed at the front of each log book, had been read by most people and were found very useful.

Comments were invited on how structured logs had been introduced. The importance of involving operators in the design process was referred to by many people, and was felt to have been a crucial factor in the pilot project's success. Typical comments included:-

“ the effort which was made to win people round was necessary”
“I think it was done quite well - (the project co-ordinator) gave briefings and got feedback”.

The impression gained from the interviews, is that the introduction of structured logs had been well received *and has helped facilitate desired changes in behaviour at shift changeover*. The standards described will be used as the basis for auditing of shift handovers in future.

Conclusions

The approach described has proved to be a practical, empirically-based method of assessing current standards of shift handover communication and achieving measurable improvements. By involving post-holders in the process, a degree of commitment was obtained which is unlikely to have resulted from other methods. The approach described may prove useful to other industries endeavouring to improve their standards of shift handover communication.

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