RESEARCH & DISCOVERY PROJECT

RESEARCH AND REVIEW OF INDUSTRY BEST PRACTICE – GRID MESH, BARRICADING & SHIFT HANDOVER

FINAL REPORT
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EXECUTIVE SUMMARY

John Holland Group Pty Ltd engaged Ibis Business Solutions (Ibis) in partnership with People Knowledge Consulting (People Knowledge) as experts to research, review and report industry leading practice in relation to grid mesh, barricading and shift hand over processes.

This research involved a world-wide literature review (including peer review journals and industry specific publications), industry consultation (seeking internal standards, procedures, processes and practices that describe differing organisations management of the research topics) and review of legislative and other requirements (including quality standards, codes of practices, guidance and advisory materials).

GRID MESH

With regard to the installation, removal, inspection and auditing of grid mesh installations, key findings outline:

- Two specific regulatory documents were found to be relevant to the selection and installation of grid mesh; the Western Australia Health and Safety Regulations and AS/NZS 1657 (1992).
- There are two main types of grid mesh available on the market for flooring use, Expanded Metal Mesh and Grid Grating.
- Factors to identify which style of Grid Mesh is most suitable for installation include location, traffic volume, possible vehicle movement and load bearing capacity.
- Securing grid mesh using a minimum number of fastening points is recommended by one major supplier and whether secured by welds or clips/clamps is based on the criteria for the selection of the style suitability.
- Where any work is undertaken on grid mesh, whether installation, fixing or removal work, it was identified that the majority of participants ensure that the works activities are conducted under a works permit to ensure that the works are conducted in accordance company procedures and do not introduce new hazards to the work place.

A number of key areas that have been identified as ensuring best practice include:

- Ensuring that all activities, including installation, fixing and removal of grid mesh are conducted under a works permit issued by a competent and authorised company representative.
- A risk assessment or Job Hazard Analysis is to be completed specific to the activity and work area prior to any work activity commencing.
- All personnel involved in the grid mesh work activities are trained in working at heights and in using the relevant equipment, and in the company processes and procedures for the grid mesh work activity.
- A method for ensuring that grid mesh installations are clearly identified as having been inspected, whether by application of an inspection plate or some other mechanism.

BARRICADING

A review of legislation, codes, standards, guidelines and published literature showed that there is very little in the way of documented industry standards that specifically relate to the selection and installation of barricading. The one exception to this was the code of practice developed by Abu Dhabi EHS Centre (2012).

Also, the literature review did not identify any specific research associated with the selection and installation of barricading. The only articles identified related to the use and effectiveness of signage in general.

In contrast, the industry consultative process revealed that the majority of organisations that had actively participated had either:

- A dedicated standard that identified types of barricading to be used, outlined the selection process for the use of barricading and installation and removal procedures; or
- The requirements associated with barricading were addressed (to varying degrees) in other standards relating to hazard specific activities such as working at heights and / or system manuals.

There are a number of key areas that have been identified as ensuring best practice. These areas include:

- Clearly defining the types of barricades and specific requirements for their selection, installation, use and removal.
- Documenting and communicating installation and removal procedures.
- Having clear signage that is visible, recognised and understood by all.
- Use of information tags that communicate clear and concise information regarding the barricade and responsible person.
- Consider establishing removal checklist procedures / permits where life may be endangered without warning.
- Implement general awareness training for all personnel and competency based training for personnel with key responsibilities for barricading.
- Implement an audit and inspection program.

SHIFT HANDOVER

With regard to the shift handover process, key findings outline:

- Shift handover is sensitive to context and accordingly is hampered in achieving a standardised approach to handover content.
- There are specific references to shift handover obligations in Australian mining regulations but limited guidance materials or standards available in how to best conduct or structure shift handovers.
- Leading industries (e.g. Healthcare, Oil and gas, and Aviation) have commissioned significant research in the topic of shift handover and have documented practices, guidelines and procedures that are well advanced.
- Typically shift handover planning forms that were reviewed from Australian construction and heavy industries were highly generic and consisted mainly of free form fields.
- Commonly shift handover is conducted face to face between supervisors or superintendents with the outcome of the handover fed into the oncoming shift's pre-start meeting, contrary to NASA's researched best practice of face to face, team to team.
- From Australian construction and heavy industries procedures reviewed, shift log or plod books are rarely mentioned or used and rarely do current procedures reviewed reference where the shift handover should be conducted.
- The inclusion of auditing arrangements, analysis of shift handover records and the inclusion of communication skills in selection criteria could not be evaluated from the materials provided.
- One organisation has made significant investment and advancement in the use of technology aligned with best practices approached in its engagement with shift handover.

Key findings outline that current advancements to standardise shift handover in several industries are challenging given the differing risk profiles of activities being handed over and sensitivity of shift handover to context. Based on a wide ranging review of shift handover materials and research, it is suggested that:

- There should be provision of clear procedures/ written guidance describing the key information to be exchanged during shift handover, with a structure for the conversation and suggestions on how this how this should be done.
- Shift handovers should be conducted face-to-face, crew to crew.
- There should be two-way shift handovers, with both participants taking joint responsibility for ensuring accurate communication and understanding.
- Handovers should include both verbal and supporting handover artefacts which best practice currently points towards as being visual technologies of site. These have improved from electronic static databases and hand written log or plod sheets.
- Training should be provided to ensure that employees are competent to use handover procedures, logging, plod sheets, database or associated technologies that accompany shift handover processes and have the opportunity to develop their presentation, facilitation and communication skills.
- Shift handover records should be maintained and analysed for learning opportunities.

INTRODUCTION

John Holland Group Pty Ltd engaged Ibis Business Solutions (Ibis) in partnership with People Knowledge Consulting (People Knowledge) to conduct research into, and review, current safety practices and requirements in the Australian construction industry and internationally. This research involved a world-wide literature review (including peer review journals and industry specific publications), industry consultation (seeking internal standards, procedures, processes and practices that describe differing organisations' management of the research topics) and review of legislative and other requirements (including quality standards, codes of practice, guidance and advisory materials). The focus of the research was to identify industry leading practice in relation to grid mesh, barricading and shift handover processes as outlined in this report.

This report sets out the findings and recommendations of the research undertaken and details all practices researched and reviewed. Recommendations for industry leading practice are specified and the justifications for selection of these recommendations as industry leading practice are provided for each of the processes.

GRID MESH

Research, review and report industry leading practice in relation to grid mesh standards, practices and procedures to identify:

- Documented industry standards for the selection and installation of grid mesh,
- Documented installation, fixing and removal procedures.
- Installation, fixing and removal checklist procedures including permitting requirements.
- Industry training in relation to the use, installation, fixing and removal of grid mesh.
- Industry accepted auditing processes for ensuring compliance.

BARRICADING

Research, review and report industry leading practice in relation to barricading standards, practices and procedures to identify:

- Documented industry standards for the selection and installation of barricading.
- Types of barricading including selection criteria and fitness for purpose.
- Documented installation and removal procedures.
- Barricading signage requirements.
- Installation and removal checklist procedures including permit requirements.
- Industry training in relation to the selection, installation and removal of barricading.
- Industry accepted auditing processes for ensuring compliance.

SHIFT HANDOVER

Research, review and report industry leading practice in relation to shift handover standards, practices and procedures to identify:

- Industry accepted definition of *"shift handover"*.
- Criteria (type of project, type of activity, etc.) to trigger shift handover requirement.
- Documented industry standards and procedures for the documentation of shift handover including:
  - method of shift handover,
  - items / issues to be discussed and included in shift handover,
  - communication of information at shift handover.
- Industry training in relation to shift handover methods and communication.
- Industry accepted auditing processes for ensuring compliance.

METHODOLOGY

The purpose of the review was to examine current practice and make recommendations based on leading approaches and standards to identify the most comprehensive, accurate and safe procedures in the areas of grid mesh, barricading and shift handover. The commencement and project planning for this review began in the week of September 3rd, while the formation of the project team and data collection commenced on Monday September 10th. In total, the research project had a seven week window with submission of this report on Monday October 29th.

At the outset the research team identified a three pronged methodology as the most appropriate and effective way of maximising data collection within the project timeline. This multi front approach sought maximum involvement of industry through personnel (namely safety professionals) most affected by any changes in current practice while simultaneously engaging with peak bodies, industry collaborative forums, safety authorities, regulators and legislative guardians. Underlying this consultative data collection more passive documentation including written materials, industry publications, empirical studies, journal articles, books, conference proceedings and the internet were also searched for relevant best practice material and findings. A detailed explanation of each approach taken to collect and maximise research materials across these three different fronts is outlined in the following sections.

INDUSTRY STANDARDS

For each of the three processes under review (grid mesh, barricading and shift handover) all forms of relevant Australian legislation, codes of practice, regulations, rules and standards were researched. These were sourced directly and indirectly from a variety of bodies including state regulators and government departments, Standards Australia, industry associations, peak safety bodies and consultation with safety professionals. Materials collected for review included state based *Occupational Health and Safety Acts*, relevant regulations and mandatory standards, codes of practice and non-mandatory standards and specific guidance material. Each of the collected materials was reviewed and compared in its content relevant section in the *"findings and discussion"* section of this report.

It is important to note at this point, that this paper does not discuss and contrast different safety legislation worldwide, nor discuss the current changes with harmonisation of workplace health and safety legislation in Australia. Rather, the contribution of this section of the review is to provide a starting point for the various minimum standards imposed on operators in relation to the three subject processes (grid mesh, barricading and shift handover). These minimum obligatory standards, guidelines or rules provide the baseline from which the various approaches to the three practices under review can develop and expand. Effectively, review from this section provides the framework for the minimum level of compliance while guidance material provides insight into general thinking and suggested innovation in industry approaches, if any.

INDUSTRY CONSULTATION

In addition to a review of legislation and the existing standards and guidance materials the project team also sought to engage a range of subject matter experts, industry associations and collaborative bodies and organisations. A contact list was developed to identify relevant sources that could provide information, insight, and specific materials around their internal policies, standards, procedures, processes and practices in the three processes under review. This contact list included more than 70 organisations across various sectors in Australia and overseas. The contact list was provided to John Holland's Project Manager for review and input prior to commencement of consultation. Where possible large multinational organisations were targeted to gain access to overseas practices, while the final contact list included involvement from the following industries:

- Building and Construction
- Mining and Mineral Processing
- Engineering and Construction Management
- Oil, Energy and Gas
- Heavy Manufacturing
- Maintenance Services
- Water and Waste Services
- Higher Education
- Health Care

Industry engagement was intended to be broader than the construction sector to gain a broader view of best practice by engaging organisations and individuals with experience and exposure to the three processes under review.

Contact with organisations was targeted through key individuals, usually safety professionals at senior levels within the organisation. These contacts therefore had delegations that enabled them to agree to participate in the research on behalf of their organisation and had the access and resources to provide the requested materials. Consultation was conducted using a semi structured interview process with initial contact made via face to face or telephone and a follow up request for materials via email. A copy of the semi structured interview guide is provided in the Appendices.

Responses to our request were variable across the three processes, though generally limited to less than 20 companies (roughly a 27% response rate) in total which provided documentation within the project timeframe. Each industry sector was represented by at least one example. The major blockages for organisations not being able to contribute included:

- Key personnel being unable to be contacted, return calls or redirect queries for requests for materials due to existing operational commitments and/or travel.
- Inability to prioritise requests for materials in the given timeframe due to existing or unforeseen commitments.
- Citing a lack of existence, lack of having documented formal, or immature existing procedures and systems for the three processes requested.
- Concerns around intellectual property or detriment to their competitive advantage.

A structured approach for the data collected was used to examine current policies, procedures, documentation, and all information sourced. These materials were reviewed from a desk top standpoint as no opportunity was available to gauge implementation, effectiveness or practicality of these systems.

LITERATURE REVIEW

Review of existing literature included searches for relevant materials on grid mesh, barricading and shift handover and involved searching a range of media including but not limited to:

- Peer reviewed journals.
- Library catalogues, eBooks and book reviews.
- Electronic databases and publication resources.
- Industry publications, journals, newspapers and magazines.
- Conference proceedings, presentations and academic theses.
- The world wide web.

This documentation was systematically collated and evaluated for each of the specific topics under review and their relevance for inclusion. Applicable articles and papers used in the review are for the purpose of identifying or justifying better practice and are referenced in this report.

FINDINGS & DISCUSSION

GRID MESH

Throughout this report, Grid Mesh will be referred to for use in flooring materials as its sole application. No reference or identification for the installation, use or auditing of other applications of Grid Mesh products is intended to be included as part of this review.

DOCUMENTED INDUSTRY STANDARDS FOR THE SELECTION AND INSTALLATION OF GRID MESH

Legislation (Acts & Regulations), Codes, Standards, Guidelines

Following review of the legislation, codes, standards and guidelines applicable to grid mesh globally, four criteria were found to be relevant to the selection and installation of grid mesh.

AS/NZS 1657 (1992) documents the requirements for ensuring that grid mesh used in a flooring application must meet the following characteristics:

- Grated floors shall be constructed in such a form as will provide a slip-resistant surface.
- The smaller dimension of any opening shall not exceed 40mm and the area of any opening shall not exceed 5000mm^2.
- Any gap between adjacent made up sections of grated floors shall not exceed 10mm and may be of any length.
- Where the slope of a walkway exceeds 1 in 8 (7 degrees), the walkway shall be of (a) grating (expanded type metal, metal grating); (b) metal plate fitted with cleats; (c) timber complying with Clause 2.2.3.1 fitted with cleats; or (d) other acceptable material. Where grating is used, it shall be subject to acceptance by the authority having jurisdiction.

The Western Australia Health and Safety Regulations state that a person who, at a workplace that is a construction site, is the main contractor, an employer or a self-employed person must ensure that if grid mesh or checker plate flooring panels are being installed at the workplace each panel is securely fixed, in accordance with manufacturer's specifications, to a supporting structure before the support structure is placed into position on the building or structure under construction and where this is not practicable, then each panel is securely fixed to the building or structure under construction immediately after the panel is placed into position.

Industry Consultation

There are two main types of grid mesh available on the market for flooring use. These are identified as Expanded Metal Mesh and Grid Grating.

A number of factors are used to identify which style of grid mesh would be most suitable for each installation, including location, traffic volume, possible vehicle movement and load bearing capacity.

Expanded Metal Mesh is manufactured from solid sheets of carbon steel, galvanised steel, or aluminium and other metal/alloys. In the expanding process, the sheet is simultaneously slit and stretched, expanding the slits into diamond-shaped holes of uniform size, shape and regularity. No metal is lost in the expanding process and the final product is stronger per kilogram and lighter per metre than the original sheet. The newly formed strands and knuckles of the diamond-shaped trusses are at an angle to the original plane of the sheet, adding strength and rigidity.

From consultation with manufacturers and suppliers generally, the expanded metal mesh is considered to be more slip resistant due to the angled diamond pattern creating ridges that provide a greater level of traction than standard grid grating. However, the increased traction comes at the price of raised sharper edges on the mesh which can cause more injury in the event of a fall. When selecting the style of grid mesh based on slip-resistance it is critical to ensure that the increased exposure in the event of a fall is considered.

Grid Grating is a commonly used product in the manufacture of stair treads, walkway flooring, screens and drain covers. It is a metal panel manufactured by welding a series of load bearing bars to a cross bar positioned at 90 degrees. This grid is then *"banded"* with a metal flat bar to provide additional rigidity and stability to the load bearing bars. Grid grating is available as either hot dip galvanised or untreated (ungalvanised) steel. Galvanised grid grating has a durable, abrasion resistant coating of metallic zinc and zinc-alloy layers metallurgically bonded to the steel base in accordance with AS/NZS 4680:2006. Grid grating can also be manufactured in three different load bearing bar section shapes, in either I-bar, flat bar or serrated bar depending on the application.

When installing either style of grid mesh, accepted and recommended practice is to ensure that the manufacturer's guidelines for installation are followed. This will include methods of securing and supporting the grid mesh. There are two categories of securing grid mesh that are available – welding and via clips/clamps.

From reviewing materials supplied by the manufacturers and suppliers of grid mesh grating products, it has been identified that one major supplier recommends using the following number of fastening points as a minimum when securing grid mesh:

SPAN	CLIPS / WELDS
500 to 1500mm	4
1500 to 3000mm	6
3000 to 4000mm	8
4000 to 5000mm	10
5000 to 6000mm	12

Whether the grid mesh grating panels are secured by welds or clips/clamps depends on the same factors as selection of the grid mesh product as well as how often the grating will be required to be lifted or removed.

Expanded metal mesh can be secured by either welding or clamping methods depending on the frequency of the panel needing to be removed. When using welding as the fixing mechanism, the panel should be secured in accordance with the manufacturer's guideline which is a weld every third or fourth stag depending on the product being used.

Documented Installation, Fixing and Removal Procedures

There are no specific standards or legislation for the installation of grid mesh (only for the manufacture) however the installation must meet the requirements of AS/NZS 1657 (1992).

Following review of the materials supplied by industry participants, it was identified that the installation process is broken down into three sections.

The first section is the pre-installation activities that are completed before work activities commence. These involve conducting job/task assessments, communicating with relevant parties and obtaining a work permit for the activities being conducted. It was identified that 66% of companies undertaking grid mesh installation, fixing and removal activities required that a job hazard analysis or risk assessment be completed before activity commenced, however only one company stated as part of their procedure that the assessment was to be conducted for the specific work location.

In addition to conducting a risk assessment or job hazard analysis, 30% of companies stated that the assessment must be clearly displayed on notice boards or formally communicated to all work parties impacted by the work activities being conducted. Communication with the immediate work party is part of the accepted assessment process, however, the additional requirement to communicate with work parties in the affected area ensures that all parties are aware of the work being conducted on site.

For 30% of the procedures provided by industry, it is compulsory for a work permit to be in obtained in order for any work activity to be conducted in relation to grid mesh. The permit must be specific to the activity and location and must be issued by an authorised company representative.

The second section of the grid mesh process is in relation to the process of installing grid mesh.

In 30% of the procedures reviewed, it was a requirement that, where possible, the structural support members were to be installed and fully secured prior to the installation of the grid mesh.

It was also identified that guard rails, hand rails and kick boards were to be installed at the limits of the grid mesh installation activities and that fall arrest equipment was to be used by installers to assist in the prevention of falls from height. This was identified as accepted practice by the majority of the company procedures and processes reviewed. In 30% of the procedures reviewed additional hard barriers were required to isolate the area directly underneath the installation area to prevent injuries from falling objects.

When conducting the installation of the physical panels, 30% of the procedures reviewed called for temporary fixing with wires or clamps during the emplacement process prior to being permanently fixed in place by either welding or fixing clamps/clips. This was to ensure that the panels couldn't be moved or nudged out of position while adjacent panels were moved into position or the panel didn't shift while being secured into place.

Where, during the installation process there is an instance of the panels not fitting, 30% of the procedures reviewed called for a cessation of all installation activities until remedial action had been completed and the panels were fitting in place as designed.

The final section of procedural process was in relation to the removal activities relating to grid mesh.

With regard to the removal of grid mesh, 33% of the procedures required a works permit to be in place prior to the commencement of any removal activities. In one instance, written authorisation for the specific work zone is required in addition to holding a works permit for the removal activity.

In all procedures reviewed, solid barricading is required around the extremities of the work zone where grid mesh is to be removed. In addition, in 20% of processes, the area below the work zone must be hard barricaded and signed notifying works being undertaken overhead.

In all instances of grid mesh installation, fixing and removal, training is required to be completed as identified in the section in this report on industry training in relation to the use, installation, fixing and removal of grid mesh.

Installation, Fixing and Removal Checklist Procedures Including Permitting Requirements

Review of the procedures and documentation supplied by participants has identified the following areas as being of key concern when performing an inspection of installation, fixing or removal / re-instatement activities with grid mesh:

- Loose panels
- Loose or missing fixing clips/clamps
- Unsupported load bars
- Deformation or damage to panels
- Trip hazards or panels sitting up creating a raised edge
- Corrosion

In one instance, a company has created a post work inspection checklist that is signed off by an independent inspector once the work activity has been completed and inspected. The checklist ensures that the installation or reinstatement has been completed in accordance with the manufacturer's installation requirements and is safe for use.

Where any work is undertaken on grid mesh, whether installation, fixing or removal work, it was identified that the majority of participants ensure that the work activities are conducted under a works permit to ensure that the works are conducted in accordance with company procedures and do not introduce new hazards to the work place.

Industry Training In Relation to the Use, Installation, Fixing And Removal Of Grid Mesh

Currently, there are no standardised industry training courses available for the use, installation, fixing and removal of grid mesh.

Discussions with manufacturers and suppliers of grid mesh have indicated that the general trend is for them to be sole suppliers and not be involved in the use, installation, fixing or removal process.

Discussions with industry has identified that it is common practice for companies to train their personnel using internal procedures for working with grid mesh. Nationally certified training is provided to support the use, installation, fixing and removal processes in the following areas:

- Working At Heights
- Fall Arrest
- Rigging

Additional training is also provided in internal Permit to Work systems as the majority of companies surveyed identified that no work activities involving grid mesh were to be conducted without a Permit to Work being in place.

Industry Accepted Auditing Processes for Ensuring Compliance

There are no specific legislative requirements with regard to inspection of grid mesh.

In literature available during this review, it was evident that regular inspection of grid mesh installations is highly recommended as there is a high incidence of injury and accident due to grid mesh panels being damaged, corroded or unsecured.

All manufacturers and suppliers consulted indicated that there was a need to ensure that regular inspections of grid mesh installations were conducted based on the level of risk of an installation. It was indicated that the frequency of inspections could be pushed out to a maximum of five years depending on the securing mechanisms, the level of traffic, environmental conditions and cleaning/chemical usage on grid mesh panels.

In one instance a colour coded inspection plate was secured to the grid mesh panel indicating the date of inspection and approval to remain in service following inspection. This allowed all personnel to quickly identify which installations had been assessed and were considered safe to use and which were still to be reviewed.

Documentation provided by industry indicates that inspections of grid mesh installations are to be regularly conducted; however the frequency of inspection is dependent on the perceived risk of the installation.

BARRICADING

At the outset, the term barricading and its relevance to the research undertaken needs to be clarified. For the purposes of this research, (based on the definition contained within Abu Dhabi EHS Centre (2012)) barricading is defined as:

A temporary structure (rigid or flexible in nature) consisting of vertical and / or horizontal components (eg. mesh, tape, panels, rails etc.), or similar objects, used to create a restricted access area to prevent unauthorised entry into a particular work area or area where a hazard may exist.

It should be noted that guarding / formwork / scaffolding / guard railing / perimeter fencing or perimeter screens which are used for the purpose of traffic management, machinery access / protection or fall prevention eg. working on roofs - edge protection; multilevel buildings - perimeter screens; walkways; work platforms; scaffolds; stairs; blast protection; etc. were not considered to fall under the definition of barricading for the purposes of this research.

DOCUMENTED INDUSTRY STANDARDS FOR THE SELECTION AND INSTALLATION OF BARRICADING

A review of legislation, codes, standards, guidelines and published literature showed that there is very little in the way of documented industry standards that specifically relate to the selection and installation of barricading. The one exception to this was the code of practice developed by Abu Dhabi EHS Centre (2012). Abu Dhabi EHS Centre (2012) defines requirements for the use of barricades including:

- Training and competency needs.
- Assessing the need for barricades.
- Defining the different types of barricades.
- Installation of barricades.
- Barricading signage.
- Use of barricading tape.
- Barricading materials.
- Lighting.
- Prevention of unauthorised access.
- Inspection requirements for barricading.
- Removal of barricading.

Also, the literature review did not identify any specific research associated with the selection and installation of barricading. The only articles identified related to the use and effectiveness of signage in general Bruner L. (2007), K.L. Chan Alan H.S. Chan (2011), Chan A. H. S. & Ng A. W. Y. (2010), Laughery K. R. & Wogalter M. S. (2012) and Townsend D. (2008). For a summary of the findings of this research, refer to the section titled Barricading signage requirements below.

It should be noted that the opposite applies when reviewing barricading associated with hazard specific activities such as:

- Excavations – *Occupational Safety and Health Regulations 1996 (2012)* requires that suitable barriers are installed to protect persons at risk of injury from excavation work. WorkSafe Western Australia (2009) states that a plastic safety mesh barrier 900mm in height attached to star pickets is an acceptable alternative to a rigid barricade for protection around excavations.
- Public access – *WorkSafe Western Australia (2009)* states that the horizontal guardrail is to be between 900mm and 1100mm from the ground when it is necessary to exclude members of the public from a temporary construction site or work area.
- Work at heights / prevention of falls – *Australian Safety and Compensation Council (2008)* and *Workplace Health and Safety Queensland (2011)* for example, outline specific requirements for barricading associated with the prevention of falls at roof edges, mezzanine edges, walkways, stairways, roof structures, shafts, pits, etc. Identified requirements relate to types of barricading, height of guard rails, ability of barricading to withstand a predetermined force and signage.

Industry Consultation

In contrast, the industry consultative process revealed that the majority of organisations that had actively participated had either:

- a dedicated standard that identified types of barricading to be used, outlined the selection process for the use of barricading and installation and removal procedures; or
- the requirements associated with barricading were addressed (to varying degrees) in other standards relating to hazard specific activities such as working at heights and / or system manuals.

TYPES OF BARRICADING INCLUDING SELECTION CRITERIA AND FITNESS FOR PURPOSE

There are various types of barricading that can be used in the work environment. The types of barricading can be generally categorised as hard or soft barricading. For the purposes of this evaluation, hard and soft barricading is defined as:

- Hard barricading – Provides a solid / rigid barrier that cannot be walked through and is generally constructed of scaffold tube, mesh, metal or wooden posts or rails, etc. Hard barricades may include fences, building walls, concrete structures, standalone A'frames, earthen berms, water filled plastic barriers, etc.
- Soft barricading – Delineates an area that has restricted access due to an activity that is occurring or warns of a hazard / danger that may exist. The barricade does not provide a solid / rigid barrier and can be easily walked through. Soft barricades may include coloured rope / ribbon, bunting, cones, flagging, bollards, etc.

Based on the documented industry standards and industry consultation, the selection criteria and fitness for purpose as to which type of barricading to be used was determined by one of and / or both of the following factors:

- Assessed level of risk to an individual should they be exposed to the particular hazard / danger or activity being undertaken. For example:
  - Employers shall use soft barricading to prevent entry of personnel and equipment as an immediate and short-term control where a risk assessment indicates that the associated risk is low; and use hard barricading to prevent entry of personnel and equipment to areas where a risk assessment indicates the use of solid barricades to provide a physical barrier.
  - Soft barricades are to be used for areas of low risk where it is intended only to identify that the area is not generally suitable for personnel access on a temporary basis; and hard barricades are to be used for areas of medium to high risk where there is a requirement for personnel to remain clear, or not enter, due to an active process or specific danger.
- The particular activity being undertaken within the barricaded area or the type of hazard / danger that was present. For example:
  - Hard barricading shall be used to provide physical protection for high risk hazardous areas / activities where persons are working at height, elevated work areas, vehicle / pedestrian interaction, around excavations, steel erection, slewing mobile plant / equipment, etc.
  - Hard barricading shall be used to protect employees from immediate risk by preventing entry to a hazard such as open hole conditions or dangerous ground conditions that may be undetectable that will endanger life with no warning.

Other considerations for the selection of barricading included familiarity with the hazard, visibility of the hazards and the amount of clearance from the hazard.

Some of the standards developed and used by organisations contained a matrix that identified certain scenarios / activities / hazards and the specific types of barricading required to be implemented for that specific situation in accordance with their standards. This serves as a quick and effective reference guide for personnel who need to implement barricading.

DOCUMENTED INSTALLATION AND REMOVAL PROCEDURES

A review of Abu Dhabi EHS Centre (2012) and organisational standards demonstrated that there were common requirements associated with installation and removal procedures. These included:

- Barricades must be installed before the commencement of works.
- The barricaded area is to encompass the entire potentially affected area of the hazard.
- Barricading is to be installed at least two metres away from the hazard. Where this cannot be done, a risk assessment should be undertaken.
- Barricading is to be maintained in good condition ensuring that it remains effective.
- A hard barricade shall have a solid top and mid rail (e.g. scaffold tube or equivalent). The top rail must be between 900mm and 1200mm high and mid rail shall be no more than 560mm from the floor if no toe board is fitted, with 450mm between rails. It must be able to withstand a force of 0.55 – 0.90 kN (approximately equivalent to 55 – 90 kg) applied at any point.
- Hard barricading is to be accompanied at all times with relevant flagging / tape.
- Barricading materials such as mesh and/or tape shall be installed with the top edge at a height between 900mm and 1200mm.
- Plastic mesh barriers shall be a minimum 900mm high supported by capped star pickets or other upright structures.
- Barricade supports shall be at maximum spacing of three metres.
- Barricades shall be maintained in a taut and level position to prevent sagging.

- Water filled plastic barricades are classed as a suitable barricading method. If they are used where there is potential for a vehicle impact they shall be linked together and filled.
- Barricading shall not be tied to valve handles, conduit, instrument tubing, electrical gear, or other fragile items.
- Barricades shall be installed in such a way as to eliminate accidental entry into the barricaded zone.
- Entry points in barricading shall be arranged such that personnel entering the area cannot walk directly into the hazard.
- Where a barricade would not support a person's weight, it shall be placed so that any person falling through it would not reach the hazard.
- No person shall enter a danger barricade area unless authority is obtained from the barricade owner as listed on the barricade tag.
- Caps shall be fitted to star pickets or stakes.
- Warning lights, such as amber flashing beacons, are provided at appropriate intervals where the risk assessment indicates the need to warn people of the presence of a barricade during darkness.
- Barricading signage shall be installed on all barricades in accordance with requirements outlined below under *"barricading signage requirements"*.
- Barricades are to be removed immediately once the work is completed or the hazard no longer exists.

In summary, the majority of differences from one standard to another were minimal when it came to installation and removal procedures.

BARRICADING SIGNAGE REQUIREMENTS

Legislation (Acts & Regulations), Codes, Standards, Guidelines

Abu Dhabi EHS Centre (2012) requires that employers ensure:

- That where solid barricades are used they are accompanied with signs to communicate the hazard information.
- Barricading signs are attached in appropriate numbers to ensure visibility under all circumstances.
- Barricading signs shall provide the name and phone number of the contact person/responsible supervisor in addition to the expected duration that the barricading shall be in place. Where appropriate, signs shall also have attached specific hazard information eg. - *"Danger no access-persons working above"*.

Standards Australia (1994) AS1319 does not specifically refer to or relate to signage for barricading but does specify requirements for safety signs in the occupational environment. Relevant categories within the standard that can be applied to barricading signage include regulatory signs and hazard signs. The standard outlines specific requirements for colour, shape, layout, use of symbols, use of wording, sign size and legibility, symbol and letter size, sign material, sign construction, sign erection and removal, sign location, and sign maintenance. It also outlines specific requirements for the use of accident prevention tags. Relevance of this standard to required barricading signage will depend primarily on the purpose of the barricade, level of risk and site conditions.

It should be noted that the opposite applies when reviewing barricading associated with specific activities such as:

- Excavations – *Occupational Safety and Health Regulations 1996 (2012)* requires that suitable signs that warn of the risk are erected at the place where the excavation work is to be done.
- Perimeter fencing work at heights – *Australian Safety and Compensation Council (2008)* states that signage should be erected which warns against entry to those areas.

Literature Search

The literature review did not identify any specific research associated with the selection and installation of barricading signage. The only articles identified related to the use and effectiveness of signage in general Bruner L. (2007), K.L. Chan Alan H.S. Chan (2011), Chan A. H. S. & Ng A. W. Y. (2010), Laughery K. R. & Wogalter M. S. (2012) and Townsend D. (2008).

These articles outlined key points in relation to general signage:

- If you have a multilingual work force, make sure that the wording on the signs is in the relevant multiple languages.
- Be sure that your signs comply with any regulatory and other industry standards.
- Use colour coding to comply with mandated regulatory standards where required.
- Graphics on signs should be colourful and bold and immediately convey the message.
- Place appropriate signs at the point of danger.
- Consistent format for signs and labels should be used throughout the facility for clarity.
- Create customised messages to clearly identify requirements for entering a specific area or operating a specific piece of equipment.
- Materials used for signs and labels should be able to endure the environment where they are used. Specially designed and tested materials are needed to withstand harsh environments.

They identified that the comprehensibility of safety signs was better for the signs which were familiar, concrete, simple, meaningful and able to be associated with the underlying concepts.

Laughery K. R, & Wogalte, M. S. (2012) found that the factors that have shown significant effects are:

- Location – placed where it is likely to be encountered.
- Size – bigger is generally better.
- Colour – hue differences for prominence.
- Contrast – brightness differences; black on white or vice versa for greater legibility.
- Format – *"chunked"* text and outline/bulleted lists attract attention better than large dense paragraphs of text.

Townsend D. (2008) states that for a sign to be effective it must be visible, readable, noticeable and legible. He also outlines U.S. OSHA requirements for signage as:

- Danger signs – used only where an immediate hazard exists. Danger signs have red as the predominant colour for the upper panel; black outline on the boarders; and a white lower panel for additional sign wording.
- Caution signs – warn against potential hazards or unsafe practices. They have yellow as the predominant colour, black upper panels and borders with yellow lettering.
- Safety instruction signs – are white with green upper panel and white letters to convey the principal message.

Industry Consultation

Standards obtained from participating organisations outlined signage requirements based on the type of barricade and the intended purpose of the barricade. This included:

- Signage needed to identify date and time erected, name of responsible person with phone number or means of contact, duration of project and reasons for the barricade (hazard present). This information was required to be generally recorded on an information / barricade tag that is attached to the barricade.
- All barricades shall have an information tag and signage attached at all faces and designated access points. The intervals of signage was not specified for the faces.
- There were three types of signs identified:
  - Danger signs – generally denoted by red, red and white, or red and black signs or tape.
  - Caution signs – generally denoted by yellow, or yellow and black signs or tape.
  - Information – generally denoted by blue signs or tape. These were generally used for special activities such as commissioning, operational exclusion zones, etc.
- Signs should be located where the messages are legible, and so that they attract the attention of, and are clearly visible to all concerned.
- Signs should be mounted as close as practicable to the observer's line of sight and positioned so as to give the viewer ample time to heed the warning.
- Signs shall be constructed and erected so that they don't create a hazard and shall be maintained in good condition, kept clean and well illuminated.
- The meaning of safety signs used on a site must be communicated to the workforce at the induction, toolbox meetings and pre-start meetings.

INSTALLATION AND REMOVAL CHECKLIST PROCEDURES INCLUDING PERMITTING REQUIREMENTS

None of the standards (legislation, codes, standards, guidelines and published literature and industry consultation) reviewed required the use of installation and removal checklists or any permitting requirements. One organisational standard required that for entry beyond their *"high risk level"* barricade, an entry permission form was required. The high risk level barricade denoted that there was an immediate risk to employees such as open holes, dangerous ground conditions etc. where life may be endangered without warning.

It should be noted that for other specific scenarios (not part of the scope of this research), installation and removal checklists that include permit requirements exist such as removal of grid mesh, removal of guard rails on walkways and work platforms, etc.

INDUSTRY TRAINING IN RELATION TO THE SELECTION, INSTALLATION AND REMOVAL OF BARRICADING

There are no industry training packages available that are associated with the selection, installation and removal of barricading. Abu Dhabi EHS Centre (2012) states that employees are trained in the barricading of hazards and understand the risks associated with using the equipment and the control measures implemented. Abu Dhabi EHS Centre (2012) goes on further to say:

- Training shall be competency based and include:
  - Systems of work needed for the safe use of barricades.
  - Types and selection of correct barricades.
  - Barricade equipment.
  - Care, maintenance and inspection of barricades.

- Additional retraining shall be conducted whenever a periodic inspection reveals, or there is a reason to believe, that there are deviations from inadequacies in the employee's knowledge of barricading hazards.
- Employers shall conduct additional retraining whenever a barricading of hazards procedure fails.
- Employers shall ensure that where solid barricades are used they shall be erected by a competent person.

Less than one quarter of the organisational standards reviewed required some type of training / instruction. This varied from completion of a site induction (the majority) that contains information on barricades, signs and work area demarcation to having a training package and competency assessment based on the standard for barricading.

INDUSTRY ACCEPTED AUDITING PROCESSES FOR ENSURING COMPLIANCE

Only one of the organisational standards that were reviewed required that an audit process be established to assess implementation of barricading processes. However it did not go into any further detail regarding frequencies or scope.

Other organisational standards (less than one third) required regular inspections to be conducted to ensure that barricades are correctly erected and maintained to the required standard. The frequency of required inspections varied from before work commences, during the work activity, at the completion of the work activity, at the end of each shift, daily and weekly. They also required that the inspections be recorded either on the attached hazard tag or in a formal inspection checklist.

Abu Dhabi EHS Centre (2012) specifically states:

- Barricades shall be kept in a condition that doesn't reduce their effectiveness which includes:
  - Signed appropriately and clearly visible.
  - Effective at preventing accidental contact
  - Visible during the hours of darkness where required.
  - Removed promptly when the work is completed or the hazard has been removed.
- Barricade components are to be inspected frequently and those with defects shall be withdrawn from service for repair or disposal and tagged or marked as *"Dangerous, Do Not Use"*.
- As a minimum, a weekly formal inspection shall be undertaken and documented for all barricading.
- Employers shall consider the use of inspection tags fixed to each barricade. The inspection tag can be used to record the following information:
  - Identification mark of the barricade.
  - The date the barricading was first erected.
  - Date of the last inspection
  - Result of inspection.
  - Name of the person carrying out the inspection.

SHIFT HANDOVER

Shift work is defined by the ABS as *"a system of working whereby the daily hours of operation at the place of employment are split into at least two set work periods (shifts), for different groups of workers"* (Australia Bureau of Statistics, 2009). Likewise Buxton (2003) notes that shift work involves the alternation of teams of workers each working a certain *"shift"* (the hours of work), and who usually perform the same work duties so that operations can be continued for longer than allowed by any single worker.

Shift work and extended working hours are increasing in many industries and organisations in Australia. The ABS (2009) reported that in November 2009, 1.4 million Australian employees usually worked shift work in their main job which accounted for 16% of all employees. The industries with the highest proportion of employees who usually worked shift work were 'Mining' for men (52%) and 'Health care and social assistance' and 'Accommodation and food services' for women (both 32%). The industries with the next highest proportions were 'Accommodation and food services' for men (44%) and 'Transport, postal and warehousing', 'Mining' and 'Arts and recreation services' for women (all 24%). With an increase in the prevalence of shift work there is a growing emphasis on the improvement in shift related health and safety processes. The transition of work teams or *"shifts"* is a defining aspect of shift work that enables it to achieve its goal of uninterrupted vocation, or provision of continuous service across the 24 hours in a day. Accordingly at the heart of shift work process improvement efforts is the fundamental concept of shift handover which depending upon the industry, is also referred to as shift changeover, handoff, sign out, sign over, turnover, and/or transfer.

INDUSTRY ACCEPTED DEFINITION OF *"SHIFT HANDOVER"*

In industries which operate continuous processes, continuity is maintained across shift changes as outgoing personnel transfer accountability for the workplace to the incoming personnel responsible for performing the same duties on the subsequent shift. The goal of a shift handover is to accurately and reliably communicate task relevant information across shift changes, thereby ensuring continuity of safe and effective working (Lardner, 1996). However there are relatively few commonly accepted definitions for shift handover, an example of which is found in the healthcare industry:

"the transfer of professional responsibility and accountability ..... to another person or professional group on a temporary or permanent basis"

(Australian Commission on Safety and Quality in Healthcare, 2012; Manser & Foster, 2011).

However, shift handover as a transfer of responsibility is defining an outcome and not the underpinning process of information exchange which is fundamental to the activities that follow in the subsequent shift. As such shift handover encompasses all reporting mechanisms employed when workers change shifts, and while the communication processes used to convey information about the job is an integral component, shift handover also performs a number of other functions. These include error correction, planning of future work, creation and reinforcement of local norms and teaching and learning (Symons et al., 2012). Appreciation of the multiple functions of shift handover demonstrates that it is not just a one way information transmission but a team activity with interaction between all participants and subject to all the advantages and disadvantages of team working (Symons et al., 2012). Accordingly a more rounded definition for shift handover includes the description of communication exchange and is listed below from Cohen & Hilligoss (2010) definition which has been adapted for the construction industry:

"the exchange between shifts of information and risks relating specifically to the job or tasks being performed which accompanies either a transfer of control over, or of responsibility for, the work."

This characterisation of shift handover emphasises the process of *"exchange"* and is aligned with the construction industry procedures collected throughout this review. Industry materials while not directly defining the concept of shift handover commonly describe it as a *"system for the relay of information"*. Supporting this definition Grusenmeyer (1995) and Lardner (1996) detail that an efficient shift handover should include three different stages: (1) preparing information to pass on, (2) executing the shift *"handover"* during which the outgoing worker communicates task-related information to the incoming worker, and (3) matching the information handed over by the outgoing operator to the information taken off the system by the incoming operator. Likewise an audit methodology developed by the Keil Centre (2006) consistently references the importance of effective communication in successful shift handover. Accordingly, the exchange of information to establish the current state of the workplace and its context is an essential element of effective shift handover (Carroll, Williams, & Gallivan, 2012; Cohen & Hilligoss, 2010; Lardner, 1999; Thompson & Plocher, 2011; Wallis, 2010) and our definition of exchange highlights this process while simultaneously encompassing differently labeled interactions and the variations in the their accompanying events and purposes.

However, an important point of differentiation should be made between communication events that occur at the start of a shift, namely shift handover and pre-start meetings. While both fundamentally require effective communication of information dependent upon execution and inclusion, they may involve some overlap even though their primary objectives differ. A shift handover is about transfer of situational awareness while a pre-start meeting is focused on building on this information to plan and strategise the execution of the work to be done in the coming shift. A key difference between these two processes is that a shift handover requires the active participation or input of at least one member from the previous shift, while a pre-start does not. Accordingly, a shift handover may occur and on departure of the outgoing shift the incoming shift may then conduct their pre-start meeting using the information handed to them from the previous shift. Again reinforcing our definition of shift handover as an exchange, if a pre-start is conducted based only on records or logs from a previous shift, then the record or log essentially takes on the function of a shift handover.

LEGISLATION (ACTS & REGULATIONS), CODES, STANDARDS, GUIDELINES

As there are only a few publications that offer general definitions of shift handover, there are no widely accepted standards of what activities the term *"shift handover"* does or does not include, and why. A search to identify existing shift handover materials that stipulate regulations, standards or codes or practice produced only a relatively few resources, most of which offer only generic guidance materials. However, observation of search outcomes did identify that the concept of shift handover is experiencing increased regulatory attention across a number of industries. Specifically this attention is driven by the increasing acknowledgement of the importance of the role that the shift handover process plays in workplace health and safety.

Legislative Framework

Modern Occupational Health and Safety (OH&S) law is described as performance based, highlighting the achievement of safety outcomes rather than defining in great detail the way in which the outcome is to be achieved. Accordingly while not specifically named the general function of a shift handover can be inferred from relevant sections set out in Australian OH&S legislation, examples of which are provided in the following table:

ACT & JURISDICTION	SECTION	DETAIL
WORKPLACE HEALTH AND SAFETY ACT (2011) National Uniform Legislation	**Part 2:** Health and safety duties **Division 2:** Primary duty of care **Section 19:** Primary duty of care	(3) Without limiting subsections (1) and (2), a person conducting a businesses or undertaking must ensure, so far as reasonably practical: (c) the provision and maintenance of safe systems of work; and (f) the provision of any information, training, instruction or supervision that is necessary to protect all persons from risks to their health and safety arising from work carried out as part of the business or undertaking
	Part 2: Health and safety duties **Division 4:** Duties of officers, workers and other persons **Section 28:** Duties of workers	The Act also specifies that in determining whether a worker failed to take reasonable care, 'regard must be had to what the employee knew about the relevant circumstances'.
	Part 5: Consultation, representation and participation **Division 1:** Consultation, cooperation and coordination between duty holders **Section 46:** Duty to consult with other duty holders	Even more specifically the Act stipulates that if more than one person has a duty in relation to the same matter, each person with the duty, must so far as is reasonably practical, consult cooperate and coordinate activities with all other persons who have a duty in relation to the same matter.
MINES SAFETY & INSPECTION ACT (1995) Western Australia	**Part 2:** General duties relating to occupational safety and health **Division 2:** General duties **Section 9:** Employers, duties of	An employer must, so far as is practicable, provide and maintain at a mine a working environment in which that employer's employees are not exposed to hazards and, in particular, but without limiting the generality of that general obligation, an employer must: (a) provide and maintain workplaces, plant, and systems of work of a kind that, so far as is practicable, the employer's employees are not exposed to hazards; and (b) provide such information, instructions and training to and supervision of employees as is necessary to enable them to perform their work in such a manner that they are not exposed to hazards;
COAL MINING SAFETY AND HEALTH ACT (1999) Queensland	**Part 3:** Safety and health obligations **Division 3:** Obligations of holders, coal mine operators, site senior executives and others **Section 42:** Obligations of site senior executive for coal mine	A site senior executive for a coal mine has the following obligations in relation to the safety and health of persons who may be affected by coal mining operations (f) to provide for (v) appropriate inspection of each workplace at the mine including, where necessary, pre-shift inspections.
MINING AND QUARRYING SAFETY AND HEALTH ACT (1999) Queensland	**Part 3:** Safety and health obligations **Division 3:** Obligations of holders, operators, site senior executives and others **Section 39:** Obligations of site senior executive for mine	*"as above"*

Table 1: Relevant Australian safety legislation pertinent to shift handover.

In support of the various Acts, workplace health and safety regulations were also reviewed for prescribed procedural, other mandated approaches, ways duties imposed by the Act could be performed, or for any specific mention of shift handover. As with the various Acts the majority of shift handover references were located in mining specific regulations, which aligns with the prevalence of shift work in the mining industry as previously discussed from the ABS (2009). Table 2 outlines the relevant regulations referencing or relevant to shift handover, below.

REGULATION & JURISDICTION	SECTION	DETAIL
WORK HEALTH AND SAFETY REGULATION 2011 Queensland	**Part 3.2:** General workplace management **Division 1:** Information, training and instruction **Section 39:** Provision of information, training and instruction	(1) This section applies for section 19 of the Act to a person conducting a business or undertaking. (2) The person must ensure that information, training and instruction provided to a worker is suitable and adequate having regard to: (a) the nature of the work carried out by the worker; and (b) the nature of the risks associated with the work at the time the information, training or instruction is provided; and (c) the control measures implemented. (3) The person must ensure, so far as is reasonably practicable, that the information, training and instruction provided under this section is provided in a way that is readily understandable by any person to whom it is provided.
OCCUPATIONAL HEALTH AND SAFETY REGULATIONS (2007) Victoria	**Part 5.3:** Mines **Division 2:** Safety duties of mine operators **5.3.19:** Communication in respect of shift change-over	The operator of a mine must ensure that there is a system by which: (a) the supervisor of each outgoing shift provides a written report to the supervisor of the incoming shift, in relation to the state of the mine workings and plant and any other matters that relate to health or safety; and (b) the supervisor of the incoming shift communicates the content of the report provided under paragraph (a) to the employees on the incoming shift.
MINE HEALTH AND SAFETY REGULATION (2007) New South Wales	**Part 3:** Duties of operators relating to health, safety and welfare at mines **Division 1:** Mine safety management plan **Clause 14:** Additional contents of mine safety management plan	For the purposes of section 30 (3) (d) of the Act, the mine safety management plan for a mine must include the following: (f) the arrangements for communication at the mine, including (but not limited to): (i) the exchange of information between shifts regarding hazards that may affect the health and safety of persons at the mine
MINES SAFETY AND INSPECTION REGULATIONS (1995) Western Australia	**Part 10:** Specific requirements for underground mines **Division 2:** General **Section 10.30:** Shift communications	The manager of an underground mine must ensure that if any hazard to any employee in a workplace in the mine has not been remedied or removed before the end of a shift: (a) a record is made in writing, and signed, by the supervisor of the shift for the workplace concerned setting out: (i) the nature of the hazard and its location; and (ii) the state of corrective measures taken to remedy the hazard; (b) the record is read and countersigned by the supervisor of the next shift (the new shift) for the workplace concerned before any employee does any work in the new shift in the workplace; and (c) before any employee does any work in the new shift in the workplace, the supervisor for that shift has advised the employee of: (i) the nature of the hazard and its location; (ii) the state of corrective measures taken to remedy the hazard; and (iii) the work and precautions required to be taken to remove or remedy the situation.

Table 2: Australian safety regulations referencing shift handover.

Codes of Practice and Industry Standards

There were no identified codes of practice that directly related to shift handover. The vast majority of standards and codes of practice in this arena were focused on shift work and the management of the risk factors associated with extended working hours and fatigue. However, none of these codes and/or standards devoted to the health effects and management of shift work, mentioned the role or provided guidance around the impact of shift handover on health and safety. Several examples of these broader shift work materials are listed below:

- Australian Medical Association (2006) - National Code of Practice: Hours of Work, Shiftwork and Rostering for Hospital Doctors
- WorkSafe, Department of Commerce, Western Australia (2006) - Code of practice: Working hours
- Safe Work, Department of the Premier and Cabinet, South Australia (2010) - Code of practice: Working hours
- Mines Occupational Safety and Health Advisory Board, Department of Industry and Resources, Western Australia (2000) - Guideline for Fatigue Management for the Western Australian Mining Industry
- Royal Australasian College of Surgeons (2007) - Standards for Safe Working Hours and Conditions for Fellows, Surgical Trainees and International Medical Graduates

Leading from these there were two codes of practice, listed in table 3, which linked to or reflected upon the shift handover process. However, in both these cases the codes referred to processes that augment shift handover (i.e. logs and training) rather than directly providing guidance on the inclusions required for an effective shift handover. The third guideline reviewed in table 3 is the UK safety and environmental standards for fuel storage sites, which provides the most detailed account of the recommended suggestions for shift handover inclusion identified. The majority of regulatory and guidance materials reviewed that referred to shift handover highlighted the importance of its function but rarely detailed the elements which should be present for effective communication, i.e. analysis of information needs, face to face, two way communication, and written and verbal communication (Lardner, 1996).

PUBLISHER	TITLE	REFERENCE
SAFE WORK AUSTRALIA	The Mine Record – draft Code of Practice (2011)	A mine record provides essential information on incidents that may impact upon the safety of workers. The contents of the mine record must include: • written records from the supervisor of each outgoing shift to the supervisor of the incoming shift to include in the state of the mine workings as at the end of the outgoing shift • all records or reports about safety incidents and any high potential incidents, and • all notices, reports, findings and recommendations which arise through monitoring and enforcement action by the Regulator under the WHS Act and Regulations as well as any notices issued under Part 5 (consultation, representation and participation), Division 7 (provisional improvement notices) of the WHS Act.
AUSTRALIAN SAFETY AND COMPENSATION COUNCIL	National Code of Practice for Induction for Construction Work (2007)	Task-specific induction is required to provide information and instruction to anyone undertaking a particular construction activity to involve the risk factors and control measures relating to that task.
BUNCEFIELD STANDARDS TASK GROUP	Safety and environmental standards for fuel storage sites (2007)	Operators should set and implement a standard for effective and safe communication of issues relevant to fuel transfer and storage at shift and crew change handover.
		The handover procedure should carefully specify what key information needs to be communicated at shift and crew change, at key positions in the organisation. The requirements may well be different for different positions, but should consider issues such as: • product movements, both ongoing and planned; • control systems bypassed; • equipment not working or out of commission; • maintenance and permits; • isolations in force; • trips defeated; • critical or high-priority alarms activated and actions taken; • health, safety or environment incidents or events; • modifications; and • personnel on site; • use suitable aids, such as logs, computer displays etc. to provide a structured handover of key information, while aiming to cut out unnecessary information; • capture key information that needs to be carried forward across successive shifts (e.g. equipment out of service); • allow sufficient time for handover, including preparation time; • ensure that key information is transmitted both verbally and in writing; • encourage face-to-face, and two-way communication, with the recipient asking for confirmation, repetition, clarification etc. as appropriate; and • specify ways to develop the communication skills of employees.
		The handover procedure should take account of situations that are known to be especially liable to problems, including: • during maintenance, if the work continues over a shift change; • during deviations from normal working; • following a lengthy absence from work (either as a result of a regular long shift break or individual absence); and • handovers between experienced and inexperienced staff.
		Techniques that have been reported from the industry, and that companies may wish to consider in development of their procedure, include: • use of electronic logs, with password systems for acceptance; • systems to project electronic logs onto a screen (for team briefing); • use of team briefings, e.g. with staggered shift changes between supervisors and operators; • use of pre-printed paper logs in a structured format; and • use of white boards for recording systems that may be out of service for several shifts.
		Companies must have the facilities and management arrangements necessary to ensure that the standard set are indeed complied with. These include: • arrangements to minimise distractions during handover; • instruction and training of employees in handover procedures; and • supervision, audit and review to ensure that the procedure is complied with and the necessary information is communicated and understood.

Table 3: Codes of practice and standards for shift handover.

In addition to these codes of practice and standards, international guidelines and codes of practice around permit to work procedures reinforce the general flavour guidance materials available on shift handover. Using a specific application of information to be exchanged, permit to work guidelines (outlined in table 4) have a greater opportunity for specificity of the shift handover process for the continuation of permits.

PUBLISHER	TITLE	REFERENCE
INTERNATIONAL ASSOCIATION OF OIL & GAS PRODUCERS	Guidelines on permit to work (P.T.W.) systems (2001) Report No. 6.29/189	• Installation owners should take into account, when developing P.T.W. systems, the importance of planning the shift change such that there is sufficient overlap to allow proper review and discussion of the status of all permits to work. • Written means of communicating information can be by: • Permit Log Book • Permit File • Display Boards • Computer Screen/Print Out or a combination of any of the above. • Whichever arrangements are adopted, the shift handover arrangement should be monitored regularly to ensure its continued effectiveness.
ABU DHABI EMIRATE ENVIRONMENT, HEALTH AND SAFETY MANAGEMENT SYSTEM	Code of Practice 21.0 Permit to Work (2012)	**3.3 When is a permit to work required?** PTW Systems are normally considered most appropriate: (v) where there is a transfer of work or groups from one group to another.
		3.10 Communication A formal handover process shall be implemented to ensure (i) effective communication of all relevant work details and control measures between off-going and on-coming shifts; and (ii) handover of Permit Authority, Permit Holder and Work Party responsibilities.
		3.13 Management of Change If work covered by a PTW proceeds from one shift to the next, the PTW shall be re-validated with the new (on-coming shift) AP (permit issuer) confirming that it is safe to recommence work.
UK HEALTH AND SAFETY EXECUTIVE	Guidance on Permit To Work Systems (2005)	If work is carried over to another shift, e.g. the job takes longer than expected, then a shift handover procedure should be in place. This handover procedure should ensure that the incoming shift is aware of any outstanding permit-controlled jobs, the status of those jobs, and the status of the plant. Work-in-progress should be left in a condition that can be reliably communicated to, and understood by, the oncoming shift. A permit log, permit file or display boards are ways of recording ongoing permits. It is essential that there is good communication between incoming and outgoing issuing and performing authorities and it is recommended that the incoming issuing authority signs to allow the continuation of a permit.

Table 4: Codes of practice and guidelines for the handover of permits to work.

However, the existence of formal communication systems for permits to work does not outline greater detail for the inclusions of an effective shift handover process. Similarly table 5, which outlines some examples of the more general guidance materials on the shift handover process also generally reinforce this observation.

PUBLISHER	TITLE	REFERENCE
NORTHERN TERRITORY WORKSAFE (2003)	Safety Management - A Guide **Regulation 44:** Consultation	These are a very important form of consultation where changes of shift are involved. Safety issues should be included as a routine item for the brief handover meetings between staff starting and finishing shifts.
ACTU OHS UNIT (2000)	Health and Safety Guidelines for Shift Work and Extended Working Hours **D No. 66/2000**	Appropriate mechanisms should be in place to enable efficient and safe hand-over between shifts and to ensure that new shifts are adequately informed about all issues that have arisen in the workplace.
UK HEALTH AND SAFETY EXECUTIVE (2006)	**HSG256 -** Managing Shiftwork Guideline **Table 3:** Shift Pattern	Improve communication at shift handover to ensure that new shift teams are fully aware of issues that have arisen during the previous shift.
	HSG256 - Managing Shiftwork Guideline **Table 9:** Management Issues	Agree on, and make sure timing and procedures for transmitting information to the next shift team are clear, available to all staff and followed at all times. Avoid extending shifts by good planning of the handover, e.g. by building in a small overlap between start and finish times on consecutive shifts. Ideally, shift handovers should be conducted face-to-face and be two-way, with all participants taking responsibility for ensuring accurate communication, using both verbal and written means, be based on a pre-determined analysis of the information needs of incoming staff and be given as much time as necessary to ensure clear and accurate communication.
SYDNEY SOUTH WEST AREA HEALTH SERVICE, NSW HEALTH (2007) **CLINICAL HANDOVER GUIDELINE NO: SSW_GL2007_002**	Lists ten key principles with each principle having two to three specified actions or guidelines. **1.** Clinical handover is supported by appropriate policies, procedures and resources. **1.1** Each facility/ service has documented policy in place for clinical handover. **1.2** There are clear protocols outlining the minimum information requirements for effective nursing, medical & multidisciplinary handover for the following circumstances: • Shift to shift handover • After hours and weekend handover • Transfer of care from one team/clinician to another • Transfer of care from one facility to another **2.** Clinical leadership is a key component of clinical handover **2.1** The clinical handover processes are structured and are led/facilitated by the most senior member of the clinical team. **2.2** Clinical handover is an interactive process, which provides learning opportunities and guidance for junior staff. **2.3** Clinical handover is issue/problem focused to maximise the transfer of key information. **3.** Rostering of medical & nursing staff allows clinical handover to be time protected **3.1** Clinical handover occurs in work time and is monitored to ensure efficient use of allocated time. **3.2** Attendance at handover is mandatory, is monitored /recorded and reviewed. Reasons for non attendance are analysed and strategies to reduce non attendance rates are implemented. **4.** Multidisciplinary handover in specified areas is fundamental to continuity of care **4.1** Specialty units should have at least one multidisciplinary handover per day • ICU & HDU • Emergency **4.2** Night medical handover should involve the after hours nurse managers. **5.** Patient involvement in clinical handover, which is seen as the key to safer health care, is accommodated and promoted. **5.1** Options to increase patient involvement in clinical handover should be identified, piloted, & evaluated, e.g. use of patient notebooks. **5.2** Clinical handover occurs at the patient bedside when appropriate and patients are given the opportunity to validate information as necessary.

PUBLISHER	TITLE	REFERENCE
		6. Transfer of care poses significant patient safety risk and therefore requires both high quality verbal and written communication. **6.1** All patients are provided with information about their health care team (medical nursing & allied health) and provided with documented information when this team changes. **6.2** All patients are made aware of which RN is responsible for their nursing care on a shift-to-shift basis. **6.3** Transfer of care from one team to another is clearly documented within patient's medical records and signed and dated by the referring & receiving team. E.g. use of a stamp with predetermined fields including date, time, referring team, receiving team, date time and referring /receiving officer signature. **6.4** Receiving teams/staff are provided with a summary of care including a documented list of problems & issues and tasks outstanding at the time of transfer of care. **7.** Handover documentation is integral to safe transfer of information. **7.1** Documentation related to patient handover must be in a form which protects patient privacy and be retained and stored accordingly. **7.2** Use of electronic handover modalities be explored and piloted. **7.3** Handover documentation must enable correct identification of patients (use of bed numbers is discouraged). **8.** Clinical records are central to continuity of care. **8.1** Clinical Records should be utilised to facilitate continuity of care (medical handover) by providing a summary of care, including issues /problems and management plan for relieving staff. (Especially weekends and after hours). **9.** Evaluation of handover processes demonstrates the effectiveness of the processes in terms of patient safety and quality of care **9.1** Incidents related to clinical handover are monitored, reported in IIMS and trended to allow adjustments/improvements to the handover processes. **9.2** Audit process for clinical handover is developed and implemented. **10.** Educational strategies to improve clinical handover skills/competency are effective, & patient safety focussed. Clinical handovers are used as educational opportunities **10.1** Clinical handover requirements are included in all orientation programs and RMO/ Nursing information handbooks. **10.2** Education programs based on the guidelines for clinical handover are implemented and evaluated in terms of impact on patient safety. **10.3** Clinical handover is promoted as a learning environment.

Table 5: Examples of general guidance materials published on shift handover.

The key points from guidance materials on shift handover is that processes need to ensure that the right information is communicated to the right people at the right time and that information is communicated unambiguously and that the recipient properly understands it. Weaknesses in communication systems can cause a lack of co-ordination or understanding between different shifts. Across the guidance materials reviewed the detail as to how to best conduct shift handover has become more apparent in contemporary resources. Prior to four years ago a lot of guidelines and non mandatory standards were quite generic with detail and support from these resources increasing in recent years with efforts to attain greater levels of standardisation. The health care industry in Australia is one of the leading sectors in this regard.

Trends and Observations

Shift handover is a fundamental and dynamic process that has prominence in legal OH&S requirements, yet it is not widely documented as to its effective employment or application. As noted, it was often absent from much of the regulatory materials and standards reviewed, with the notable exception of the *"Safety and environmental standards for fuel storage sites"* (Buncefield Standards Task Group, 2007). International reports confirm that this lack of guidance material is translating to an absence of policy. Wallis (2010) reports that a progress report into patient safety in New Zealand Hospitals showed that handover practices and the information that was handed over ranged widely with no consistency of practice. Further, Alvarado et al. (2006) report that many Canadian hospitals also have no policy or standards for shift handover.

Most industry standards that did refer to shift handover often only did so to reinforce its importance rather than to provide practical advice on how to increase the value of its engagement. A consequence of this vagueness of scope, standards and regulations is that organisations seeking to improve shift handovers by standardising their procedures, confront uncertainty about the range of activities that should be subject to such efforts. Reinforcing this assertion and demonstrating its impact, the introduction of a mandatory shift handover approach that was to be standardised in the US caused wide spread uncertainty in 2006. The joint commission whose mission is to *"improve the safety and quality of care provided to the public through the provision of health care accreditation and related services that support performance improvement in health care organisations"* in the US by means of its accreditation standards, added to its National Patient Safety Goals Requirement. 2E: *"Implement a standardised approach to 'hand off' communications, including an opportunity to ask and respond to questions."* Further, the flow on effects from a standardised or consistent approach which is being more strongly pursued now than previously, is the detail that the associated research is identifying in the criteria for an effective shift handover process e.g. Clinical Handover Guideline No: SSW_GL2007_002, (Sydney South West Area Health Service, 2007). Likewise, the application of these standards through the ability to transfer them into various settings is also appearing in matrices that detail a variety of handover options for differing situations as listed in:

- *"Clinical Handover: critical communication"* Medical Journal of Australia Supplement (Australian Commission on Safety and Quality in Health Care, 2009a).
- The OSSIE Guide to Clinical Handover Improvement – for clinician leaders and managers (Australian Commission on Safety and Quality in Health Care, 2009b).
- Safe Handover: Safe Patients Guideline (Australian Medical Association, 2006).

Wallis (2010) states that continued national collaboration is needed in Australia to maintain the priority of standardising handovers of both nursing and medicine. However, the importance for research investigating how shift handovers are accomplished and how they could be improved is not isolated to the Australian healthcare sector. The shift handover process is a focus of the FAA and NASA research (Parke & Kanki, 2008). The U.S. Department of Energy (1998) has long been interested in shift turnovers and has issued shift turnover guidelines for nuclear facilities in an attempt to improve procedures. The United Kingdom Department of Health and Safety Executive (2000) has sponsored research on best shift turnover practices, as has the French National Research and Safety Institute.

LITERATURE REVIEW

As illustrated through the review of the legislative and guideline resources, the large body of relevant literature shows shift handover to be highly sensitive to variations in context. Further, shift handover is an activity that is essential for multiple important functions that range far beyond safety, and is subject to difficult tensions that are driving efforts to standardise approach within highly differentiated settings. In addition, there is little empirical evidence regarding the magnitude of the impact of handover on safety and service quality, making the potential gains and complications from standardisation uncertain.

Accidents have commonly been related to shift handover and errors have also been reported to occur disproportionately after shift handover in dynamic industries. Lardner (1996) cited several international studies supporting this finding across a range of industries such as oil and gas, healthcare, manufacturing and industrial settings such as sawmills (Cloutier & LaFlamme, 1994; Cullen, 1993; Werner, 1979). Similar reports have appeared in analyses of offshore rig accidents (Dobson, 1999), and in expensive *"stuck pipe"* errors for the oil industry (Bradley, 1991). Higher error rates also occur in U.S. and Canadian air traffic control in the period after position relief briefings (Stager & Hameluck, 1988). In one U.S. study, it was found that a quarter of all operational errors occurred in the first 15 minutes after position relief briefings in air route traffic control centres and terminal radar control facilities (Della Rocco, Cruz, & Clemens, 1999). Likewise in the healthcare

industry case record reviews suggest that between 15 and 28% of malpractice claims and adverse events are due to deficiencies in handover (Symons et al., 2012).

Collectively, incidents and research suggests that there is a need for a more efficient way to guarantee that the next shift gets the information needed for shared situational awareness. The most common causes of incidents related to shift handover include poorly conducted shift handovers (e.g. lack of complete and accurate reporting, reliance on operator memory, time pressures, ineffective two way communications) and poor records and structure (e.g., lack of structure, no clear indication about what to log and how to structure entries) (Thompson & Plocher, 2011). Research suggests that the critical role of communication and its effectiveness along with better structure and organisation are the keys to more comprehensive and effective shift handovers and records. Considering these general findings relating to areas of common deficiency in shift handover, we will consider the practice in terms of both its content (i.e. what is included in shift handovers) and its process (i.e. how it is conducted).

SHIFT HANDOVER CONTENT

Since the exchange of information is a core function of shift handover, the selection of appropriate content is central to its success. In reviewing the literature key indications were sought to identify what information to include during shift handover, the role that information artefacts play, and how language can further complicate the communication of handover content.

Handover Inclusions

From our definition of shift handover, the decisive intrinsic feature that distinguishes handover from other communication about the worksite is the transfer of responsibility or control. It is this that establishes one of the central purposes governing handover content: to convey concisely what the newly responsible party may need to know in the ensuing course of the shift. Communication problems at the shift handover lead to loss of information, misalignment of knowledge or misunderstandings about the job at hand. Research suggests that key information needs to be communicated at shift change (Australian Commission on Safety and Quality in Health Care, 2012; Bhabra, Mackeith, Monteiro, & Pothier, 2007; Buncefield Standards Task Group, 2007; Currie, 2002; Judice, 2009; Klee, Latta, Davis-Kirsch, & Pecchia, 2012; Lardner, 1996; Mikkelsen, Ringstad, & Steineke, 2004; NT WorkSafe, 2003; Parke & Mishkin, 2005; Porteous, Stewart-Wynne, Connolly, & Crommelin, 2009; Sydney South West Area Health Service, 2007; UK Health and Safety Executive, 2005) though these requirements may well be different for different positions and industries, but should consider issues such as:

- product and plant movements, both ongoing and planned;
- control systems bypassed;
- equipment not working or out of commission;
- maintenance and permits;
- isolations in force;
- trips defeated;
- critical or high-priority alarms activated and actions taken;
- health, safety or environment incidents or events;
- modifications;
- the work schedule and work undertaken;
- recent audit or inspection reports;
- personnel and or subcontractors on site; and
- unusual occurrences conveyed as problems, hypotheses, and intent, rather than simply listing what occurred.

To consider the breadth of shift handover across industries it seems very unlikely that there is a single best list of required handover information content. While measures of handover content seem rather straightforward and usually involve key information to be transmitted, the agreement as to which items should be included in such a list is frequently debated, and existing shift handover protocols vary considerably in this respect (Bhabra et al., 2007; Chuang & Lee, 2009; Cohen & Hilligoss, 2010; Odell, 1996). However, handover of a small number of highly relevant items may be more effective than the handover of a larger number of less relevant items. The importance of inclusion in shift handover content goes beyond the handover itself as it also provides insights into the best ways that handover education, tools and practice could be restructured to facilitate more effective, efficient shift transitions.

However, in line with the conceptualisation of handovers as episodes of information transfer, the evaluation of handover quality has mostly concentrated on the completeness and accuracy of information and related errors (Cullen, 1993; Lardner, 1999). These studies frequently found verbal handover to be incomplete when compared with the information available in logs or records (Bhabra et al., 2007) or when compared with a pre-defined handover protocol (Dayton & Henriksen, 2007).

Handover Artefacts

A lack of documented structure in shift handovers increases the likelihood that critical information will be missed and misunderstandings will occur. Approximately 80% of industrial operations lack a structured approach to shift handovers (Thompson & Plocher, 2011). Further, engaging in verbal handover only, compared to verbal handover with some documentation, relies heavily on memory skills and has been classed as a high risk strategy (Bhabra et al., 2007). The performance of doctors on

simulated handover cycles showed that only 33% of information was retained after the first handover cycle and only 2.5% of information after five handover cycles (Pothier, Monteiro, Mooktiar, & Shaw, 2005) using pre-prepared data sheets resulted in the full retention of data. Review of the designs of the artefacts, documents, information systems and other such tools used during shift handover indicates that these assist by automating the process as much as possible and provide numerous functions and procedures that ensure handovers are as comprehensive and consistent as possible. Also, artefacts make information more visible and this means that there are more stakeholders with an interest in maximising the quality of shift handovers and who are more likely to intervene where these requirements are not achieved.

Typically, shift handover artefacts which include items that provide structure and standardisation such as forms or checklists (Ahmed, Mehmood, Rehman, Ilyas, & Khan, 2012; Porteous et al., 2009) serve as memory aids. Records of activity such as logs or run sheets (e.g. Klee et al., 2012; Parkes, 2012) provide expert input through relevant standards procedures or guidance materials (e.g. Australian Commission on Safety and Quality in Health Care, 2012; The Keil Centre, 2006) and even capture some details from the handover for subsequent use and learning (Thompson & Plocher, 2011; Yurkovich & Smyer, 1998). Key criteria for the increased utility of these artefacts for use in shift handover are:

- *Facilitate recording of information:* Whatever method of capturing operational information is used, it will be, to some degree, an imposition on the scribe and hence the more efficient the design of the proposed approach (written, electronic or otherwise) the lower the impost. Likewise if the scribe is guided through the recording process in a structured way, ensuring all essential information is captured, the greater the quality of the information captured.
- *Provide a structured recording environment:* It is essential that any approach provides the flexibility to capture all the varied operational activities required in records across the operation. At the same time, it is important to impose a level of structure on the record to encourage consistency of input.
- *Allow for easy sharing of information:* The approach should allow records to be easily shared across multiple sites throughout the operation. This is to ensure that important information is highly visible to the appropriate people and/or issues are effectively escalated.
- *Allow quick searching and reporting of records:* The approach should allow easy access to records, whether it is the current shift reviewing the previous shift records, engineers carrying out analysis of historic records or management reporting across multiple records. Providing a structured template allows reports to be very easily compiled. This helps turn the records from an operational register to be filed away into a live repository of valuable information. The logs become valuable assets of the business.

Approaches to handover records and artefacts general take the form of paper based books or computerised databases for log or plod records, forms and checklists, and more recently technology enabled agenda supported by visual aids. These approaches in their advances are increasingly seeking to engineer out the human factor aspects (discussed in the process section) of shift handover. However, history is littered with examples where technology based products have failed to achieve their potential because they were not used as intended. In developing modernised systems and information technology engineered solutions, it is essential that these improve the shift handover process. Therefore, as a minimum shift handover artefacts should allow:

- a simple method for recording information;
- structure in recording and conveying information;
- information to be highly visible so that people know what is happening;
- reporting of valuable information to not only indicate what has happened, but explain why;
- compliance with legislative requirements;
- record keeping to evidence occurrence, attendance and agreed outcomes; and
- analysis of historical information.

Language used in Handover

Attention to the language and terminologies used at shift handover and the development of practices to measure and ensure comprehension have also received research attention (Friesen, White, & Byers, 2008; Lardner, 1999; McMullan, 2007; Odell, 1996). Language problems have been found to contribute to problems during shift handovers in several ways. As a function of a second language different dialect, explanations, accents, terms, and nuances may be misunderstood or misinterpreted by the shift worker receiving the handover. Similarly, unfamiliar jargon, abbreviations and acronyms that are unique to certain settings, professions and experiences may be confusing to a worker coming from a different background, working in a different setting or conducting a specialised task. Finally, ambiguity also increases the risk for confusion and is common through the use of subjective terms, norms and cultural references and misalignment in experience of workers and familiarity with the site.

One suggested remedy for these language issues is to ensure comprehension of recipients, through the use of linguistic checks such as having the recipient repeat back their understanding of the information being conveyed (The Keil Centre, 2006). These strategies and greater exploration of communication processes are discussed in the following section.

SHIFT HANDOVER PROCESS

Symons et al. (2012) noted that information transfer alone does not capture all aspects of a shift handover's quality. Particularly given that *"exchange"* is a defining characteristic of shift handover, beyond what is being exchanged, the methods employed in enacting the exchange are fundamental to its success. Further to this point, research into shift handovers of nurses in European countries highlighted that the percentage of dissatisfaction with shift handovers, which ranged from 22% in England to 61% in France, was primarily due to *"too many disturbances"*, followed by *"lack of time"* (Meissner et al., 2007). Accordingly, a key for participant engagement in shift handover and ultimately the effectiveness of its outcome is dependent upon the process.

The most important person in any handover is the person finishing their shift. The quality of the information they provide and their communication skills will have the greatest influence on how well informed the person starting their shift is. However, at the end of a shift even the most conscientious person will be interested in getting home. Also, some may have the attitude that any problems they leave are going to be dealt with by someone else (i.e. the incoming shift). It is true that the person starting their shift can influence the quality of the handover they receive. Asking questions and being interested will tend to improve the quality of the handover. However, they are not in a particularly powerful position because they do not know what questions to ask, especially if key data has not been logged. The process of shift handover and its associated research findings are presented in following sections.

Handover Guidance and Support

It is important that individuals are aware of what is expected of them and the support afforded to them through the handover process. The literature suggests that the emphasis and support of the organisation play a considerable role in the effectiveness and perceived importance of the shift handover process. Key roles and responsibilities need to be explicit, as they assist in defining a structured and consistent approach and avoiding confusion of individuals for their involvement and expectations during the process of handover (McFetridge, Gillespie, Goode, & Melby, 2007). Further the physical environment can affect the handover conversation negatively when it distracts with background noises and interruptions or hinders confidentiality (Hunns, 1986; McMullan, 2007). Research has identified several key processes for improving shift handover that are symptomatic of organisational support and include:

- clearly assigned handover roles and responsibilities
- provide time to prepare for shift handovers
- foster a safe learning environment/culture for the handover to take place within such that participants:
  - are willing to say if they do not understand what they have been told
  - are willing to challenge what they have been told
  - are able to predict what someone else needs to know
  - demonstrate that they are interested in what they are being told;
  - make time for and prioritise the handover process
- providing a defined space free from interruptions and distractions
- defined handover policies, procedures, guidelines and standards (defining performance and informing training and development of existing staff)

Handover Capability and Training

Technological advancements, construction materials, differing design approaches, the social, economic, geographic and regulatory environment, and the complexity of construction contracts are all remarkably dynamic. Construction and the people working in the industry need to engage in continuous learning in order to adapt to these unrelenting changes. Some of this learning has been via explicit training, but a much larger part has occurred through accumulating the lessons embedded in day to day experience. Since shift handovers are one of the more frequent and consequential moments of considering construction progress, they are the inherent locus of a large share of this vital learning.

However training in conducting shift handover was not explicit in construction focused literature. Health care was the only field in which research mentioned training in conducting shift handover. Even then Yurkovich and Smyer (1998) highlight the limited emphasis on education and training on handover for medical and nursing students. Their paper describes a learning project and its use of reflection and analysis of audiotape records during the psychiatric rotation and how this prepared the students to engage in professional nursing practice and behaviour (Yurkovich & Smyer, 1998). Likewise, the US Federal Aviation Administration (FAA) is now requiring that position briefings be audio recorded in all air traffic control facilities so that handover techniques can be studied and improved (Parke & Kanki, 2008).

Nestel, Kneebone, and Barnet (2005) report on a training program on handover presentation skills developed using adult learning theory to train specialists to conduct the handover process. Arora, Johnson, Meltzer, & Humphrey (2008) also describe a case study that demonstrates capability development using a conceptual framework. The paper defines two aspects of a competency based approach to improve handover: communication (transfer of information) and professionalism (transfer of responsibility). The paper then presents some strategies to ensure development of these competencies including the development of dedicated educational

materials and a *"train the trainer"* dissemination method. However no papers reported evaluation of their training interventions against outcomes measures related to safety or handover performance.

It is generally acknowledged that training in communication skills and the development of junior members to conduct handover is beneficial (Australian Commission on Safety and Quality in Health Care, 2009b). However it should be highlighted that training courses are not the only means of developing handover and communication skills. Other techniques include on the job rehearsal accompanied by coaching with experienced staff and computer or video based training. Education and training of those facilitating is critical to improving handover and more research is required into the utility and validity of different methods to ensure the development of best practice in approaches used.

Handover Communication

People tend to underestimate how complex the communication process is and consequently overestimate their ability to communicate effectively. The reality is that error is a natural and inevitable aspect of communication because language is inherently imprecise and ambiguous. A successful communication is one where a person receiving a message achieves exactly the same understanding of that message as the person transmitting it intended. However, the following factors, as listed by Lardner (1999) can interfere with this process:

1. It is not possible to transfer meanings from one person to another directly. Rather, the receiver creates meaning in his or her mind;
2. Anything is a potential message, whether it is intended or not;
3. The message received is the only one that counts;
4. Taking the above together, unintentional meaning is likely and potential miscommunication is the norm.

Experimental evidence gained from studies of social interaction in small groups has also highlighted the essential contribution of feedback to ensuring accurate communication (Lardner, 1999). 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 cognitive theory of reliable communication (Hunns, 1986). Accordingly, communication channels should encourage staff to raise potential concerns as a standard course throughout the handover process.

Taken collectively, a study by Parke, Patankar, & Kanki (2003) applies these principles in an experimental design to investigate the alternatives communication processes for shift handover. Their findings suggest that the order of effectiveness for the following approaches from least effective (i.e. static handover) to most effective (i.e. dynamic face to face):

1. Static handover – written logs or diary passed on without explanation
2. Shift supervisor to shift supervisor – the supervisor on the outgoing shift briefs the supervisor on the incoming shift to pass the information on to his or her personnel. This approach creates a bottleneck where the recipient of the information could at best expect to receive it second hand. Filtering will occur from outgoing crew to supervisor, supervisor to supervisor and supervisor to incoming crew.
3. Outgoing shift supervisor to Incoming shift - the supervisor on the outgoing shift briefs the incoming shift as part of their pre-start.
4. Static face to face – all members of the outgoing shift brief their counterpart on the incoming shift. A role to role handover comprising a one to one information download and question and answer. This approach does not allow for interaction of activities or systemic risk unforeseen within a single role.
5. Dynamic face to face – all members of the outgoing shift collectively handover to all members of the incoming shift as lead by the outgoing supervisor. Further supporting this approach a more recent study by Symons et al (2012) has found that improved teamwork might be expected to reduce adverse events following team handover, as opposed to one to one.

Communication requires effort by both parties to avoid miscommunication. Although not infallible, face to face communication is generally the most reliable, not necessarily because it is a better way of transferring understanding, but because it allows immediate discussion (Lardner, 1999). In contrast, written communication is generally less reliable because of this lack of immediate feedback. However face to face handovers improve exponentially when combined with written support as used in many high risk domains such as nuclear power, air traffic control, off shore oil, and mission control for both shuttle and the space station. In aviation maintenance, face to face handover briefings between outgoing and incoming technicians, with written support, have been shown to reduce errors compared to having just verbal communication (Parke et al., 2003). Improved communication not only improves accuracy and reliability of the information exchanged but when combined with leadership increases engagement of staff, especially those who have only a peripheral role in a shift handover (Symons et al., 2012).

Teamwork During Handover

Shift work can be regarded as a teamwork system that relies on cooperation across different shifts requiring building and updating a shared knowledge base and coordinating work activities (Le Bris et al., 2012). Improvements in cooperation and team coordination benefit planning of future work, prioritisation and allocation of tasks. Enhanced monitoring or situational awareness may allow handover participants to be aware of staff who have not understood or neglected aspects of the handover (Symons et al., 2012). Despite this research evidence and the importance of key team behaviours such as communication, leadership and development of shared mental models to handover, the use of teamwork skills in the assessment and training of handover is rare. This is a relatively new area of research. Symons et al., (2012) found that teamwork skills did not correlate with the completeness of information transfer and without a suitable method of assessing teamwork in handover it is not possible to identify the effects of any intervention to improve handover quality.

Review and Auditing of Shift Handovers

In reviewing handover process measures these are often grouped into environmental (e.g. interruptions, noise level and workload) and in behavioural aspects (e.g. shared planning, shared decision making, critical review of existing documentation, verbal report and acknowledgement of information received) (Manser & Foster, 2011). Research in this area that goes beyond the information transmission aspect for the review of shift handover effectiveness is only in its infancy. For example, Apker, Mallak, & Gibson (2007) provide a detailed account of the communication activities performed during handover. However, it is still an open question how the various process measures translate into safe outcomes.

Outcome measures for handover usually include satisfaction with the handover and should also assess the safety relevant consequences on subsequent worksites. Only then will we begin to assess handover safety as well. So far, many studies investigated the satisfaction of health care providers with the current practice of handovers in a specific clinical setting (e.g. paramedics to resuscitation room). In this type of study, the perspectives of transferring as well as receiving clinicians are considered. In a study of handover assessments in three different clinical settings (paramedic to emergency room, anaesthetist to recovery room and recover room nurse to ward nurse), Manser, Foster, & Gisin (2010) found that although information transfer was the key characteristic, overall handover quality was predicted by three factors: information transfer, shared understanding and working atmosphere.

In understanding the complex dynamics of effective patient handover, it is essential not to consider the different quality aspects in isolation but to investigate their interrelations as well. So far, few studies have tried to link handover content or process characteristics with outcome measures. Only two studies were found that experimentally manipulated a handover characteristic and assessed the effect in terms of handover outcomes (Bhabra et al., 2007; Dowding, 2001). In the study by Bhabra et al., (2007) participants were given handover information and then simply had to wait until they handed the patient information over to another participant. That is, no work was carried out (i.e. the context of clinical work was missing). A similar problem is present in the study by Dowding (2001) in which participants had to write down a plan after receiving a shift handover, and this plan was then judged against an expert solution. Again, no actual work was carried out. Thus, before we can actually answer the question *"What constitutes a handover that contributes to the quality and safety of patient care?"* there is a need for randomised controlled trials to establish a causal link between certain handover characteristics and their effects.

Following from this there are very few auditing tools or auditing guides for shift handover. Given the complexity from a lack of research into the contribution of handover process to safety outcomes, and the variability of handover content which is context dependent, any related auditing tools would need to be strongly grounded in their beliefs. The only guide reviewed for the auditing of shift handover was published by the Keil Centre (2006), and while it is very generic (to accommodate reasons stated above) it is presented in addendum 1 of the shift handover appendices of this report.

Organisational Learning

Organisational learning that occurs via shift handovers can take a number of forms (Yurkovich & Smyer, 1998). Because it has been uncommon for researchers studying handovers to inquire about these issues, this commentary about organisational learning is less often supported by citations from the existing literature. Exchanges during handovers can spread, reinforce, or undermine informal norms, changing the way the group perceives its duties and obligations and impact upon the site base safety culture. For example, Lally (1999) says *"During shift handovers observed, junior nurses learnt 'the way things are done around here'. The shaping and guiding of nurses which takes place at the report not only socialises nurses into the ward culture, but by enhancing a shared value system, also increases the cohesiveness of the group."* Although the role of handover in reinforcing norms is particularly well documented in the nursing report literature (e.g. Holland, 1993; Miller, 1998).

SUMMARY AND CHALLENGES

The role of shift handover is integral to the safe functioning of a worksite through a transition of personnel. However, given the specific risk profiles of different work sites, variable construction methodologies and workplace hazards, prescribing the content for shift handover is problematic and inclusion always challenging, and while

the literature suggests some shift handover process inclusions have proven value, there is little empirical evidence as to the linkage of these to safe outcomes. Adding to these complexities there is compelling evidence from accident analyses that miscommunication of maintenance issues over a shift change can have serious safety implications (Lardner, 1996). Incoming personnel may take actions without a full understanding of current status. Also, handovers following a lengthy absence, or between experienced and inexperienced staff, require extra effort to bridge their gap in understanding (Parkes, 2012). Further to this collection of high risk or potentially problematic handover situations are the added demands on shift supervisors who are required to be present for shift handover at both ends of an operating shift.

In this context of shift handover research regulatory bodies are also seeking greater standardisation of handover processes in the healthcare industry. Hence, efforts to standardise handover, while simultaneously pairing experienced and less experienced staff for learning, acknowledge the conflicting role demands being placed on the function and execution of shift handovers. Likewise, there is a recognition that the handover process would be similar throughout an organisation, but practically the handover process would differ from one setting or function to another.

It is not surprising that the most recent research in this area is focusing on the role of teamwork and relational communication competencies that support effective exchange of information and productive working relationships (Carroll et al., 2012).

However, it is apparent that with appropriate work practices, the risk of shift handover errors can be reduced (Parke & Kanki, 2008). In summary, the review of handover research indicates that leading practice is defined by:

- the level of priority shift handover communication is afforded on a worksite;
- the existence of standard shift handover operating protocols, policies or procedures and their integration within the safety system;
- the allocation of time to prepare shift handover materials prior to the end of the shift;
- the inclusion of a minimum standardised structure and suggestive content on shift handover forms;
- the allocation of appropriate space to conduct the shift handover that minimises distractions and interruptions;
- a shift handover environment that encourages challenging of assumptions and seeks assurance of understanding;
- shift handovers conducted face to face, crew to crew;
- two way shift handovers, with both participants taking joint responsibility for ensuring accurate communication and understanding;
- shift handovers that use a range of verbal and written/recorded means of communication;
- shift handovers that use supports and artefacts (logs, plods, databases or IT solutions) designed on the basis of the incoming shift's information needs and that are structured and easy to use;
- shift handovers are afforded the time necessary to ensure accurate communication;
- the recognition of longer or more detailed handovers when staff have returned following a lengthy absence from work; during plant maintenance; during deviations from normal working/duties; and when handovers take place between experienced and inexperienced staff. As these high risk scenarios for shift handover are consistent with those situations and processes that consistently emerge as contributing factors in incident investigations.
- inclusion of communication skills in selection criteria for shift workers;
- investment in the development of the communication and presentation skills of key handover staff to improve confidence and effectiveness in delivering shift handover;
- existence of checklists for the review and rating of face to face handovers ;
- involvement of employees in the examination and improvement of the practices;
- existence of change management processes to update systems in light of information from incidents and accidents due to shift handover problems and bringing this to the attention of employees;
- maintenance and analysis of shift handover records for learning opportunities;
- audit of shift handover records for both content and process.

INDUSTRY CONSULTATION

Key findings from the review of shift handover systems provided by a range of organisations across a variety of heavy industries (e.g. mining, engineering, construction etc.) consistently included:

- consideration or reference to legal OH&S requirements or obligations in handover procedures;
- an outline of the key purpose for conducting a shift handover;
- identification of key personnel and responsibilities in conducting a shift handover;
- explanation of the handover procedure and record keeping protocols;

- a generic record keeping/pre-planning form that provided structure but mainly free form fields in which to record what was to be, or what was actually discussed. Most commonly these forms included topics/headings such as:
  - personnel in attendance
  - tasks and progress (forecast and actual)
  - hazard near miss observations reported and resolved/unresolved
  - safety issues resolved/unresolved
  - equipment issues resolved/unresolved
  - Safe Work Method Statements (SWMS) and permits relevant to the oncoming shift
  - safety concerns/task concerns
  - non conformances
  - environmental issues
  - inspections completed/checks required.

A range organisations that were engaged through the consultation of this report did not have mature systems for shift handover. In several cases documentation was often limited to a shift handover form rather than an integrated procedure or specified practice. Consistent with a *"risk based"* approach to shift handover all forms were commonly free form.

One of the main limitations in procedures reviewed was the stipulation that shift handover, while conducted face to face, was done so between supervisors or superintendents with the outcome of the handover to be fed into the oncoming shift's pre-start meeting. In a few instances work crew responsibilities identified the need for them to be prepared for questions from the incoming supervisor/superintendent. Also, logs or plods were rarely mentioned or used and there was no reference as to where the shift handover should be conducted. The inclusion of auditing arrangements, analysis of shift handover records and the inclusion of communication skills in selection criteria could not be evaluated from the materials provided.

One exception to the general approach to shift handover has been developed and is being employed across all sites of a large engineering/maintenance organisation. Termed SH2 (or Shift Handover 2) this approach utilises cutting edge technology and real time reporting to maintain up to date communications across its operations. SH@ is an iOS (apple) based software, utilising iPads and Apple TV to integrate to TV screens. The software features an interactive communication platform that provides visibility of operational status, hazards, maintenance schedules and productivity performance. Using the latest technology, the system runs off a web based data server which deploys data to and from sites, and integrates with existing applications. All shift hand over records are archived and fully searchable, and have reporting software that can analyse trends, including the most common hazards, times spent on different topics, attendees and what was discussed. Also, SH2 can receive real time input from corporate to include key organisational messages, safety alerts or reports from other sites. The roll out of this application is currently taking place and is supported with training in use of the technology (Apple touch and type) as well as presentation and facilitation skills training. All shift handovers accompanying the SH2 rollout are conducted team to team, face to face with the aid/assistance of the visual display and structured agenda provided by the software. All supervisors responsible for conducting the handovers are afforded time during and at the end of shift to plan the shift handover meeting. Culturally this roll out is also reinforcing the phrase *"shift handover – your most important conversation of the day"*.

CONCLUSION & RECOMMENDATIONS

GRID MESH

DOCUMENTED INDUSTRY STANDARDS FOR THE SELECTION AND INSTALLATION OF GRID MESH

It is critical to ensure that all aspects of the area in which the grid mesh will be installed have been considered prior to selecting a product. While the manufacturer or supplier of the grid mesh should be requesting all relevant information regarding the application/use of the grid mesh in order to assist in providing the correct product, it is critical to ensure that the following information is considered prior to selection:

- Location (restricted area, adjacent to machinery).
- Support structure.
- Possible vibration.
- Vehicle traffic (if any).
- Pedestrian traffic (maximum and minimum).
- Load bearing capacity (will there be working loads / loaded trolleys or carts / stationary loads).
- Environmental conditions.
- Ease of inspection / maintenance.
- Accessibility of fixing mechanisms.

DOCUMENTED INSTALLATION, FIXING AND REMOVAL PROCEDURES

Prior to the installation of grid mesh the following are required to allow the work activity to be commenced:

- A risk assessment or job hazard analysis of the activity in relation to the specific area where the work will be conducted.
- Communication of the risk assessment or job hazard analysis to the work parties impacted by the works or in the vicinity of the work zone.
- A works permit issued by a competent authority representing the company.

From review of the procedures and processes provided by industry, the following appear to be the key components of an installation process:

- Where possible, the structural support members are to be installed and fully secured prior to the installation of the panels.
- All edge protection and fall arrest equipment is to be in place before installation activities commence, including barricading of the area below the work zone.
- Temporary fixing of panels during the installation process to ensure limited movement of panels.
- Where panels are not able to be fitted in accordance with the design, all activities are to cease until this issue has been rectified.

When commencing removal activities with regard to grid mesh, there must be a works permit issued by a competent authority and hard barricading must be in place surrounding the works area to prevent access by unauthorised personnel.

INSTALLATION, FIXING AND REMOVAL CHECKLIST PROCEDURES INCLUDING PERMITTING REQUIREMENTS

Ensure that a checklist is developed assessing the completed installation, fix or re-instatement of grid mesh panels to ensure that the grid mesh has been left in a condition suitable for the activities it is supporting.

INDUSTRY TRAINING IN RELATION TO THE USE, INSTALLATION, FIXING AND REMOVAL OF GRID MESH

It is recommended that all personnel involved in the installation, fixing and removal of grid mesh are trained in working at heights and fall arrest as a minimum and in the internal company procedures for the work activity involving grid mesh.

INDUSTRY ACCEPTED AUDITING PROCESSES FOR ENSURING COMPLIANCE

Auditing and inspection of grid mesh installations is to be conducted regularly. Inspection is not to exceed five years by manufacturer's recommendation, however more frequent inspections are to be considered based on the criteria detailed in the selection process and documented above. Consideration to be given to a mechanism to identify clearly which panels have been inspected and approved for use and which have yet to be inspected.

BARRICADING

TYPES OF BARRICADING INCLUDING SELECTION CRITERIA AND FITNESS FOR PURPOSE

The standards (legislation, codes, standards, guidelines and published literature and industry consultation) reviewed showed that there is no *"single / magic"* barricade that is suitable for all situations and risks. Rather, that a multi-tiered approach is best practice. This consists of:

- Defining the types of barricades available that are suited to the sites and activities where works are being undertaken and categorising these into two to three levels e.g. hard barricades and soft barricades. Some organisations chose to categorise barricades into three levels e.g. Level 1, 2, 3 or Class A, B, C. These were generally associated with levels of risk – high, medium, low.
- Identifying within each category the specific barricades that are permitted to be used. For example:
  - Hard barricading – to be constructed of scaffold tube, mesh, metal or wooden posts or rails, etc. Hard barricades may include fences, building walls, concrete structures, standalone A'frames, earthen berms, water filled plastic barriers etc.
  - Soft barricading – includes coloured rope / ribbon, bunting, cones, flagging, bollards etc.
- Adopting a risk based approach for the selection of suitable barricading. This should also mandate certain types of barricading for certain levels of risk or hazardous situations such as identified high risks will use hard barricading only; fall risks will use hard barricading only etc.
- Consider the development of a quick reference guide for use by site personnel that outlines the types of barricades and the requirements associated with their installation and use.

DOCUMENTED INSTALLATION AND REMOVAL PROCEDURES

It is recommended that installation and removal procedures give consideration to the following requirements:

- Barricades must be installed before the commencement of works.
- The barricaded area is to encompass the entire potentially affected area of the hazards.
- Barricading is to be installed at least two metres away from the hazard. Where this cannot be done, a risk assessment should be undertaken.
- Barricading is to be maintained in good condition ensuring that it remains effective.
- A hard barricade shall have a solid top and mid rail (e.g. scaffold tube or equivalent). The top rail must be between 900mm and 1200mm high and the mid rail shall be no more than 560mm from the floor, if no toe board is fitted, and 450mm between rails. Be able to withstand a force of 0.55 – 0.90 kN (approximately equivalent to 55 – 90 kg) applied at any point.
- Hard barricading is to be accompanied at all times with relevant flagging / tape.
- Barricading materials such as mesh, and/or tape shall be installed with the top edge at a height between 900mm and 1200mm.
- Plastic mesh barriers shall be a minimum 900mm high supported by capped star pickets or other upright structures.
- Barricade supports shall be at maximum spacing of three metres.
- Barricades shall be maintained in a taut and level position to prevent sagging.
- Water filled plastic barricades are classed as a suitable barricading method. Where there is potential for a vehicle impact they shall be linked together and filled.
- Barricading shall not be tied to valve handles, conduit, instrument tubing, electrical gear, or other fragile items.
- Barricades shall be installed in such a way as to eliminate accidental entry into the barricaded zone.
- Entry points in barricading shall be arranged such that personnel entering the area cannot walk directly into the hazard.
- Where a barricade would not support a person's weight, it shall be placed so that any person falling through it would not reach the hazard.
- No person shall enter a danger barricade area unless authority is obtained from the barricade owner as listed on the barricade tag.
- Caps shall be fitted to star pickets or stakes.
- Warning lights, such as amber flashing beacons, are provided at appropriate intervals where the risk assessment indicates the need to warn people of the presence of a barricade during darkness.
- Barricading signage shall be installed on all barricades in accordance with requirements outlined below under *"Barricading signage requirements".*
- Barricades are to be removed immediately once the work is completed or the hazard no longer exists.

BARRICADING SIGNAGE REQUIREMENTS

The recommended best practice for signage requirements is as follows:

- Types of signage, definition, size, colouring etc. should be in accordance with Standards Australia (1994) AS1319.
- Signage needs to identify date and time erected, name and phone number of responsible person or means of contact, duration of project / barricade and reasons for the barricade (hazard present). This information should be recorded on an information / barricade tag that is attached to the barricade.
- Information tags and signage is to be attached at all faces and designated access points. The intervals of signage and tags attached at barricade faces shall be determined by a risk assessment.
- Signs should be located where the messages are legible, and so that they attract the attention of, and are clearly visible to all concerned.
- Signs should be mounted as close as practicable to the observer's line of sight and positioned so as to give the viewer ample time to heed the warning.
- Signs shall be constructed and erected so that they don't create a hazard and shall be maintained in good condition, kept clean and well illuminated.
- The meaning of safety signs used on a site must be communicated to the workforce at the induction, toolbox meetings and pre-start meetings.
- If there is a multilingual work force, words on signs should be in the relevant multiple languages.
- Graphics on signs should be colourful and bold and immediately convey the message.
- Appropriate signs should be placed at the point of danger.
- Consistent format for signs and labels should be used throughout the facility for clarity.
- Customised messages should be created to clearly identify requirements for entering a specific area or operating a specific piece of equipment.
- Materials used for signs and labels should be able to endure their environment. Specially designed and tested materials are needed to withstand harsh environments.

INSTALLATION AND REMOVAL CHECKLIST PROCEDURES INCLUDING PERMITTING REQUIREMENTS

While the research did not identify any specific installation and removal checklist procedures including permitting requirements, consideration should be given to establishing such requirements, especially where entry to the barricaded area may pose an immediate risk to employees such as open holes, dangerous ground conditions, structural collapse etc. where life may be endangered without warning.

INDUSTRY TRAINING IN RELATION TO THE SELECTION, INSTALLATION AND REMOVAL OF BARRICADING

The recommended best practice for training in relation to the selection, installation and removal of barricading includes:

- The site induction contains information and instruction regarding barricading and associated signage including types of barricades / signage and key requirements / rules associated with barricades eg. entry requirements, meaning, signage etc. for all site personnel to ensure that relevant requirements are understood by all.
- For personnel responsible for the selection, installation, removal and inspection of barricading, training shall be competency based (reflecting the standard) and include:
  - Systems of work needed for the safe use of barricades.
  - Types and selection of correct barricades and signage.
  - Barricade equipment.
  - Care, maintenance and inspection of barricades.
- Additional retraining shall be conducted whenever a periodic inspection reveals, or there is a reason to believe, that there are deviations from inadequacies in the employees' knowledge of barricading hazards.
- Employers shall conduct additional retraining whenever a barricading of hazards procedure fails.
- Where barricading is of a proprietary nature, guidance on competency requirements shall be sought from the manufacture / supplier.

INDUSTRY ACCEPTED AUDITING PROCESSES FOR ENSURING COMPLIANCE

The recommended best practice for ensuring compliance is:

- Developing and implementing an audit program for the barricading standard. This audit program should look at the effectiveness and level of implementation and compliance with the barricading standard.
- Developing and implementing an inspection program which includes regular formal inspections undertaken at the commencement and conclusion of each shift / work activity. Details of the inspections shall be recorded including identification mark of the barricade, date the barricade was first erected, date of last inspection and name of person carrying out the inspection. Also, the person responsible for the erection of the barricade should conduct regular inspections throughout the shift / work activity to ensure that the barricade has not been compromised.
- Where defects are identified with the barricading components or the erected barricade is not fit for purpose:
  - All components should be tagged out of service / not for use and repaired or replaced.
  - All works in the affected area should cease until the barricading is corrected and deemed to be fit for purpose.

SHIFT HANDOVER

Shift hand over requires skills and systems for effective communication and information management. Also, there is an opportunity to explore how technology can help with this task: certainly, content management (the way information is collected and structured) to assist in the maintenance of site and specifically shift safety.

CRITERIA (TYPE OF PROJECT, TYPE OF ACTIVITY ETC.) TO TRIGGER SHIFT HANDOVER REQUIREMENT

Recommended industry best practice identifies that a transfer of responsibility or accountability for a specific task or range of activities requires a handover or exchange of information. Shift handover being a specific case of this defined by:

"the exchange between shifts of information and risks relating specifically to the job or tasks being performed which accompanies either a transfer of control over, or of responsibility for, the work."

DOCUMENTED INDUSTRY STANDARDS AND PROCEDURES FOR THE DOCUMENTATION OF SHIFT HANDOVER INCLUDING METHOD OF SHIFT HANDOVER

Recommended industry best practice for documenting shift handover includes the provision of clear procedures/ written guidance describing the key information to be exchanged and how this should be done (e.g. word of mouth, in writing or both), as well as a structured record (usually provided to prepare for shift handover) and typically in the format of a written form (though the adoption of new technologies is currently leading edge and holds great promise in this area). Other shift handover documentation included aids such as log books (plods, databases, etc.) during handover, using more than one communication medium (for example, both written and verbal), and addition to modified procedures and specialist information (e.g. Material Data Safety Sheets [MSDS] or inspection/ audit reports that are amended to the handover form). Also checklists for the review and rating of face to face handovers and shift handover audit forms.

DOCUMENTED INDUSTRY STANDARDS AND PROCEDURES FOR THE DOCUMENTATION OF SHIFT HANDOVER INCLUDING ITEMS / ISSUES TO BE DISCUSSED AND INCLUDED IN SHIFT HANDOVER

Recommended industry best practice for documentation of shift handover content inclusions:

- product and plant movements, both ongoing and planned;
- control systems bypassed;
- equipment not working or out of commission;
- maintenance and permits;
- isolations in force;
- trips defeated;
- critical or high priority alarms activated and actions taken;
- health, safety or environmental incidents or events;
- modifications;
- the work schedule and work undertaken;
- recent audit or inspection reports;
- personnel and or subcontractors on site; and
- unusual occurrences conveyed as problems, hypotheses, and intent, rather than simply listing what occurred.

DOCUMENTED INDUSTRY STANDARDS AND PROCEDURES FOR THE DOCUMENTATION OF SHIFT HANDOVER INCLUDING COMMUNICATION OF INFORMATION AT SHIFT HANDOVER

Recommended industry best practice indicates that handover communication works best if it captures problems, hypotheses, and intent, rather than simply listing what occurred. Addendum 2 contains a list of guidelines based on the literature on best practices in shift handover (Parke & Mishkin, 2005; Parke et al., 2003). While the summary of communication practices suggest:

- the allocation of time to prepare shift handover materials prior to the end of the shift;
- the allocation of appropriate space to conduct the shift handover that minimises distractions and interruptions;
- a shift handover environment that encourages challenging of assumptions and seeks assurance of understanding;

- shift handovers conducted face to face, crew to crew;
- two way shift handovers, with both participants taking joint responsibility for ensuring accurate communication and understanding;
- shift handovers that use a range of verbal and written/ recorded means of communication;
- shift handovers are afforded the time necessary to ensure accurate communication;
- the recognition of longer or more detailed handovers when staff have returned following a lengthy absence from work; during plant maintenance; during deviations from normal working/duties; and when handovers take place between experienced and inexperienced staff. As these high risk scenarios for shift handover are consistent with those situations and processes that consistently emerge in as contributing factors in incident investigations;
- inclusion of communication skills in selection criteria for shift workers;
- involvement of employees in the examination and improvement of the practices;
- existence of change management processes for updating systems in light of information from incidents and accidents due to shift handover problems and bringing this to the attention of employees;
- maintenance and analysis of shift handover records for learning opportunities.

INDUSTRY TRAINING IN RELATION TO SHIFT HANDOVER METHODS AND COMMUNICATION

Recommended industry best practice includes:

- Providing training and having systems to ensure that employees are competent in using handover procedures.
- Providing training and having systems to ensure that employees are competent in using logging, plod sheets, database or associated technologies that accompany shift handover processes.
- Investing in the development of presentation, facilitation and communication skills of staff to improve confidence and effectiveness in delivering shift handover (be it on the job, mentoring, formal training, or job rehearsal accompanied by coaching with experienced staff and computer or video based training).

INDUSTRY ACCEPTED AUDITING PROCESSES FOR ENSURING COMPLIANCE

Recommended industry best practice for this section was not uncovered.

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APPENDICES

ATTACHMENT 1: SCRIPT FOR CONVERSATIONS WITH INDUSTRY RE RESEARCH PROJECT

This would also form the basis of written (email) request following any conversations…

INTRODUCTION

Hello, my name is…. I am from Ibis Business Solutions / People Knowledge Consulting…

PURPOSE

I am undertaking research for our client John Holland regarding industry best practice in some specific areas of workplace safety management.

If asked why??? This is about proactive research undertaken to address some identified improvement issues in the business.

I was wondering if I could have approximately 15 minutes of your time to discuss these specific areas.

If response is not now / busy ask – Would you mind if I called you back at a more suitable time and make an appointment to call back.

The results of this work are intended to benefit industry and results will be made publically available.

SPECIFICS

Our project aims to identify industry (worldwide) leading practice in the following areas:

- Grid mesh.
- Barricading.
- Shift hand over.
- Management of specialist subcontractors.

Specifically, we are seeking information (standards, practices and procedures) covering the following areas to identify:

GRID MESH

- Documented industry standards for the selection and installation of grid mesh.
- Documented installation, fixing and removal procedures.
- Installation, fixing and removal checklist procedures including permitting requirements.
- Industry training in relation to the use, installation, fixing and removal of grid mesh.
- Industry accepted auditing processes for ensuring compliance.

BARRICADING

- Documented industry standards for the selection and installation of barricading.
- Types of barricading including selection criteria and fitness for purpose.
- Documented installation and removal procedures.
- Barricading signage requirements.
- Installation and removal checklist procedures including permitting requirements.
- Industry training in relation to the selection, installation and removal of barricading.
- Industry accepted auditing processes for ensuring compliance.

SHIFT HANDOVER

- Industry accepted definition of *"Shift Handover".*
- Criteria (type of project, type of activity, etc.) to trigger shift handover requirement.
- Documented industry standards and procedures for the documentation of shift handover including:
  - Method of shift handover.
  - Items / issues to be discussed and included in shift handover.
  - Communication of information at shift handover.
- Industry training in relation to shift handover methods and communication.
- Industry accepted auditing processes for ensuring compliance.

CONFIDENTIALITY

Any information will be treated with strict confidence.

Material provided will only be viewed by the Ibis / PK research team.

Copies of procedures, forms, standards, etc. will not be provided to John Holland (our client) or any other third party, and will be returned / erased following report completion.

However, it should be noted that information contained within your documents may be used in the research and reporting, e.g. a hard barricade is defined as... **NB There will be no link / reference as to where this information came from.**

Use of specific examples or any of your company materials in our report will not be made without written permission from your company.

Your company will be listed as a participant / contributor in the report for the purposes of demonstrating the breadth of consultation undertaken, however, no contact details, or other company or personal information will be documented.

RESULTS AVAILABILITY

We are able to provide you with a copy of our research report after completion of the work.

The only restriction is that this will be provided after review by John Holland.

TIMEFRAME

Can you please provide this material in as short a time as possible (one week?) as we have limited time to complete the project.

OTHER CONTACTS

Can you suggest any other organisation / individuals that we should contact?

WRITTEN FOLLOW UP

We will send you a written request (if required).

QUESTIONS

Can we clarify anything?

THANKS

Thank you for your cooperation with this project.

APPENDIX A: SHIFT HANDOVER

ADDENDUM 1: SHIFT HANDOVER AUDIT TOOL (THE KEIL CENTRE, 2006)

DOCUMENT	OBTAINED	NOTES
COPY OF SAFETY SYSTEM (Are shift handover arrangements referenced in the safety system?)		
MINIMUM STANDARD (Does the organisation define a minimum standard for shift handovers to make it clear what is expected of individuals and provided a basis for monitoring/auditing?)		
WRITTEN GUIDANCE (Is written guidance available to operational personnel on how to conduct an effective shift handover?)		
WRITTEN REQUIREMENT FOR SUPERVISION/ AUDITING (Is there a written requirement for periodic monitoring or auditing of shift handovers?)		
PERSON SPECIFICATION/ SELECTION CRITERIA (Are communication skills amongst the selection criteria for the operations supervisor/superintendent? Do operations supervisor/superintendent job specifications list shift handover as their task and/or responsibility?)		
DETAILS OF COURSE/ RESOURCES (relevant training and development undertaken to improve communication skills for shift handover – note many communication skills are transferable.		
CHART ILLUSTRATING SHIFT SYSTEM (Evidence that there is a well designed structured log and/or computer display to help ensure the most important topics are discussed at shift handover?)		
COPY SHIFT LOG (Copy of the log for the last complete shift worked by the key post holder collected?)		
EXAMPLES OF GOOD PRACTICE		
OTHER DOCUMENTS (SPECIFY)		

ADDENDUM 2: CHECKLIST FOR EFFECTIVE SHIFT HANDOVER (PARKE & MISHKIN, 2005; PARKE ET AL., 2003)

1. Is sufficient schedule overlap time and distraction-free space allocated for effective one on one, face to face shift turnovers?
2. Is sufficient time and distraction-free space allocated for necessary group turnovers?
3. Are turnovers face to face, or if not, is there an opportunity for two way communication regarding tasks; that is, can questions be asked? For example, prior arrangements can be made to have questions answered via other technologies (phones or e-mails) or third parties.
4. Is time allocated and are resources provided for the outgoing shift to prepare any turnover material?
5. Are the necessary information sources readily accessible to the incoming worker?
6. Is time allocated and are resources provided to develop written support of turnovers, such as structured shift turnover worksheets with specific questions or a list of material to be covered?
7. Was this written material developed with the input of those who will use it?
8. Was the written material evaluated by the workers in a trial period with the opportunity to recommend additions or deletions?
9. Does the written material have some blank fields for workers to describe unusual occurrences?
10. Does the written material demand inclusion of relevant information as ascertained by worker input, critical incident analysis, and careful consideration of risks associated with not handing over the material in question?
11. In both written and verbal descriptions of tasks and occurrences, is there an effort to capture problems, hypotheses, and intent, rather than simply listing what occurred?
12. If there are multiple tasks or sources that must be reviewed before coming onto a shift, is there a checklist to ensure that all will be accomplished?
13. Are the shift turnover procedures written up?
14. Are the shift turnover procedures specifically trained?
15. Are shift turnovers periodically monitored?
16. Is handing over known to be an equal responsibility of both incoming and outgoing worker?
17. Is there an effort to promote a culture where communication mistakes are expected, and efforts are made to avoid them or mitigate their consequences when they occur? In this type of culture, phrases such as *"Good catch!"* are heard.
18. Are workers alerted to the necessity for lengthier and more thorough turnovers in abnormal operations, when either person is new at the job, and when the one taking over has been away from work for a few days?
19. Are days off staggered in a team to preclude their all returning at once?
20. Are computer databases, word processing programs, and other software and hardware tools used when possible to reduce turnover workload and to provide graphic displays?
21. Are turnover databases searchable?
22. Are turnovers seen not only as error prone, but as sometimes potentially beneficial? Problems encountered in the first shift can be viewed by a second pair of experienced eyes and personnel from both shifts can engage in collaborative problem solving.

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