Harpur Hill, Buxton, Derbyshire, SK17 9JN
Tel: 01298 218 000
Fax: 01298 218 590

HEALTH & SAFETY LABORATORY

# Measuring Workplace Transport Safety Performance

**HSL/2005/03**

Project Leader: **Nick Dickety**
Author(s): **Nick Dickety, Andrew Weyman and Peter Marlow**
Science Group: **Human Factors**

**PRIVACY MARKING:**

Available to the public

| | |
|---|---|
| HSL report approval: | Dr. A.K. Weyman |
| Date of issue: | December 2003 |
| Job number: | JS2002176 |
| Registry file: | RA/RE/52/00 |
| Electronic filename: | O:\ergonomics\js2002176\workplacetransportsafetyperformance.doc |

## ACKNOWLEDGEMENTS

The authors would like to thank all the HSE staff that participated in this project.

# CONTENTS

# EXECUTIVE SUMMARY

## SUMMARY

This report presents findings from a project conducted by the Health and Safety Laboratory (HSL) on behalf of the Health and Safety Executive (HSE). The research was funded by the Hazards and Technical Policy Division of HSE as part of the workplace transport priority programme initiative. The overall aim of the project was to identify causal factors in workplace transport accidents and outline areas where intervention might be effective.

## OBJECTIVES

1. To identify causal factors in workplace transport accidents by a review of literature and an analysis of a sample of reported accidents.

2. To identify gaps in knowledge regarding accident causation and prevention and propose areas meriting further study.

3. To identify areas where intervention might be effective based on the review of literature, analysis of accident reports and information gathered during site visits.

## MAIN FINDINGS

1. A number of workplace transport accident causation factors have been identified and are described in terms of safe site, safe vehicle and safe driver.

2. The following controls for preventing workplace transport accidents have been identified:

- **Pedestrian and vehicle separation:** where possible, pedestrians should be segregated from vehicle traffic through the provision of protective barriers and clearly marked separate gangways. Routes used by vehicles such as forklifts inside buildings should be indicated by lines drawn on the floor to inform pedestrians, as should walkways designated for pedestrian use only.

- **Vehicle routes**: route planning should take into consideration the path and ultimate destination of the pedestrian flow (e.g. location of time clock, canteen, toilets etc) and vehicle traffic should be minimised at times of peak pedestrian activity, e.g. meal breaks, shift hand-over etc.

- **Reversing & Traffic Management:** the need for reversing can be minimised through the use of one-way traffic systems that incorporate drive-through loading and unloading positions. One-way systems can also keep traffic away from vulnerable plant and equipment. Speed limits and speed humps are also an effective means of controlling site traffic although thought should be given to forklift trucks and load stability.

- **Signage**: signs should be clear and unambiguous for both drivers and pedestrians For example, drivers need to know in advance about hazards such as sharp bends, junctions, crossings, blind corners, steep gradients and limited headroom.

- **Lighting**: adequate lighting is important to assist drivers detect hazards such as pedestrians, machines and other vehicles

- **Conspicuity**: the extent to which objects 'stand out' from their background is affected by a number of factors including 'adaptation', 'disability glare' and 'veiling effects'. These factors can be controlled by avoiding large changes in levels of illumination (e.g. between the inside and outside of premises) and the provision of sun visors etc. High visibility clothing can increase conspicuity and assist drivers detect the presence of pedestrians.

- **Loading Bay**: the Loading Bay has been identified as being a 'high risk' area due to the limited manoeuvring space available for forklifts and other powered industrial vehicles. Unauthorised trailer departures pose another problem and control measures, such as wheel restraints, may be necessary.

- **Ground Conditions**: attention should be paid to the gradient, quality and frictional characteristics of the floor upon which forklifts and other vehicles travel. Gangways should be clearly demarked with non-skid paint and oil, grease and fluid 'spill kits' should be easily accessible so that any spillage is quickly cleaned up.

- **Vehicle selection**: the degree of fit between the driver and the vehicle was identified as being important. The following issues in particular warrant careful consideration when selecting a vehicle:

- **Control compatibility:** the vehicle controls of powered industrial vehicles can vary and the potential for human error (slips) will increase if operators are required to drive more than one type of vehicle (with different controls) in the same workplace (especially during the same shift);

- **Driver access/egress** the design and layout of some vehicles make it difficult for operators to enter and exit the cab safely. Vehicles that include well-designed steps and conveniently located hand grips can reduce the need for drivers to jump from their cabs

- **Driver protection:** the use of Roll-Over-Protective-Structures (ROPS) is not fully effective unless the driver is wearing an appropriate seat belt or other restraint. Arrangements should be in place to monitor compliance with this requirement. Workers are more likely to use protective equipment, such as a seat restraint, if they have had some degree of involvement in the selection of the safety equipment.

- **Driver comfort:** driver comfort can be enhanced by the inclusion of vibration damping equipment, noise reduction measures, adjustable seating, good ventilation and weather protection.

- **Maintenance:** good vehicle maintenance management is key to the prevention of workplace transport accidents. A competent mechanic should inspect the mechanical condition of each workplace vehicle at specified intervals. Drivers should also carry out basic safety checks before using vehicles and arrangements should be in place for fault finding and defect reporting. Preventative maintenance programmes need to be properly managed in terms of planning what work needs to be done and in what order.

- **Driver selection:** Forklift truck driving requires a high degree of psychomotor skill, therefore, potential lift-truck operators should be selected carefully.

- **Driver training:** Training should reflect the actual conditions that the operator will meet at work and provide the driver with information and knowledge needed for safe operation of the vehicle. Training should also include a familiarisation stage. The previous experience of drivers new to the organisation should be checked and their performance assessed to ensure they are competent before receiving authorisation to drive.

- **Refresher Training:** Refresher training is an important mechanism for enhancing competence levels and also as a necessary check and balance against the development of informal procedures. Refresher training should be provided at set intervals for all drivers and also following incidents, the introduction of new vehicles or significant changes in site layout (including modes of production);

- **Pedestrian Training:** pedestrians represent a high-risk group in the workplace therefore, training programmes should be developed that aim to familiarise pedestrians with the unique operating characteristics of powered industrial vehicles. Emphasis should be given to the main operating differences that exist between a car and a powered industrial vehicle, e.g. manoeuvrability, visibility and load stability.

- **Safe Operating Procedures:** Compliance will be enhanced by ensuring that procedures are practical, easy to follow and fully understood by staff.

- **Workload:** workload should be controlled to prevent drivers and other employees from having to rush to complete their work on time. Work design and driver incentive schemes require careful management so that they don't inadvertently encourage unsafe driving behaviour.

- **Supervision and monitoring:** close supervision of newly qualified drivers is identified as being very important as to is the monitoring of experienced drivers to ensure that they continue to operate vehicles in a safe fashion. Supervisors need support and training in line-management skills so that they can encourage and support high standards of driving behaviour and good teamwork. Managers also need to ensure that supervisors have sufficient training and experience in the desired working practices to enable them to identify poor working methods.

- **Time-on-shift effects:** research indicates that working long hours will impact negatively on driver safety performance. Key to managing time-on-shift effects is the provision of adequate rest breaks and a good working environment. At present there isn't any regulation that limits the number of hours a driver of a forklift truck or other powered industrial vehicle can work. This is at variance with regulations governing drivers of commercial goods vehicles.

- **Shift patterns:** forward rotation of shift patterns is currently considered less detrimental to performance than reverse rotation. Research indicates that true adjustments to shift patterns rarely occur and that changing shift patterns about once a week is likely to cause more difficulties than a faster or slower changing pattern. Using appropriate lighting levels can help adjustment from day to night shifts.

- **Shift handovers**: shift handovers should receive high priority, be seen as a two-way process with shared responsibly and be given the necessary resources (e.g. sufficient time).

3. It is concluded that workplace transport accidents can be prevented by establishing an effective safety management system. The constituent elements of an effective safety management system include policy and organising, planning and implementation and measuring performance, audit and review (POPMAR).

4. The importance of collecting data and information relating to how well the safety management system is controlling workplace transport activities has been identified. The difficulties that organisations have in obtaining such data, (especially upstream or 'active' measures) was also acknowledged.

5. A method for improving active monitoring activity has been proposed that specifies using unsafe behaviours and unsafe situations as the unit of workplace transport safety performance measurement.

6. Details of how to identify key behaviours have been outlined along with worked examples of how to score, collate and manage the results.

7. It has been observed that other benefits can accrue from measuring workplace transport safety performance such as improving worker involvement in the risk control process;

8. The approach of documenting unsafe situations and unsafe behaviours was also recognised as being beneficial to the supervision of workplace transport activity.

9. Elements of good supervision have been outlined and include giving positive feedback (to reinforce desired behaviours). The influence that team dynamics can have on safety related behaviour was also identified.

10. The potential for enhancing organisational safety culture has been recognised in terms of securing co-operation, improving communication, contributing to competence and exerting control over workplace transport risks.

## RECOMMENDATIONS

1. Encouraging employees to identify unsafe behaviours and unsafe situations represents an effective means of involving employees in the risk control process. The approach outlined in this report could be broadened to include other aspects of workplace transport activity such as delivery/collection vehicle movements or visitor driver behaviour etc. Consideration should be given to providing advice and guidance on how to develop (and extend) workplace transport safety performance measures, e.g. they could be made available in an electronic format so that organisations can access the methodology and gain access to the safety performance inventories.

2. The issue of driver selection has been identified as being an issue that merits further study. Research indicates that forklift truck driving requires a high degree of psychomotor skill. However, it would appear that many organisations rely on the process of natural selection to recruit drivers. Therefore, it is recommended that work be commissioned to develop an aptitude test (or battery of tests) that will assist employers identify 'suitable' individuals to receive forklift truck driver training.

3. The effects of shift work and driver fatigue are known to be associated with workplace transport risk; however, the relationship between these factors is unclear. Further

research would be beneficial in establishing the extent to which fatigue and shift work contribute to the causation of workplace accidents.

# 1 INTRODUCTION

This report presents findings from a project conducted by the Health and Safety Laboratory (HSL) on behalf of the Health and Safety Executive (HSE). The research was funded by the Hazards and Technical Policy Division of HSE as part of the workplace transport priority programme initiative. The overall aim of the project was to identify causal factors in workplace transport accidents and outline areas where intervention might be effective.

## 1.1 BACKGROUND

The Government and the Health and Safety Commission's (HSC) **Revitalising Health and Safety** (RHS) Strategy Statement, June 2000, set the following national targets for health and safety:

- reduce the number of working days lost per 100 000 workers from work-related injury and ill health by 30% by 2010;
- reduce the incidence rate of fatal and major incidents by 10% by 2010;
- reduce the incidence rate of cases of work-related ill-health by 20% by 2010; and
- achieve half the improvement under each target by 2004.

In a bid to meet national targets, the HSC has identified eight areas of activity or 'priority programmes' where improvements in health and safety are needed. The priority programme areas represent hazards and sectors where large numbers of people are employed and the incidence rate of injuries and/or ill health is high. Workplace transport has been chosen as a priority programme area because each year approximately 70 people are killed and 1000 more are seriously injured in vehicle accidents at work, making it the second largest cause of fatal accidents in the UK workplace. Most workplace transport accidents involve people being struck by moving vehicles, falling from vehicles, being struck by parts of loads falling from vehicles or being injured as a result of vehicles overturning. According to the Health and Safety Executive, four out of five workplace transport accidents could be prevented (HSE, 2000). An integral part of priority programme activity involves conducting research and developing the knowledge base concerning the causation of accidents. The aim of this project was to highlight causal factors in workplace transport accidents and to identify gaps in knowledge regarding accident causation and prevention and propose areas where workplace interventions might be effective.

## 1.2 OBJECTIVES

The project was in two stages with the following objectives:

Stage 1

1. To identify causal factors in workplace transport accidents.
2. To identify gaps in knowledge regarding accident causation and prevention and propose areas meriting further study.

Stage 1 involved the analysis of 246 workplace transport accident report forms and a review of the relevant research literature.

Stage 2

3. To identify areas where intervention would be effective.

Following the identification of a range of accident causation factors, Stage 2 of the project involved the use of a case study firm[1] to develop safety performance measures that can be used as an active monitoring tool to help manage workplace transport safety.

### 1.3 STRUCTURE OF REPORT

The report is structured as follows: the identification of workplace transport accident causation factors is discussed in section two of the report. Section three of the report proposes an approach to managing workplace transport safety using safety performance measures as an active monitoring tool. Section four of the report discusses how the workplace transport safety performance measures were developed using the case study firm. Conclusions from the research are given in section five, main findings in section six and recommendations in section seven.

[1] The case study firm is a large employer (>250 employees) specialising in the manufacture of frozen foods. The company has a number of sites across the UK that make extensive use of workplace transport equipment, particularly counterbalance and reach lift trucks. The case study element of the project involved visits to three of the firm's main sites.

# 2 FACTORS AFFECTING WORKPLACE TRANSPORT SAFETY

In this section of the report the main findings of stage one of the project are summarised: identification of workplace transport accident causation factors. The findings are based on a review of literature and the analysis of 246 workplace transport accidents reported to the Local Authority Unit of HSE under the **R**eporting of **I**njuries, **D**iseases and **D**angerous **O**ccurrences **R**egulations 1995 (RIDDOR)[2]. The majority of accidents analysed involved people being injured by industrial lift trucks in a warehouse environment - either through being struck by, falling from or being struck by loads falling from a lift truck. Similarly, the review of literature focused on accidents involving lift trucks and other powered industrial vehicles (for a more detailed description of the accident analysis methodology and scope of this review see Dickety, 2001, 2002). The main results of the accident analysis and literature search are discussed in terms of **safe site**, **safe vehicle** and **safe driver** (see Figure 1.0). This approach is consistent with HSE guidance (e.g.'Workplace Transport Safety', *HS(G)136*). In addition, reference is made throughout the discussion to the workplace transport activity observed during site visits to the case study firm.

Finally, as it is recognised that human error contributes to 80% of workplace accidents and incidents, this report is written from a human factors perspective, i.e. the primary focus is on the factors that affect the human performance of workplace transport activity.

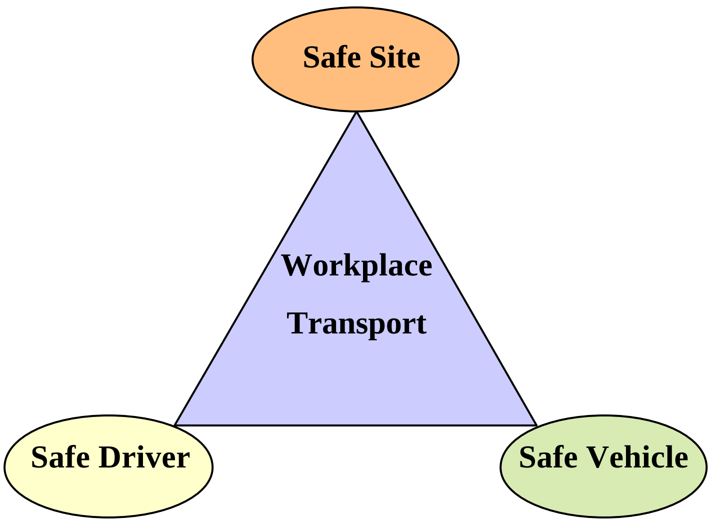



Figure 1.0: HSE's approach to workplace transport safety.

[2] 246 RIDDOR forms classified as involving workplace transport were obtained from the Local Authority Unit of HSE. The sample was drawn from the 'Storage and warehousing' and 'Courier' sectors of industrial activity according to SIC 92 allocation.

## 2.1 SAFE SITE

Safe site refers to the planning of vehicle movements and the physical dimensions of the work site layout. In a recent study of workplace transport accidents, 75% of the investigated accidents (n=577) found workplace design and layout to be a significant initiating factor (Smith, 2001). In this section of the report, work site design and layout issues will be discussed with reference to the review of literature, case study visits and analysis of lift truck accidents. As previously stated, the emphasis of the discussion will concern the risk factors associated with operating industrial lift trucks within a warehouse environment[3].

### 2.1.1 Pedestrian and vehicle separation

Approximately 70% of workplace transport fatalities reported to HSE are 'struck by vehicle' accidents. 'Inadequate pedestrian segregation' is a contributory factor in a large proportion of these accidents (Smith, 2001). Research literature indicates that relatively simple adjustments to the ergonomics of the work environment can reduce the risk of a workplace transport accident (O'Mara 1989, Collins *et al* 1999). For example, by providing protective barriers for pedestrians and separate gangways for vehicles[4]. Guidance indicates that routes used by vehicles should be clearly marked (as should those for pedestrians). In premises where separate pedestrian doors are provided, the doors should be fitted with vision panels so that the user can see if there is anything coming (Svensson & Ostberg, 1974).

### 2.1.2 Vehicle routes

Research indicates that the routing of vehicle traffic is important in the control of workplace transport accident risk. For example, route planning should take into consideration the path and ultimate destination of the pedestrian flow (e.g. location of time clock, canteen, toilets etc). Collins *et al* (1999) in a study of 916 incidents involving forklifts and other powered industrial vehicles found an overrepresentation of pedestrian 'struck by vehicle' incidents during shift changes and other plant wide breaks. Therefore, vehicle traffic should be minimised at times of peak pedestrian activity, e.g. meal breaks, shift hand-over etc. At the case study firm, vehicles were prevented from entering the site 15 minutes either side of the main shift change by lowering the barrier at the main site entrance. Booth (1979) suggests that there should also be suitable pedestrian crossing points on vehicle routes (see figure 2.0).

Figure 2.0: Example of desired walking lines

[3] For a more detailed analysis of workplace control measures, the reader is directed to the following HSE guidance: HS(G)136 (*Workplace Transport Safety*).
[4] Regulation 17 of The Workplace (Health, Safety and Welfare) Regulations (1992), place certain legal obligations on duty holders to separate vehicle traffic from pedestrian movement.

Where possible, these should represent the paths pedestrians naturally follow to enhance compliance with site safety procedures. HSE guidance (HSG 136) indicates that traffic lights, zebra crossings and footbridges can be used to assist pedestrians to cross busy vehicle routes. At the case study firm, a footbridge has been constructed to take workers from the main production areas to the canteen thus avoiding the need to cross a busy traffic route (see Figure 3.0)

Figure 3.0: Footbridge to link canteen with main production area of case study site.

In addition to being it being a legal obligation on employers to remove obstructions[5], research findings indicate that 'obstructions' represent a significant factor in the causation of workplace transport accidents. For example, Collins *et al* (1999) conducted a study of risk factors associated with forklift truck and other powered industrial vehicle collision injuries. This study involved investigating incidents over a 3-year period, at 8 automobile plants in the USA. The researchers found that obstructions in the aisles were present in 100 out of 167 incident sites examined, and that two-thirds of the obstructions were temporary, e.g. racking or a bin etc. Furthermore, the risk factor of a collision increased if obstructions were placed in close proximity to aisles and intersections of aisles due to reductions in the visibility of both pedestrians and forklift truck drivers. It was also noted that if a forklift struck a fixed object (e.g. roof support) then more often than not, it resulted in an injury to the driver. However, if the forklift struck a non-fixed object such as a pallet or stillage, then it would create a 'pinch-point', which often resulted in an injury to the pedestrian.

### 2.1.3 Reversing

In HSL's study of 246 workplace transport accidents reported to the Local Authority Unit of HSE, 'injured by reversing vehicles' accounted for around 11% of the sample. The HSE suggest that around 25% of all deaths involving vehicles at work occur while the vehicle is reversing (HSE, 2000). However, this situation does appear to be improving (in 1978-80 HSE put the figure of 'reversing fatalities' at 47%) and much of this improvement can be attributed to the development of 'reverse-in-safety' systems such as CCTV, motion detectors, warning lights and reversing bleepers, that give an audible warning when a vehicle is moving backwards[6].

[5] Regulation 12 (3) of The Workplace (Health, Safety and Welfare) Regulations (1992) states that "*every floor in a workplace and the surface of every traffic route must be kept free from obstructions*"

[6] For a more detailed discussion of visibility from vehicles in general and reversing activities in particular, the reader is directed to the following publication: *Improving the safety of workers in the vicinity of mobile plant*. RR358/2001 HSE Books 2001. ISBN:0 7176 2071 9

### 2.1.4 Traffic management

Associated with the issue of minimising reversing hazards is the establishment of one-way traffic systems that incorporate drive-through loading and unloading positions, so that the need for reversing is reduced. One-way systems can also be effective in keeping traffic away from vulnerable plant and equipment (e.g. pipework, chemical storage drums etc.). Effective traffic management can also be achieved through the imposition of speed limits, although as Booth (1979) notes it is important that speed limits are both realistic and enforceable.

If traffic calming measures such as speed humps are to be used as part of the traffic management system, then thought should be given to forklift trucks and the need to maintain load stability. Swartz (2000) reviewed data from the USA relating to injuries to pedestrians from forklift trucks and found that a notable proportion were sustained when loads fell from moving forklift trucks. This scenario accounted for 11 out of the 246 reportable injuries in the HSL study. According to Swartz (2000) loads can fall whilst being transported by forklifts because often they tend not to be uniform in size and hence may be difficult to secure. Moreover, forklift trucks do not to have shock absorbers therefore, hitting even a small bump in the ground may dislodge a stacked load and cause it to fall.

### 2.1.5 Signage

Research indicates that safety and warning signs should be clear and unambiguous. Drivers need to know in advance about hazards such as sharp bends, junctions, crossings, blind corners, steep gradients and limited headroom. In general, road signs used to warn or inform should be consistent with the design of those used on the public highway, including being reflective (e.g. speed limit sign). Booth (1979) suggests that warning signs and instructions should be informative rather than monosyllabic – this may be particularly relevant to visiting drivers, especially if they are new to the site and they require additional information on site layout and vehicle route. At the case study firm, drivers new to the site(s) are provided with a plan of the workplace, which indicates vehicle routes, pedestrian walkways, speed limits etc.

### 2.1.6 Lighting

Adequate lighting is important to assist drivers detect hazards such as pedestrians, machines and other vehicles. Both the Chartered Institution of Building Services Engineers (CIBSE) and the HSE have published guidelines for levels of illumination for different work locations and activities. The HSE guidance HSG 38 (*Lighting at Work*), presents recommended illumination levels for 5 categories of work area. Using the case study firm as an example, the guidance states that where it is necessary to see detail to recognise a hazard, or where error in performing the task could put someone else at risk, the level of illumination should be increased to that for the next category 'movement of people, machines and vehicles in hazardous areas'. This category has a recommended average illuminance level of 50-lux and a minimum 20-lux. In the CIBSE publication 'Lighting Guidelines 1 – The industrial environment (warehouses)' the recommended average illuminance level is 100-lux and a minimum of 25-lux. However, it should be noted that the CIBSE lighting recommendations relate more to the needs of workers picking orders and reading labels than the safe movement of vehicles.

### 2.1.7 Conspicuity

Conspicuity refers to the extent to which objects can be discriminated relative to their background (i.e, the degree to which they 'stand out') In a workplace transport safety context, this could refer to how easily a driver of a site vehicle can detect a pedestrian. Research indicates that conspicuity is affected by a number of factors including 'adaptation' (Krais & Moraal, 1976). Adaptation is the overall level of light to which the eye has become accustomed, i.e. the general level of 'brightness' of the surroundings. Large changes in levels of illumination can cause problems because the human eye needs time to adapt to the changes in the amount of light entering it. This adaptation process can take several seconds, during which time it might not be possible to see certain shapes or objects (it is also worth noting that adaptation from light to dark takes significantly longer than dark to light). Therefore, in terms of workplace transport safety, it is important to avoid strong illuminance differences, for example between the inside and outside of premises or between different warehouses. Veiling effects' may also compromise conspicuity. Recent incident support work undertaken by HSL (Riley, 2003) found that for certain types of powered industrial vehicle, daylight can create a strong reflection of the driver's body on the inside of the cab windscreen, particularly if the driver is wearing high visibility clothing. Depending upon the colour and reflectiveness of the driver's clothing, this reflection could have a significant 'veiling' effect. This effect may be increased if the driver is looking and moving into a relatively darker area and could result in a reduction in the probability of a driver detecting a hazard (see Figure 4.0):

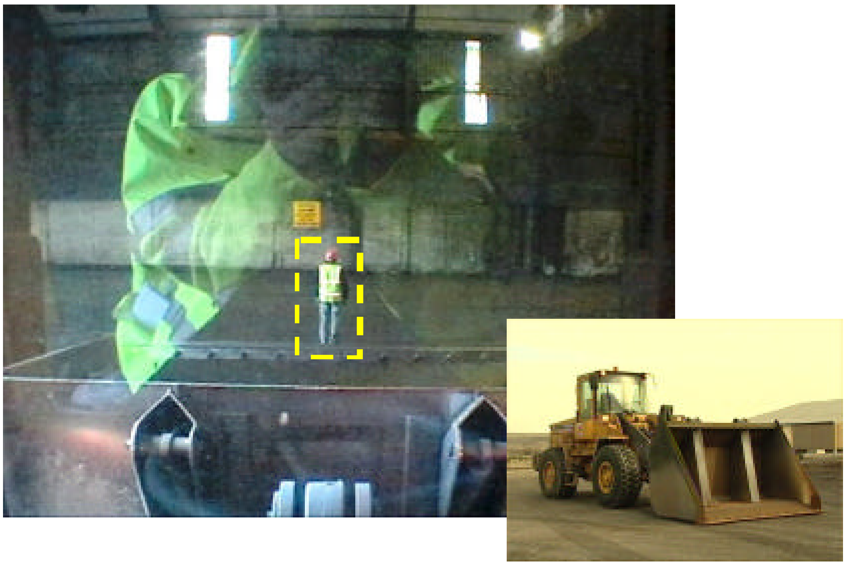


Figure 4.0: view from the cab of a Shovel-Loader showing veiling effect caused by light reflecting off the driver's high-visibility jacket.

It has also been recognised that glare from the sun can affect conspicuity. The significance of bright items within the field of view is that such areas of brightness can reduce the ability to detect small differences in contrast elsewhere in the visual field (and especially close to the bright source). This is called disability glare, and is the result of light scatter within the ocular media of the eye. Sensitivity to disability glare increases with age; therefore, measures may be needed such as sun visors etc. to avoid this problem.

Finally, the use of high visibility clothing, such as jackets and trousers made from light reflective material, is a good way of enhancing levels of conspicuity. Therefore, it is important that staff working in the vicinity of mobile plant, especially during night shift, wear high visibility clothing. Recent incident support work indicates that retro-reflective strips placed on safety helmets could increase the conspicuity of pedestrians working in close proximity to mobile plant, especially where forward visibility might be an issue (Riley, 2003).

### 2.1.8 Loading bays

Loading Bays are known to be 'high risk' areas for workplace transport accidents. In the HSL study of 246 workplace transport accidents, 26 per cent of the accidents happened in or around the 'Loading Bay' area. Similarly, a US Department of Labour study (1986) analysed some 2,700-worker injuries that occurred in the warehouse sector and found that dock and loading bay injuries accounted for 29 per cent of the injury total. One reason given for the loading bay being a high-risk area is the emergence of 'just-in-time' manufacturing practices. The 'just-in-time' approach means smaller, more frequent orders and higher levels of activity with an emphasis on the flow-through of materials rather than bulk storage.

Other findings from the materials handling field cite forklift trucks driving or falling off loading bays as presenting the greatest potential for severe or fatal injury (e.g. Templar, 1999). Such incidents are usually related to congested loading bays, inattentive and poorly trained forklift truck drivers, lack of safety procedures and unexpected haulage truck departures. At the case study firm this was prevented by the provision of trailer restraints, which clamp the wheels and physically remove the drive away hazard (see Figure 5.0):


Figure 5.0: Wheel lock to prevent unexpected drive-away of trailers from the Loading Bay area.

### 2.1.9 Ground conditions

Ground conditions refer to surface features of the floor such as potholes, debris, gradient, floor, grease, oil and other contaminants. The condition of the ground was recorded as being a contributory factor in just over 7% of the reportable accidents in the HSL study (Dickety, 2001). A number of these involved a forklift truck driving over uneven ground (usually a pothole) and losing control of the steering wheel and injuring the hand or wrist. Similar findings have been observed in other studies. For example, Williams and Priestley (1980) conducted a study of forklift truck accidents and examined the records of casualties presenting at a general hospital in Manchester over an 18-month period. The 60 injuries observed were responsible for the loss of 1345 working days. A significant number of these injuries were to the hand and wrist and were sustained by the uncontrollable spinning of the forklift truck steering wheel. The HSL study also identified that a number of recorded injuries were the direct result of forklift trucks skidding on a patch of oil or grease, and colliding with either a fixed object or another powered industrial vehicle (Dickety, 2001). Other research identifies 'spillage' and 'uneven ground' as a significant factor in the causation of forklift truck accidents (Robertson, 1969). Therefore, attention should be paid to the gradient and condition of the floor surfaces. Gangways should be clearly demarked with non-skid paint and oil, grease and fluid 'spill kits' should be easily accessible so that any spillage can be quickly cleaned up.

## 2.2 SAFE VEHICLE

In this section of the report, issues relating to vehicle selection and maintenance will be discussed. As in the previous section, discussion will be with reference to the review of literature, case study visits and analysis of forklift truck accidents.

### 2.2.1 Vehicle selection

#### *2.2.1.1 Control compatibility*

Regulation 4 of the Provision and Use of Workplace Equipment Regulations (1998) places a duty on every employer to make sure that work equipment (including vehicles) is suitable for the purpose for which it is provided. When choosing work equipment, Regulation 4 also requires every employer to consider the working conditions and the risks to the health and safety of people using the work equipment. Sometimes, however, when selecting equipment, employers fail to consider how the equipment will match the attributes and capabilities of the person undertaking the task. In other words, the degree of fit between the driver and the vehicle in terms of visibility, comfort and control. Often this is because employers assume that basic ergonomic principles will have been observed during the design and development of the vehicle. Regrettably this is not always the case. For example, research indicates that in the past there was a gulf between forklift truck design and established ergonomics data, especially with regard to the configuration of controls in terms of standardisation, e.g. Astley and Lawton (1971), Booth (1979). In the HSL study of 246 workplace transport accidents (Dickety, 2001), it was identified that the 'forklift driver selecting the wrong controls' was responsible for a number of incidents. For example, selecting the accelerator instead of the brake or the reverse gear instead of the forward gear. This type of human failure is known as an error or 'slip' (action-not-as-planned). In general, it is not possible to eliminate such human error through instruction or training (Reason, 1997). The best approach to controlling 'slips' is through design, or in other words, eliminating the opportunity for making the error. Booth (1979) notes that the potential for such human error will be increased on work sites that require operators to drive more than one type of vehicle on the same site and during the same shift. However, more recently there has been a move towards greater standardisation of controls on modern forklift trucks but employers should remain mindful of the problems associated with control compatibility when, for example, purchasing or leasing older forklift trucks, or requiring employees to drive a number of different vehicles (with different controls).

#### *2.2.1.2 Driver access/egress*

The poor ergonomic design of vehicles is also thought to be a major contributory factor in the causation of falls from vehicles. In an HSE study workplace transport accidents over 40% (n=577) of major injuries were attributed to falls from vehicles (Smith, 2001). It is believed that drivers jumping and landing awkwardly cause a good number of these 'fall accidents'. In a study of forklift truck injuries, O' Mara (1986) found that just over 9% (n=263) were caused by slips and falls during alighting from vehicles. Collins *et al* (1999) suggest that the design and layout of many vehicles make it difficult for operators to enter and exit the cab safely. Often drivers have to contort their bodies into awkward positions to get in and out of the vehicle or the steps and hand holds are poorly designed or inconveniently located, thereby encouraging drivers to jump from their vehicle.

#### *2.2.1.3 Driver protection*

Vehicle overturns account for approximately 20% of all workplace transport deaths (Smith, 2001). Male (2003), carried out a survey of 1204 accidents and incidents associated with industrial trucks and found the following to be common causal factors in forklift truck overturns:

- Travelling/turning with masts and/or attachments raised (both loaded and unloaded);
- Turning suddenly when travelling on level or uneven ground;
- Turning at speed on slopes;
- Driving into potholes, kerbs and over edges;
- Contacting overhead objects.

The increasingly widespread provision and use of Roll Over Protective Structures (ROPS) is reducing the risk posed by vehicle roll-overs, but ROPS is not fully effective unless the driver is wearing an appropriate seat belt or other restraint. Therefore, the success of such an engineering control is largely dependent upon whether the driver chooses to wear a seat belt or not. Research indicates that workers are more likely to use protective equipment if they have had some degree of involvement in its selection (Zohar, 1980). Methods for enhancing compliance of safety procedures and the monitoring of driver behaviour will be discussed in section 2.3.4 and 4.0 of this report respectively.

#### *2.2.1.4 Driver comfort*

Ergonomic considerations of vehicle selection should also extend to driver comfort. For example, in the HSL study of 246 workplace transport accidents (Dickety, 2001) just over 12% (n=246) of the sample involved strain/pain injuries sustained as a result of operating a forklift truck, either through having to adopt an awkward driving posture or simply operating forklift truck controls over a prolonged period. In an examination of forklift truck accidents (n=263) in South Australia, O'Mara (1989) found that 15.5% of the injuries involved musculo-skeletal strain from driving a forklift truck. Research indicates that driver comfort could be enhanced if forklift trucks included vibration damping equipment, noise reduction measures, adjustable seating, better ventilation and weather protection (Astley & Lawton, 1971). Driver protection from the elements would appear to be particularly important, given the findings of a survey undertaken by Male (2003): over a four-year period (April 1997- May 2001) there have been 5 fatalities caused by people climbing up between the mast and the overhead guard of a forklift truck to put material (cardboard) over the guard to protect against the weather. Whilst standing on the dashboard they have accidentally knocked the tilt control with their feet and crushed themselves to death. Employers should be aware of this, especially if they are considering purchasing a second-hand forklift truck that is to be used both inside and outside buildings and which doesn't offer protection from the weather.

### 2.2.2 Maintenance

Research indicates that effective vehicle maintenance regimes are key to the prevention of a significant proportion of workplace transport accidents. For example, Male (1998) conducted a survey of 41 transport accidents attributed to technological failing and found that the majority were due to a 'lack of maintenance' or 'ineffective maintenance'. Common faults included parking and service brake failures and faults with ignition systems. The survey concluded that all the transport related accidents attributed to technological failing could have been prevented if the maintenance management function had been better organised. In the HSL study (Dickety, 2001), mechanical/technical failure of the forklift truck was cited as a contributory factor in less than 3% of the accidents analysed (n=246).

## 2.3 SAFE DRIVER

In this section of the report, issues relating to driver competence will be discussed in terms of driver selection and training. The role of the pedestrian in the causation of workplace transport accidents will also be reviewed. The importance of workable procedures and safe systems of work will be outlined with reference to human capabilities in general and non-compliance (violations) in particular. The influence of workload demands on safety performance will be explored, as will the impact of shift work and fatigue. Issues of supervision and monitoring are also considered.

### 2.3.1 Competency

HSG 65 (*Successful Health and Safety Management*), recommends that if all employees are to make a meaningful contribution to health and safety, there must be appropriate arrangements in place to ensure they are 'competent'. This means more than simply providing 'training'. Arrangements for ensuring a competent workforce include having recruitment and placement procedures, a system for identifying training needs, a means of determining levels of supervision, the provision of refresher training and arrangements by which competent cover can be provided during staff absences.

#### *2.3.1.1 Driver selection*

HSC's Approved Code of Practice and Guidance (L117) *Rider-operated lift trucks: Operator training* states that employers should select potential lift-truck operators carefully. Those selected for training need to have the ability to do the job in a responsible manner and have the potential to become a competent person. The guidance also states that those selected should have the necessary level of physical and mental fitness and learning ability for the task. Whilst further information on medical criteria is provided in HSE's booklet HSG 6 *'Safety in working with lift trucks'*, there isn't guidance on the selection of operators in terms of mental fitness or learning ability. This gap in the provision of information is perhaps surprising given the research findings of Ostberg & Svesson (1973). This study involved examining over 300 'materials handling incidents'. The conclusion reached by the researchers was that fork lift truck driving required a high degree of psychomotor skill and the natural selection of forklift truck drivers was at variance with the high morbidity and costs associated with having an accident. Therefore, it was recommended that some form of aptitude test be developed, to help employers identify individuals with the necessary level of mental fitness and learning ability to become forklift drivers (rather than relying on natural selection). However, whilst there appears to have been a proliferation in the availability of forklift truck training courses, very little has been done in terms of aptitude test development or validation. The reasons for this are not clear given that data relating to predictive selection criteria are not difficult to obtain (given the large forklift truck driver population). In summary, the scope for the development of reliable psychometric tests to screen for forklift truck driver 'suitability' should be explored.

#### 2.3.1.2 Driver training

In a recent HSE study of workplace transport accidents, 21% (n=577) of those investigated identified driver training as being a significant causal factor (Smith, 2001). Other research reviewed also points to insufficient training as being central to the causality of workplace transport accidents. For example, O'Mara (1989) performed an analysis of over 263 workers' compensation claim forms and found that unsafe driving practices, due to a lack of training, significantly contributed to forklift truck accidents. Closely associated to the provision of training in the causality of workplace transport accidents is the issue of driver experience. Collins *et al* (1999) conducted an analysis of 916 forklift truck incidents and found that 40% of all incidents occurred during their first month following qualification. These researchers gathered self-report data from the drivers and found that a number were critical of the training provision because it had not prepared them for the demanding driving conditions present in busy production areas, i.e. large volume of vehicle traffic, limited space for manoeuvring, presence of pedestrians etc. Collins *et al* (1999) recommend that a designated area be sectioned off for newly trained operators to become thoroughly familiar with their vehicles (under close supervision) before working in production areas. A further point this research illustrates is the need for driver training to be as realistic to the conditions and demands of the actual job as possible. This finding is consistent with HSE's recommendation that lift truck operator training always include the following 3 stages:

- Basic – covering the skills and knowledge needed for safe operation of the lift truck and handling attachments;
- Specific job training – use of the truck in conditions that the operator will meet at work;
- Familiarisation training – carried out on the job and under close supervision.

Cohen and Jensen (1994) carried out a study to measure the effectiveness of lift truck safety programmes and concluded that the most effective safety training courses include the following elements:

- Positive approaches that stress the learning of safe behaviours – not the avoidance of unsafe acts (i.e. training that highlights the potential hazards and emphasises the rationale underlying the training procedures);
- Suitable conditions for practice that reflect local working conditions;
- A means for evaluating training effectiveness, including feedback.

Finally, training should not in itself be assumed to be sufficient to ensure the competence of individuals: this will tend to develop with experience and should be monitored. Continued supervision will be necessary to ensure high standards of operation are maintained. Supervision and monitoring will be discussed in section 2.3.4 of this report. Further information regarding the training of lift truck drivers can be found in the HSE's Approved Code of Practice and Guidance (ACoP) on Rider-operated lift trucks: Operator training (*L117*).

#### 2.3.1.3 Refresher Training

Refresher training is acknowledged to be an important mechanism for maintaining and enhancing competence levels and also as a necessary check and balance against the development of informal procedures. There is a danger that forklift drivers can become complacent towards the hazards presented by the workplace if they are operating in the same environment every day, on the same vehicle and with the same people around them. Therefore, it is important that refresher training is given, or at the very least, that driving standards are re-assessed from time to time to establish whether refresher training is required. Other circumstances exist when refresher training might be appropriate, for example, following an incident, or if the operator has not driven for a long time or if there is a significant change to the site layout etc. However, despite its potential importance, there is no legal requirement to provide refresher training at set intervals.

#### *2.3.1.4 Pedestrian Training*

Research indicates that pedestrians are over represented in studies of workplace transport accidents and therefore represent a high-risk group in the workplace. For example, in the HSL study, approximately 70% (n=246) involved injuries to employees who interacted frequently or worked in close proximity to lift trucks e.g. warehouse operatives, freight handlers and pedestrians. Similarly, Collins *et al* (1999) examined 916 incidents involving forklifts and other powered industrial vehicles over a 3-year period and found that most incidents involved pedestrians being struck by a forklift truck. In addition, Stout-Wiegand (1987) analysed over 38,000 forklift truck injuries and found that only 12% of compensable forklift truck injuries occurred to forklift truck drivers whilst many more involved pedestrians. Larsson and Rechnitzer (1994) examined over 300 occupational injuries and fatalities associated with forklift trucks in Australia. Nearly half the injuries analysed were the result of interactions between vehicles and pedestrians. It is suggested that in most cases pedestrians lack a fundamental awareness of the unique operating characteristics of lift trucks, namely their stability, visibility and movement. For example, Swartz (2000), refers to a number of incidents that have involved pedestrians becoming pinned between the counterbalance on a forklift truck and a fixed object because they were unaware of the quick and unexpected nature of the truck's rear-end swing. The risk of pedestrian involvement in workplace transport accidents is further heightened by the widely held belief that driving a forklift is just like driving a car. For example, many fail to appreciate that a forklift is far heavier than a car and than unlike a car, it has small wheels, only two of which are for braking. Therefore stopping quickly or manoeuvring suddenly (to avoid pedestrians) can require different judgements. Furthermore, detection of the presence of a pedestrian is made harder when a forklift is carrying a load because the field of vision may be significantly restricted, especially if cargo is being carried. Therefore, in recognition that pedestrians represent a vulnerable group, training programmes have been developed which focus on the unique operating characteristics of workplace transport vehicles. Literature indicates that this approach has been successful in reducing the number of struck by vehicle injuries sustained by pedestrians, e.g. Collins et al (1999); Augusten (1996).

### 2.3.2 Procedures and safe systems of work

Procedures and safe systems of work provide important controls for ensuring high standards of safety performance. However, procedures are not always followed. For example, in the HSE study of workplace transport accidents, 25% (n=577) involved workers not following established procedures and safe systems of work (Smith, 2001). Sometimes employees might deliberately contravene established and known rules or procedures, in other words, commit violations. In human factors terms, violations are a separate form of human failure, distinct from slip and lapse errors. With violations, individuals are fully aware of what they should do but, for some reason, consciously decide not to follow approved working practices. According to guidance produced by the Human Factors and Reliability Group (HSE, 2000), retraining staff in the correct practices cannot be the answer, as they already know what they should do. Such violations should be addressed by ensuring that personnel do not perceive the benefits of non-compliance to be greater than any adverse consequences. Research indicates that this can be achieved in a number of ways; for example, by making sure that procedures are consistent with the following principles:

- Conflict - that they do not conflict with other requirements. If they are too constraining in terms of being overly restrictive or too severe, then they will be ignored;
- User-friendly – do the procedures represent the best way of doing things? Are they checked by staff to ensure that they are practical, easy to follow and fully understood?
- Explain – where possible, do the procedures explain the purpose of any controls and checks? The risk of non-compliance will be reduced if staff can understand the underlying rationale behind the existence of the procedures in the first place.
- Presentation – are the procedures clearly formatted and do they use appropriate language, i.e. avoid jargon and ambiguous phrases? Do pedestrian route maps use the same symbols as the route maps given to delivery drivers? Are they presented in a convenient orientation, i.e. can the information be readily assimilated (especially important to drivers that are new to the site, e.g. delivery drivers)? Also, safe-operating procedures should avoid excessive cross-referencing, as compliance is likely to be compromised if procedures require the user to keep referring back to other documents etc. The use of checklists and job aids can further enhance compliance.

In summary, violations are less likely to occur if procedures are practical, well presented and understood. (HSE, 1995). Therefore, as with vehicle selection, it is important that drivers (and pedestrians) be involved with and consulted on workplace transport procedures. If employees are involved in the development of workplace transport procedures then they are more likely to understand the consequences of non-compliance. Research indicates that employee involvement of this kind represents another way of increasing the amount of "buy in" to risk management or in other words, increase the level of cultural dividend (Booth, 2002; Reason, 2001, HSE, 1995).

### 2.3.3 Workload

Workload demand may also have an impact on the level of compliance with safety procedures. For example, there might be time and/or production pressures on drivers to meet targets that are unrealistic and which can only be achieved if the operator commits unsafe acts, e.g. speeding or driving through pedestrian-only zones to save time etc. Incentive and reward schemes can have the same effect if they are not properly managed and work design should be arranged carefully so as not to create perverse motivations to drive unsafely, e.g. job and finish arrangements, piece work etc. Research indicates that even with re-training, it is human nature to revert to the most economical means of achieving a goal when placed under pressure (Reason, 1997). Therefore, where possible, workload should be managed to avoid 'hotspots' and 'pinch-points' by providing additional staff or re-scheduling work patterns to spread the load during these periods (e.g. holiday periods or at the financial year end).

### 2.3.4 Supervision and monitoring

Supervision has an important role to play in correcting poor working practices and encouraging good ones. In terms of workplace transport, this includes ensuring that inexperienced operators do not attempt to replicate the skills (and perhaps poor work habits) exhibited by more experienced operators (Warburton, 1986). Research establishing the importance of providing close supervision to newly qualified drivers has already been discussed in section 2.3.1 as to have the merits of monitoring experienced drivers to ensure that they continue to operate vehicles in a safe fashion. However, the skills and abilities required by supervisors are often underestimated by organisations and quite often they are not provided with the necessary support and training. According to guidance produced by the Human Factors in Reliability Group (HSE, 2000) particular problems can occur when supervisors are promoted from within a team that still sees them as a team player rather than a team leader. Other problems may arise, especially in cost-conscious environments, where there are strong pressures on supervisors to improve productivity. In such circumstances there is a risk that supervisors may focus on meeting production targets and turn a blind eye to maintaining safety standards. Where this occurs over a long period of time staff and supervisors may come to regard these lower standards as acceptable. Therefore, supervisors should be aware that their behaviour might be interpreted by their staff as demonstrating a low commitment to safety and/or quality. For example, if a supervisor does not correct poor working practices staff may interpret this as tacit approval of those practices (e.g. not wearing seat restraints when driving the forklift truck etc.). Therefore, supervisors need support and training in line-management skills so that they can encourage high standards and support good teamwork. Managers also need to ensure that supervisors have sufficient training and experience in the desired working practices to enable them to identify poor working methods. To assist with this, HSL have developed a series of workplace transport performance measures that can be used by supervisors (and others) to actively monitor driver behaviour. Details of the approach will be discussed in section 3 and 4 of the report.

### 2.3.5 Shift work and fatigue

Shift work often requires staff to work outside of 'normal' working hours. This can influence sleep patterns and worker safety performance. Shift work is particularly prevalent in industries that make extensive use of workplace transport, e.g. 24-hour distribution centres, 'just-in-time' manufacturing sector etc. It is generally accepted that working excessive hours and/or poorly planned shift systems can have adverse health affects, including fatigue. This can lead to impaired performance at work and so to an increased likelihood of accidents (Waterhouse *et al*, 1990; Monk and Folkard, 1992; White and Beswick, 2003). Therefore, it is important that the shift schedules take account of relevant human factors guidance. The remainder of this section will outline a number of human performance factors that are relevant to workplace transport safety in general and driver performance in particular:

#### *2.3.5.1 Time-on-shift effects*

Research indicates that performance tends to deteriorate significantly with excessive hours, particularly if more than 12 hours are worked. In addition, marked decreases in alertness and performance can also be experienced in the last 3 to 4 hours of a 12-hour shift, particularly if the task is monotonous or very repetitive (Waterhouse *et al*, 1990). Key to managing time-on-shift effects is the provision of adequate rest breaks. At present, there are no specific regulations that limit the number of hours a driver of a forklift truck can work. Although the European Directive on Working Time (which came into force in the UK through the Working Time Regulations, 1998), limits working hours to no more than 48 hours a week[7], there is an opt-out clause whereby workers can agree to work longer than 48 hours a week by signing a written agreement. This is at variance with regulations[8] governing drivers of commercial goods vehicles (HGV, LGV, PSV, PCV) which limits any period of continuous driving to 4½ hours after which the driver must take a break of 45 minutes (or 2 or 3 breaks of no less than 15 minutes during or after the driving period so that the total break adds up to at least 45 minutes in the 4½ hours of driving). In addition, during any break a driver must not drive or undertake other work (although this does allow drivers to take breaks within the vehicle, which is not necessarily to be recommended). Furthermore, the daily limit on driving time is restricted to 9 hours - which can be increased to 10 hours twice a week. In summary, drivers of forklift trucks and other powered industrial vehicles are not limited in either the total number of hours they can work or the length

[7] Averaged over a 17-week period, a minimum daily rest period of 11 consecutive hours, and a minimum weekly rest period of 1 day averaged over 14 days.
[8] Regulations laid down by the Department of the Environment Transport and the Regions (DETR).

of continuous driving they can complete before having to take a rest break. Although it has not been possible to determine whether time-on-shift plays a significant part in the causation of workplace transport accidents in the HSL study (Dickety, 2001), research exists to suggest that working long hours will impact negatively on driver safety performance.

#### 2.3.5.2 Time-of-day effects

Time of day effects are difficult to quantify, but research indicates that job performance may be poorer for shift working, particularly on night shifts where work may also take longer to complete. In general, the time of highest risk for fatigue related accidents is between 2.00 and 5.00 am (HSE, 1999). Therefore, in terms of managing workplace transport risk, it might be worth considering minimising workload during these periods or perhaps increasing the number and duration of rest breaks. In addition, thought should be given to the availability of refreshments for shift workers (particularly hot drinks during winter months) and where possible, drivers should be encouraged to take rest breaks away from their vehicle.

#### 2.3.5.3 Shift patterns

Guidance produced by the Human Factors in Reliability Group (HSE, 2000) suggests that forward rotation of shift patterns is currently considered less detrimental to performance than reverse rotation. Research indicates that true adjustments to shift patterns rarely occur and that changing shift patterns about once a week is likely to cause more difficulties than a faster or slower changing pattern (Monk and Folkard, 1992) and using appropriate lighting levels can help adjustment from day to night shifts, i.e. night time work areas should be well lit [9]. Fixed shift patterns are thought to cause least decrement in performance but maybe socially less acceptable to some. The social factors that affect the acceptability of shift working should not be underestimated. Most shift workers choose to become shift workers and so can be considered to accept the social impact. However, it must be recognised that personal circumstances can change, but the financial inducements of shift work can inhibit the required move from shift work.

#### 2.3.5.4 Shift handovers

It has long been recognised in the high hazard sector that failures of communication at shift handovers are a common contributory factor in the causation of major accidents, e.g. Piper-Alpha. Whilst most research literature concerning effective shift handovers concentrates on high consequence-low probability events, many features of good practice will be applicable to workplace transport operations that have shift work arrangements. For example, HSG 48 *(Reducing error and influencing behaviour*) suggests that in order to minimise the potential for problems, shift handovers should receive a high priority with the necessary resources provided (e.g. sufficient time). For example, those beginning a shift need to know from those going off of shift about anything that may affect the operating performance of workplace transport equipment (e.g. trailer restraints damaged, faulty dock leveller etc). Whilst this can be achieved through the use of log books and checklists etc, research indicates that such information is best passed using more than one form of communication, e.g. face-to-face **and** log sheets, checklists etc. Often however, the arrangements for ensuring face-to-face handover of information between shifts are not formalised and therefore, can break down. For example, O'Hara *et al* (2000) in a study of risk assessment good practice in 24 firms found instances where face-to-face handovers didn't occur because the shift supervisors "didn't get paid for the additional 15

[9] See HSG 38 *Lighting at Work.*

minutes handover time”. Therefore, it is important that handovers receive a high priority, and are seen as a two-way process, with shared responsibility.

# 3 MANAGING WORKPLACE TRANSPORT ISSUES

Section 2 of the report highlighted a number of factors known to be associated with the causation of workplace transport accidents. These factors were based on the review of literature, analysis of accidents and case study findings and were discussed in terms of safe site, safe vehicle and safe driver. In order to achieve high standards of workplace transport safety, these three factors need to be properly controlled. This section of the report proposes an approach to managing workplace transport through the development of an effective safety management system.

## 3.1 SAFETY MANAGEMENT OF WORKPLACE TRANSPORT ACTIVITY

Section 2 of the report identified a number of workplace transport accident causation factors, which were subsumed under the headings of safe site, safe vehicle and safe driver. Section 2 of the report also illustrated that workplace transport accidents frequently involve numerous contributory elements. Some of the causes were 'active' and had an immediate effect (e.g. jumping off a moving forklift, speeding etc.), whilst others were 'latent', (e.g. vehicle design, lack of supervision, insufficient training etc). According to Reason (1997) such latent conditions are usually failures of control. An effective safety management system is recognised as being the best way of establishing and maintaining control over the operational hazards (active and latent conditions) presented by workplace transport activity. The suggested elements of safety management system are illustrated in Figure 6.0:

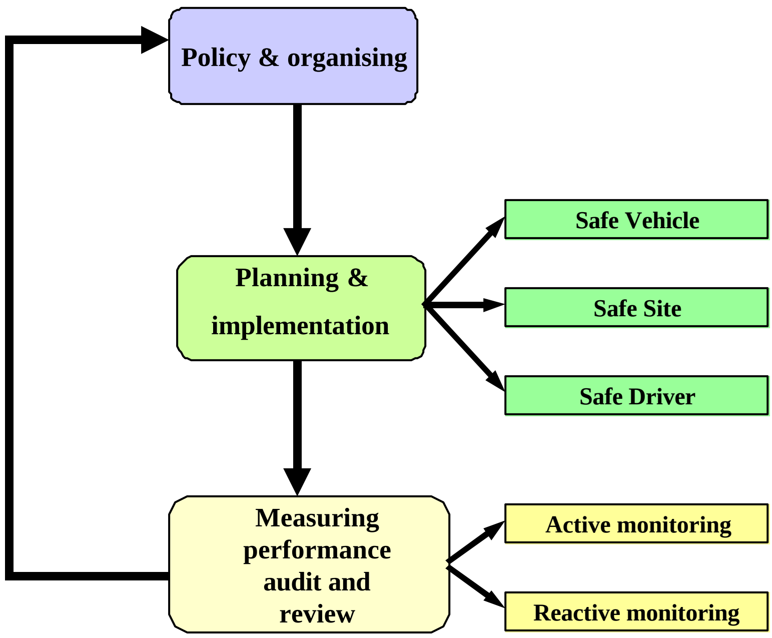



Figure 6.0: Elements of health and safety management

The diagram, outlined in Figure 6.0 (Elements of safety management system) is based on the HSG 65 (*Successful health and safety management)* and the British Standard on occupational health and safety management systems, (*Guide to occupational health and safety management*

BS8800: 1996). These elements are consistent with those suggested for commercial management systems (Total Quality Management etc). The remainder of this section will draw upon best practice guidance and research literature to describe how each element of the safety management system set out in Figure 6.0 can contribute to the control of workplace transport activity.

## 3.2 POLICY AND ORGANISING

In addition to being a legal requirement, a health and safety policy should set the tone and direction for the rest of the management system. According to HSG 65, it should promote the attitude that health and safety is being treated as seriously as other corporate aims and as such, is being resourced accordingly. Policies should be endorsed at the highest level with identification of the Chief Executive Officer or key senior manager with overall responsibility for policy formulation and development.
Research indicates that strong safety policies include a commitment to the principle that legal requirements define the minimum level of achievement and that pursuing progressive improvements is the overall objective of the safety management system (Dickety *et al*, 2002).

Providing it is consistent with an organisation's corporate objectives, companies may wish to have a separate workplace transport safety policy. A separate policy can address specific issues such the use of mobile phones whilst driving site vehicles or arrangements for drug/alcohol testing etc. However, for any workplace transport policy to be effective, it is necessary that staff feel they have ownership of the policy and share the views of the organisation. Problems can arise if workers are unaware of the workplace transport policy or do not accept it because they feel they have no ownership of it. Therefore, all staff should be made aware of how they may contribute to achieving the organisation's workplace transport safety objectives within the policy, e.g. encouraged to attend safety meetings etc. The organisation also needs to provide a framework for managing the objectives of the safety policy. In terms of workplace transport, this should include the following:

### 3.2.1 Roles, responsibilities and accountabilities

Roles should be allocated to staff at appropriate levels in the organisation, e.g. setting policy at the highest level whilst implementing and maintaining particular control measures might be expected to rest at a lower level. Employees, contractors and delivery drivers need to know who is responsible for each aspect of workplace transport management. Successful implementation of the workplace transport policy requires co-operation between different parts of the organisation, e.g. production and storage. Problems can arise if responsibilities are unclear or not well understood or if no one has been given the role of co-ordinating transport activities within a given area. Problems can also occur when this 'co-ordinator' lacks the authority to ensure compliance with the policy, especially in the face of conflicting demands.

Employers should check that there are no significant gaps in lines of responsibility and that all areas of workplace transport activity are covered. Employee understanding should also be tested and key accountabilities written into relevant job descriptions. Where driving activities are sub-contracted, a senior manager from the parent organisation should be given the responsibility for ensuring that work is undertaken efficiently and safely. Adherence to the parent company's workplace transport safety policy should appear as a condition for doing business with contractors and/or delivery drivers. This may require senior management to send a copy of the workplace transport policy to the Managing Director of every contractor/delivery company they deal with asking for an 'action plan' to be produced stating how their staff (drivers) will comply with the policy. Demonstration of senior management commitment to health and safety initiatives has been identified as being one of cornerstones of a positive safety culture. The concept of safety culture and safety climate enhancement is discussed in more detail in section 3.8.

### 3.2.2 Formal communications

Formal communications refer to the way in which an organisation obtains and disseminates information. When accidents are analysed, poor communication is often identified as a contributory cause. According to HSG 48, reliable communication is best achieved by providing a range of communication methods, for example, team briefings, notices, tool box talks, permits to work, logs, check lists etc. The key aspect is recognising the objectives of the information sender (e.g. to select who, what, when and how best to communicate) and the needs of the information receiver (suitable format, readily assimilated etc.). In terms of workplace transport, information relating to safety policy, responsibilities, training and safe working practices will have to be communicated. Canteens, smoking rooms or other areas where drivers (and pedestrians) regularly take breaks have traditionally been the favoured location to post or present safety related information. Thought should be given however, to alternative methods of presenting information, for example, a particular safety message might lend itself to being bullet pointed on a postcard and sent to every employee's home or perhaps could be inserted into weekly pay packets. Research indicates that novel approaches to the communication of safety related information is an effective way of reaching the target audience (O'Hara *et al*, 2000; Dickety *et al*, 2002).

Formal communication systems should allow for information to pass upward as well as cascading down the organisation. In some organisations confidential reporting systems have been established which allow employees to report safety concerns and worries with total anonymity. However, there is some debate between safety practitioners regarding the utility of confidential reporting systems with a number claiming that it is better if a culture of openness and trust can be encouraged rather than one of secrecy and blame (Reason, 1997, HSE 2002). However, both approaches are dependent on commitment from the highest levels of the organisation.

### 3.2.3 Co-operation

In addition to being a legal obligation, participation by employees in safety matters supports the risk control effort. According to HSG 65 employees should be actively encouraged to buy into risk management, the philosophy being that health and safety is everyone's business. There are a number of ways by which the skills and experience of staff at all levels of an organisation can be harnessed, e.g. through safety representatives, quality circles, suggestion schemes, behaviour based interventions and safety committees etc. Guidance indicates that an effective safety committee will include the following elements (Kraus, 1998):

- Meet regularly and be representative of all areas of activity;
- Chaired or attended by CEO or key senior manager;
- Include members with safety related expertise and knowledge;
- Used as a forum to discuss incidents (actual and potential), technical/legal developments that may impact on safety and lessons learnt from other organisations;
- Health and safety actions are assigned to individuals (or groups) and tracked and given a time frame for completion;
- Significant findings are fed back to the workforce using an appropriate medium.

In order to make the safety committee process more manageable, some organisations find it beneficial to establish a separate workplace transport safety committee (or working group. If a separate workplace transport committee (or working group) is to be formed then it is important that it has the necessary authority to make decisions and take action. Some organisations achieve this by appointing a senior manager to 'champion' the cause, i.e. chair the committee and promote the activity of workplace transport working group etc. Sometimes senior managers will take it in turns to champion a particular cause, such as workplace transport, over a specified interval of time (e.g. every 3 months). However, it should be recognised that with this system it is difficult to achieve true ownership of the process and that problems may arise if corrective actions are not tracked through to completion before the handover from one champion to another.

### 3.2.4 Organisational Learning

According to HSG 65, organisational learning is essential if a company is to successfully avoid repeating past failures and is to keep ahead of the competition. It also helps to demonstrate that the organisation has a commitment to continuous safety improvement. Central to the concept of organisational learning is the willingness to learn from workplace transport events (successes and failures) including those involving similar organisations and external contractors. This can be achieved by analysing all instances of good and poor workplace transport safety performance so that the underlying causes are properly understood, e.g. learning about forklift truck accidents at another site etc. Often this analysis will form the basis of safety committee discussions although some organisations prefer to use self-improvement teams (e.g. quality circles) or staff suggestion schemes to encourage staff to identify and implement improvements. Regardless of the method, many commentators believe that the key to organisational learning is staff involvement. Suggestions for improvements are more likely to be practicable if based on worker knowledge and more likely to be implemented if based on staff experience. Furthermore, research indicates that learning from 'near-miss' incidents and case studies of accidents can be a valuable way of increasing awareness of risk and improving safe behaviour (Lagerlof 1982). Finally, it is important to note that organisational learning should not focus on apportioning blame – a *culture of blame* will result in the identification of few, if any, learning opportunities (Rassmussen, 1980)

## 3.3 PLANNING & IMPLEMENTATION:

Section 3.1.1 outlined a framework for managing the objectives of a workplace transport safety policy. However, HSG 65 recognises that health and safety policy is only as good as its implementation and that no policy will be implemented unless people believe in it and take it seriously. Planning and implementation is the key activity of putting policy into effect in order to control workplace transport activity. This means managing the issues outlined in section 2 of the report which were considered in terms of safe site, safe vehicle and safe driver.

## 3.4 MEASURING PERFORMANCE AUDIT AND REVIEW

In order to identify strengths, weaknesses and areas for improvement, the safety management system must collect information and data relating to how well it is controlling workplace transport hazards. In other words, some measure of workplace transport safety performance is needed. Typically, this is achieved through active and reactive monitoring activities.

### 3.4.1 Active monitoring

Active monitoring, as the name suggests, refers to the assessment of safety performance through active processes using 'upstream' measures such as workplace inspections and risk assessments, i.e. those factors likely to cause failures. Data capture techniques for active monitoring can include:

- Site inspections;
- Safety behaviour monitoring;
- Safety tours by managers and safety representatives;
- Examination of health and safety documentation.

It should be noted that many organisations struggle with the process of active monitoring and often have weak arrangements in place for the capture of upstream performance indicators. This issue is dealt with in more detail in Section 4 of this report.

### 3.4.2 Reactive monitoring

Reactive monitoring systems use 'downstream' measures such as accidents rates and ill health to measure performance. Reactive monitoring focuses on manifest failures and their consequences provides opportunities for an organisation to learn from mistakes. Data capture techniques for reactive monitoring include:

- Accidents causing injury or property damage;
- Occupational ill-health and employee absence;
- Near-miss incidents and unsafe conditions (incidents with the potential to cause injury);
- Other incidents causing loss to the organisation.

### 3.4.3 Review

Performance review is the final step in the safety management control cycle and as such, is often overlooked. In terms of workplace transport safety management, the overall performance needs to be periodically reviewed to ensure that it is meeting the requirements of the organisation and to identify opportunities for improvement. Performance review is important because it facilitates organisational learning. It should not be confused with routine monitoring, which covers day-to-day matters. Various approaches exist for undertaking performance reviews including safety culture surveys, formal safety management audits and benchmarking exercises. HSG 65, states that it is important that there is a robust system in place for acting on the results of any reviews. Therefore, it is important that staff responsibilities and appropriate timescales are allocated for delivering any corrective or improvement actions, along with a mechanism for tracking the actions. HSE guidance warns that failure to implement necessary actions could lower staff morale (HSE, 2000).

## 3.5 SAFETY CULTURE

It is well established that safety management systems cannot operate effectively unless people believe in them and take them seriously (HSE, 1997). This means establishing a culture where health and safety is second nature rather than second thought. Although limited agreement exists between experts over the exact definition of the term 'safety culture', it is generally accepted that it describes the ideas and beliefs that members of the organisation share about hazards, risk, accidents and ill health. More specifically, safety culture refers to "the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's health and safety management" (HSC's Advisory Committee on the Safety of Nuclear Installations, 1993).

In simple terms, it refers to 'the ways things are done in a particular workplace' (CBI, 1990). Despite there being conceptual differences, research suggests that the following elements are positively associated with having strong safety culture (Pidgeon, 1998; Clarke, 1998; Glendon & McKenna, 1995):

- **Genuine and visible commitment to health and safety from the top:** senior management should demonstrate a high commitment to health and safety in a number of ways including conducting site safety inspections, attending safety committee meetings, involvement with incident investigations and delivering health and safety training etc. Management commitment can also be communicated through a willingness and demonstrable competence to manage production pressures (including working long hours) so that staff are not put under pressure to rush to complete driving duties.
- **Ownership of health and safety:** a positive safety culture depends critically on the willing participation of the workforce; the people in direct contact with the hazards. Part of that willing participation includes the lengths to which workers are prepared to go to report accidents and near misses. In most organisations this willingness is governed by how blame and punishment is dealt with. Positive safety cultures will strive to foster an atmosphere of trust where people are encouraged to provide essential safety-related information but where it is clear about where the line must be drawn between acceptable and unacceptable behaviour. Ownership of health and safety can be further enhanced by involving employees in a range of safety-related decision making processes such as vehicle selection or personal protective equipment choice. Ryan (1991) suggests that the establishment of effective channels of communication can lead to the formation of commonly understood goals. Crucial to effective communication however, is the provision of feedback. Feedback is important because it shows respect for those who took the trouble to give their views and it also represents a 'person-centred' approach (Macmillan et al, 1992).
- **Organisational learning:** the ability to learn from experience in order to avoid repeating past failures was already identified as being key to safety management, especially in terms of encouraging worker involvement in the risk control process. However, organisational learning also has a broader role to play in safety culture development. For example, by showing 'learned behaviour' in relation to past accidents and near misses, an organisation is really showing a competence to draw the right conclusions from its safety information system and the maturity to take the necessary action in order to prevent the problem from recurring. Organisational learning is also critical to business survival. As Senge (1990) points out, " learning disabilities are tragic in children, but they are fatal in organisations. Because of them, few corporations live even half as long as the person – most die before they reach the age of forty.
- **Sustained commitment:** many organisations that exhibit positive safety cultures view this as a process of continual improvement that requires sustained effort and interest. Reason (1997) likens the development of a positive safety culture to a long-term fitness campaign, where the results of effort cannot always be seen in the short-run and therefore this process requires will power and determination to see it through.

In summary, this section of the report has outlined an approach to managing workplace transport risk. The constituent elements of a safety management system have been described in terms of **p**olicy and **o**rganising, **p**lanning and implementation and **m**easuring performance, **a**udit and **r**eview (POPMAR). Within the policy and organising function the importance of allocating roles, responsibilities and accountabilities at appropriate levels has been recognised. In addition, the process of establishing formal lines of communication, gaining the co-operation of employees and exhibiting organisational learning behaviour have been identified as being key to managing workplace transport safety policy objectives.

This section of the report also highlighted the planning and implementation function of the safety management system, i.e. the process of putting policy into effect in order to control the risk posed by driver, site and vehicle. Finally, the importance of collecting performance data was noted (especially active monitoring) along with a discussion of the organisational features known to be positively associated with safety culture.

The next section of the report picks up on the theme of performance review and the problems associated with active and reactive monitoring. A method for improving active monitoring is proposed which specifies using unsafe acts (behaviours) and unsafe situations as the unit of performance measurement. A worked example of how to identify key behaviours is provided along with suggestions on how to score, collate, manage and act upon the results.

# 4 DEVELOPING WORKPLACE TRANSPORT PERFORMANCE MEASURES

## 4.1 MEASUREMENT

In Section 3 of this report, the importance of collecting safety management performance data was highlighted in terms of identifying strengths, weaknesses and areas for improvement. Specifically, the need for active monitoring was described and the value of identifying suitable upstream factors to measure safety performance was noted. Typically however, companies tend to focus their attention on reactive monitoring activities and use accident rates (down stream factors) as the primary outcome measure of safety performance (e.g. lost time and reportable accidents etc). Because of the way they are calculated, companies also typically use incidents as a benchmark to compare the effectiveness of their safety management systems against others in the same or other industries. According to Marsh *et al* (1998), this narrow focus on accident rates tends to result in 'management by exception' whereby management attention and resources are directed at safety only when accident rates rise dramatically. When the immediate problems appear to be resolved, management attention and resources tend to revert to other pressing organisational issues until such time as the accident rate rises again. Consequently, rather than being proactive, companies which focus almost exclusively on accident rates as a measure of safety performance tend to be reactive in their approach to safety.

Other problems exist with using reactive measures such as accident and incidents as the unit of performance measurement. For example, accidents tend to be relatively infrequent and can be very difficult to investigate objectively after the event (there are also the numerous controversies regarding the accuracy of figures). Heinrich (1959) showed that for every serious accident, resulting in a fatality or major disabling injury, there are approximately 300 unsafe incidents (see figure 4.1)

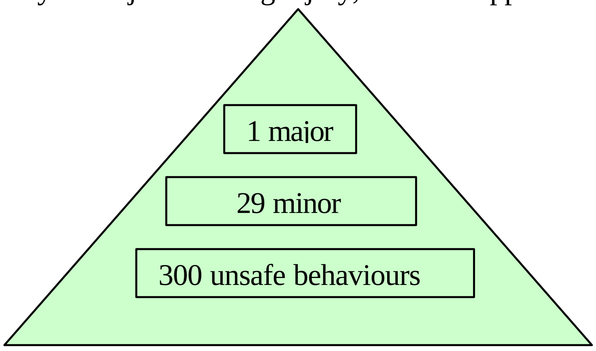



Figure 4.1 Heinrich's Triangle – *adapted from Heinrich H.W. (1959) Industrial Accident Prevention*

What Heinrich (1959) and others have shown is that unsafe behaviours are a major cause of workplace accidents. In fact, between 85-90% of all safety incidents are said by some to be due to these behaviours. Marsh *et al* (1998) suggest that because unsafe behaviours can be measured in a meaningful way (and on a daily basis), they represent a much better index of ongoing safety performance than accident rates. Furthermore, providing it is accurately collected, data relating to unsafe behaviours can be used to compete with management attention along with other Key Performance Indicators. The remainder of this section will describe how the approach of measuring unsafe behaviours and unsafe situations was applied to the case study company in order to produce a measure of workplace transport safety performance. For this phase of the project, HSL collaborated with a leading behavioural-based safety consultancy, (Ryder-Marsh

(Safety) Ltd[10]). Ryder-Marsh has considerable experience in the field of performance measure development and was involved in the original research into behavioural safety in the UK in the early 1990s, funded by the Health and Safety Executive (Cooper *et al* 1991).
The methodology for creating the measure is described so that others can, if they so wish, develop similar measures for scoring workplace transport safety performance.

## 4.2 IDENTIFICATION OF UNSAFE BEHAVIOURS AND UNSAFE SITUATIONS

The first step is to identify a set of items (unsafe behaviours and unsafe situations), which can be recorded. In the example of the case study company, this was achieved by obtaining copies of workplace transport related incident and accident reports, risk assessments, safe operating procedures and shop floor visits to observe workplace conditions. As well as written information, interviews were held with safety managers and a cross section of employees to identify any other unsafe acts not uncovered by the above that have, or might, lead to accidents or unsafe situations. In addition, findings from stage one of the project, i.e. identification of workplace transport accident causation factors (review of literature and analysis of 246 workplace transport accidents, Dickety, 2001) was used to inform and scope the items to be included in the measure. The decision was taken to focus attention on forklift truck activity (ignoring bulker delivery and collection movements for the time being). As the case study firm is a manufacturer of frozen food, most of the observations related to the cold storage and loading bay areas of the site.

## 4.3 CONSTRUCTING SAFETY PERFORMANCE INVENTORIES

Once the nature and range of the unsafe behaviours and situations had been established (and verified by a cross-section of staff), a draft safety performance inventory was constructed. The draft measure for the case study company consisted of four dimensions and represented 31 key behaviours and 14 unsafe situations, as follows (see also appendix A):

1) Forklift truck driver behaviour:
2) Pedestrian activity;
3) Housekeeping (unsafe situations)
4) Forklift truck operations – stacking/de-stacking

It was important that the items within the measure covered a comprehensive range of unsafe behaviours or unsafe situations that might lead to an accident. However, it was not possible to include each and every unsafe behaviour identified, therefore, inclusion of the item was determined on the basis of frequency (of occurrence) against potential consequence (of behaviour). According to Rockwell (1959), items should only be included if they are:

- Specific (avoid using words such as ‘correctly’ or ‘safely’);
- Measurable; (items that reflect a number of behaviours within any one item can be confusing);
- Observable; (the behaviour or situation should occur with some degree of regularity)
- Within the control of the operatives performing the task (at least largely);
- Worded as positively as possible (e.g. look for forklift truck operatives wearing seat restraints rather than *not* wearing seat restraints).

[10] Ryder-Marsh (Safety) Ltd, 62 Beech Road, Chorlton, Manchester. M21 9EG

Of course some items cannot be adequately described by words alone (e.g."*harshly* using the hydraulics on the forklift truck" or "pallets stacked *untidily*"). For such instances, an illustrative photograph should be taken or better still (in the case of the hydraulics misuse) some video footage with accompanying sound. Marsh (2003), suggests that illustrations work best if they represent 'borderline' situations rather than 'good' or 'bad' examples.

## 4.4 RECORDING OBSERVATION SCORES

According to Marsh (2003) observations relating to frequency of unsafe acts and unsafe situations should be taken when the site is busy, even though this is usually when it is hardest to do so. In the example of the case study firm, behavioural safety experts recorded observation scores over a 2-day period (at each of the 3 sites). Therefore, observations were made during busy periods and across different shifts. However, it is generally, agreed that the most accurate data is collected by shop-floor employees as their colleagues are more likely to act naturally. It is also important that observers have first-hand knowledge and experience of workplace transport safety issues and for this reason, safety committee members or safety representatives are often best placed to undertake such a role. In addition, to encourage natural behaviour, it is important to have a 'no name – no blame policy' so that observed behaviour is not attributed to any one individual. Also, as a consequence, any items that obviously relate specifically to only one or two readily identifiable individuals should be dropped from the safety performance inventory.

### 4.4.1 Recording 'safes' and 'unsafes'

The safety performance inventory was constructed so that observations could be scored as either 'safe' or 'unsafe' (see appendix A). The sum of each of the 'safe' and 'unsafe' columns was used to calculate the average percentage safe score for each of the four categories. In the case study company, the observations of 'active items' (i.e. forklift truck stacking operations/ travelling with load; pedestrian activity and forklift truck driver behaviour) were based upon the 1-minute rule or the completion of an activity or until the vehicle (or pedestrian) was out of sight. To aid the reliable scoring of active items, if the individual transgressed any of the behavioural standards then they were awarded one mark unsafe. If they carried out the activity or operated the forklift for 1-minute without transgressing any of the standards then they were awarded one mark safe. Scoring of the unsafe situations[11] (housekeeping items) was carried out by location. This was achieved by mapping the site into a number of logical 'zones' according to work activity and geographical recognition (see appendix 'B' for example of the map). If the item was found to be unsafe in a particular zone then the observers recorded one mark unsafe against that item. If the item was found to be safe in a particular zone then the observer recorded one mark safe against the item. The observers only recorded one mark per zone regardless of how many reasons there were for failing the zone.

### 4.4.2 Calculating a Percentage Safe Score

To calculate the average percentage safe score, both 'safe' and 'unsafe' columns are summed, i.e. total observations. The sum of the 'safe' column is then divided by the total number of 'safes' and 'unsafes'. The result of this is multiplied by 100 to produce a percentage 'safe' score:

[11] Accidents are caused directly by unsafe behaviour, or indirectly by creating unsafe situations. Unsafe situations tend to be present for a longer time than unsafe behaviours (which might or might not occur during observation). Therefore, it can be argued that using measures that include unsafe situations provides a more stable and representative index of site safety performance.

% SAFE = Total Safe/Total Safe + Total Unsafe x 100/1

### 4.4.2.1 *Method for Calculating a Percentage Safe Score for Forklift Truck Driver Behaviour*

In the example illustrated in Figure 7.0 (Forklift truck driver behaviour), the observer would watch the forklift truck for 1 minute (or the completion of the activity or until the vehicle is out of sight) and award one mark for every safe behaviour and one mark for every unsafe behaviour.

Figure 7.0: Forklift truck driver behaviour

In the above example, the driver would be awarded one mark safe for the following:

- Being correctly seated (with limbs inside the confines of the truck);
- Holding the steering wheel assistor correctly;
- Driving in the designated area;
- Looking in the direction of travel (1-secound glance rule)

This would give a total 4 'safe behaviours'. In terms of 'unsafe behaviours' following the same 1-minute observation (or the completion of the activity or until the vehicle was out of sight), the driver would be awarded one mark 'unsafe' for the following:

- travelling at excessive speed (faster than a person running, i.e. 6 mph);
- For not using horn coming around the (blind) corner;
- For not having a clear line of sight;
- For not wearing appropriate personal protective equipment (PPE), i.e. seat restraint.

This would give a total of 4 'unsafe behaviours'. The following behaviours (known to be associated with workplace transport accidents) were not observed during the observational period and were not factored into the % safe score:

- Mounting/dismounting vehicle properly, (i.e. truck not moving, handbrake applied, check to see if it is all clear).

- Operating the controls of the forklift from outside the truck.
- Accelerating and braking in a controlled manner (not causing load to shift on the forks) or making sudden changes in direction.

Therefore, to calculate a percentage safe score based on this (single) observation for forklift truck driver behaviour, it would be:

% SAFE = 4 Observed safes/4 Observed Safes + 4 Observed Unsafes x 100 = 4/8 = 0.5 x 100 = **50% SAFE.**

#### *4.4.2.2 Method for Calculating a Percentage Safe Score for Forklift Truck Stacking/De-stacking*

In the example illustrated in figure 8.0 (forklift truck stacking and de-stacking), the observer would again watch the forklift truck for 1 minute (or the completion of the activity or until the vehicle is out of sight) and award one mark for every 'safe behaviour' and one mark for very 'unsafe behaviour'.

Figure 8.0: Forklift truck during stacking/de-staking operations

In the above example, the driver would be awarded one mark safe for the following:

- Looking upwards, raising forks until even with pallet, inserting fork arms slowly until heel of forks touched the load;
- Fully inserting forks into load (and not making contact with other pallets and/or stacked goods);
- Tilting loads backwards in order to stabilise;
- Checking behind before reversing (and not dislodging adjacent loads);
- Making sure the load was evenly spread on the pallet;
- Travelling with load no more than 6" off the floor
- Lowering the mast before turning the vehicle;
- Wearing appropriate personal protective equipment;

- Using the hydraulics smoothly (without jerking the load);

This would give a total of 9-recorded 'safe behaviours'. There were no 'unsafe behaviours' recorded during the 1-minute observation period (or the completion of the activity or until the vehicle was out of sight). The following behaviour (included within the stacking/de-stacking inventory), was not observed:

- Travelling with load facing uphill on slopes and reversing down;

Therefore, to calculate a percentage safe score based on the above example would be:

% SAFE = 9 Observed Safes / 9 Observed Safes + 0 Observed Unsafes x 100 = 9/9 = 1 x 100 = **100% SAFE**

#### 4.4.2.3 Method for Calculating a Percentage Safe Score for Pedestrian Activity

In the example illustrated in Figure 9.0 (pedestrian activity), the observer would watch the pedestrians (standing in the background of Figure 9.0) for 1-minute (or the completion of an activity or until they were out of sight) and award one mark for every ‘safe behaviour’ and one mark for every ‘unsafe behaviour’

Figure 9.0: Pedestrian activity

In the above example, the pedestrians would be awarded one mark safe for the following behaviours:

- Paying attention to vehicle movement;
- Wearing appropriate PPE;
- Standing in pedestrian walkway;
- Not walking in vehicle route.

This would give a total of 4 ‘safe behaviours’. There were no ‘unsafe behaviours’ recorded during the 1-minute observation. The following behaviours (known to be associated with workplace transport accident risk) were not observed:

- Passing underneath raised loads;
- Running (and not walking)
- Crossing behind lift truck when it is being operated;
- Not looking where they are walking (1-second or 3-step rule);
- Distraction – pedestrians were not distracted, i.e. reading or using the phone;

Therefore, to calculate a percentage safe score based on the above example would be:

% SAFE = 4 Observed Safes/ 4 Observed Safes + 0 Observed Unsafes x 100 = 4/4 = 1 x 100 = **100% SAFE**

### 4.4.2.4 Method for Calculating a Percentage Safe Score for Housekeeping (unsafe situations)

In the example illustrated in figure 10 (Housekeeping), the observer would score the worksite by zone (see appendix B for example of map) and award one mark 'safe' for every safe situation/condition and one mark 'unsafe' for every unsafe situation/condition.


Figure 10: Housekeeping – safe and unsafe situations scored by zone

In the example illustrated in Figure 10, the zone (a series of aisles in the warehouse) would be awarded one mark 'safe' for the following situations/conditions:

- Pallet stacked on firm and even surface;
- Plastic pallets are free from cracks and mechanical damage;
- Pallets are in good condition (deck, stringer and base boards all in tact);
- Lighting working (check ceiling lights for damaged lighting or lighting that needs replacing);
- Surface conditions (firm, even and free of potholes)

This would give a total of 5-recorded 'safe situations'. In terms of 'unsafe situations', the zone would be awarded one-mark unsafe for the following situations/conditions:

- Objects and obstructions on the floor and in the aisles;
- Pallets not stacked neatly;
- Pallets not stacked in appropriate locations (obstructing aisles);
- Shrink-wrap and other 'material' left on pallets presenting 'trip hazard';
- Pallet stacks with heaviest load not always at the bottom;
- Stored goods/equipment leaning against wall.

This would give a total of 6 'unsafe situations'. The following situations (workplace transport hazards) were not recorded during the observation:

- Lift truck parked with forks resting on the ground and mast tilted forwards;
- Lift truck parked with handbrake (fully) applied (if not wheels should be chocked) and gears in neutral.
- Lift truck left with ignition keys inserted;
- Lift truck parked causing obstruction or blind spot (near doorways, intersections, pedestrian walkways, fire exits, fire hydrants etc);

Therefore, to calculate a percentage safe score based on the example illustrated in figure 10, it would be:

% SAFE = 5 Observed Safes /5 Observed safes + 6 Observed Unsafes x 100 = 5/11 = .4 x 100 = **45% SAFE**

Obviously it would not be possible to obtain reliable and accurate percentage safe scores based on a single or very few observations. As a rule of thumb, the more observations that can be made, the better. Also, observations should be undertaken at times which are genuinely random – or at least stratified to cover all days, shifts and time of shift (and the sample stratification must remain consistent if the data is to be consistent). As mentioned previously, it is particularly important that observations are taken when the work site is at its busiest.

## 4.5 ESTABLISHING BASELINE SAFETY PERFORMANCE SCORES

Once the measures have been developed the next stage in the measurement process is to establish a baseline score for each dimension or category of activity, i.e. housekeeping, pedestrian activity etc. In the example of the case study firm this was achieved by mapping the layout of each site (see Appendix B) and then collecting scores over a two-day period. As previously mentioned, effort was made to record data at busy periods and across different shifts. Generally speaking, it is advisable to spend longer than 2-days establishing the baseline. For example, Cooper (1998), suggests that observers conduct daily 10 to 15-minute observations of their peers, for a four to six week period.

As outlined in Section 4.4, company safety representatives and/or safety committee members are usually well placed to act as observers, providing they have first-hand knowledge and experience of workplace transport safety issues and are trained in the use of the measures. Once recruited, observers can either go out individually into the workplace to collect data or as part of a team. Whichever approach is chosen, it is advisable to run some form of accuracy and consistency check prior to the baseline being established. This can be achieved by getting two or more observers to score the same areas/actions at the same time but without consultation. If the independent scores are closely aligned, then it suggests that the observers are looking at the same items in the same way, i.e. consistently. Conversely, if little agreement exists between the independent assessments, then this suggests that the observers are applying different standards to the items, i.e. there is ambiguity over what constitutes safe and unsafe behaviour. Any differences should be investigated fully to see why judgements are differing. According to Marsh (2003), inconsistent scores usually occur as a result of:

- Item definitions being too vague;
- Difficult items are not properly illustrated;
- The worksite isn't mapped;
- Observers forget to score the safes; and
- Observers do not fully understand some items with a technical content.

### 4.6 FEEDBACK AND TARGET SETTING

Once the baseline period has been completed, average scores for each category can be calculated and the results can be used to chart performance and target areas for improvement (See Figure 11).

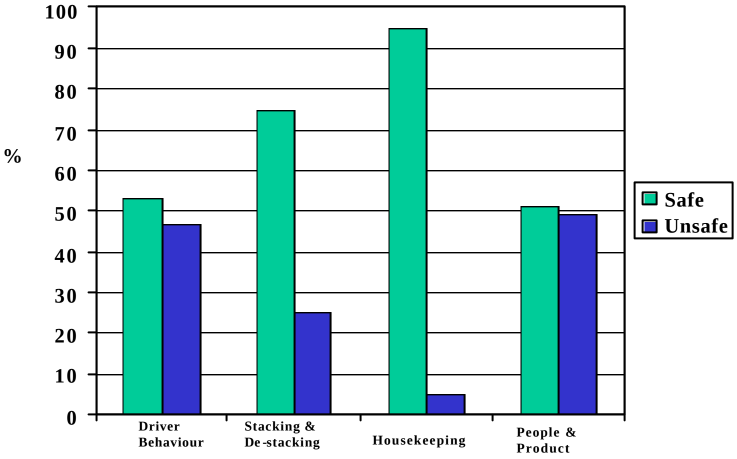



Figure 11: results can be used to chart performance and target areas for improvement.

This approach can be used to develop goal-setting sessions where the workforce are provided with feedback and are encouraged to participate in setting 'realistic' goals to improve the number of safe observations over a specified time period (see Figure 12). Research indicates that setting difficult, yet achievable goals, and providing performance feedback can improve safety related behaviour (Komaki *et al*, 1978; Sulzer-Azaroff, 1978; Reber *et al* 1983; McAfee & Winn, 1989; Locke and Latham, 1990; Duff *et al* 1993.

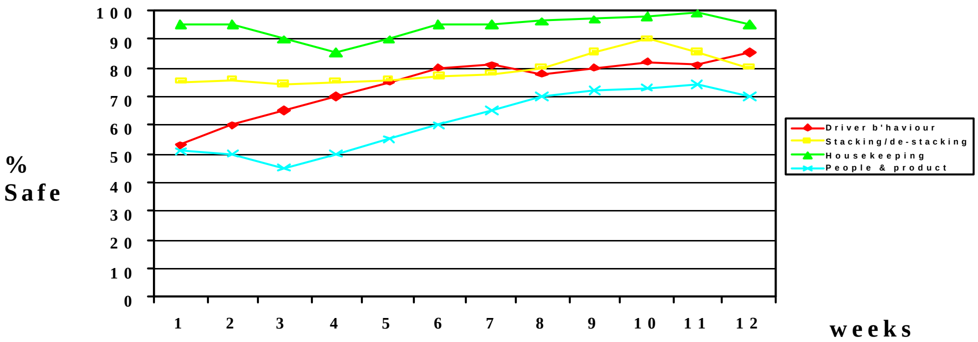



Figure 12: example of highly visible feedback chart which can be used for workforce goal-setting sessions.

There are a number of ways in which goal setting can be managed and performance feedback scheduled so that the impact is optimal. Many of these approaches use the term ‘behavioural safety’ to denote the application of reinforcement theory to foster an increase in safe behaviour. A discussion of the various behavioural safety techniques currently being employed to tackle workplace transport safety is beyond the remit of this report (e.g. ‘Top Down’ and ‘Full’ etc). However, it is worth noting that they all work to a greater or lesser extent, on the basic principle of using observed (safe and unsafe) behaviour as feedback (reinforcement) to the worker, which (theoretically), increases safe behaviour leading to continuous improvement and worker involvement (Cooper *et al*, 1991; Komaki *et al*, 1978).

### 4.6.1 Using workplace transport safety performance measures to inform risk assessments

It should be mentioned that it is not necessary to combine the approach outlined here with a behavioural safety programme. Indeed, effective as it seems to be, behaviour based safety still uses a relatively primitive version of reinforcement theory (Operant Conditioning[12]) and what many behavioural based practioners fail to address (or perhaps choose to ignore) is the concept of extinction, i.e. if the process of feedback (reinforcement) is not maintained, behaviour reverts to the original level. However, many organisations will find the process of identifying the various unsafe behaviours/conditions associated with workplace transport enormously beneficial, especially if they can engage a range of workers in this task. For instance, small and medium sized firms could use this approach to inform their workplace transport risk assessments. This process could also lead to improvements in the design and layout of the work site (safe site). For example, at the case study firm, it was noticed that the established practice of leaving pallets of product at the intersection of a pedestrian-vehicle route was effectively creating a blind corner (see Figure 13).

Figure 13: Illustration of how the pallet creates a blind corner if pedestrians are approaching from the direction of the red arrow and forklift trucks moving in the direction of the white arrow.

On the basis of this observation, a recommendation was made at the case study organisation to create (and demark) specific areas for the storage of pallets and to remind forklift truck drivers of the danger of placing pallets (obstructions) at the end of aisles and at intersections. Finally, it

[12] Developed by Skinner (1904-1990), operant conditioning is a form of learning theory, which suggests that behaviour is shaped and maintained by its consequences. According to Skinner analysis of behaviour requires an accurate but neutral representation of the relationship between the antecedents (stimulus conditions), the behaviours (or operants) and consequences (what happens as a result of operant behaviour). Similarly, applied behaviour analysis uses the antecedent-behaviour-consequence (ABC) analysis to understand safety related behaviour, i.e. to discover which antecedents (the event which triggers the behaviour) and consequences (any event that follows from that behaviour) are influencing a particular unsafe behaviour. According to applied behaviour analysis, consequences influence behaviour more powerfully and directly than antecedents and that in general, if consequences are soon, certain and positive, they will have a greater impact on predicting future behaviour. Therefore, through observation and feedback (reinforcement) the aim of behavioural-based safety is to make safe behaviours as quick, comfortable and convenient as unsafe ones.

is worth noting that involvement of workers with experience in the areas/activity being assessed will ensure that any changes recommended are both practicable and workable.

### 4.6.2 Using workplace transport safety performance measures to enhance supervision

It was mentioned in section 2.3.4 of the report that knowledge of unsafe behaviours/situations could help supervisors, especially those with limited experience, identify poor working methods and improve levels of workplace transport supervision. As Heinrich (1959) notes, "the supervisor or foreman is the key man in industrial accident prevention. His application of the art of supervision to the control of worker performance is the factor of greatest influence in successful accident prevention". It was also noted in section 2.3.4 that the skills and abilities required for the 'art of supervision' are sometimes underestimated by organisations and often supervisors are not provided with the necessary support and training.

#### *4.6.2.1 Praising safe behaviour*

Frequently employers do not fully appreciate the effect that positive feedback can have on encouraging safe working behaviour, i.e. as a powerful reinforcer of desired behaviours. Rogers (1988) suggests that this is because we learn by our successes *providing* we know why we are being successful. Therefore, supervisors should praise workers when they do things correctly, i.e. in accordance with the items on the safety performance inventory, such as sounding the vehicle horn at intersections, or wearing appropriate personal protective equipment etc. In terms of *when* to give feedback, Rogers (1988), suggests that there is a simple rule about the optimum time and that is to give it as soon as possible. The supervisor should not wait until either the triumph or error is repeated. The reason for this is that (adult) learning is like quick-drying paint. You only have a short time to correct the mistake or let it harden into a permanent error. In addition, feedback should always praise the good points before addressing any bad ones and should refer to the performance and not the person - hence the importance of making the items on the safety performance inventory specific, observable and (largely) in control of the operator. For example, if a supervisor happened to be observing the forklift truck driver illustrated in figure 8, s/he would first of all offer praise for 'driving within the confines of the vehicle' and for 'holding the steering wheel assistor correctly' etc. and then go on to offer feedback on the observed unsafe behaviours such as 'speeding' and 'not having a clear line of sight' etc, seeking to understand the reasons behind the behaviour in a non-judgemental way. Therefore, feedback from the supervisor will focus on the performance (and not the person), include reasons for the feedback (making sure they understand the purpose of the control) and check that the operator has understood by asking open-ended questions (e.g. "would you like to summarise what you think we've agreed " etc).

#### *4.6.2.2 Team work*

Research indicates that in organisations where management commitment to high standards of safety are combined with a culture of openness and trust (where concerns can be discussed and learning points identified), workers are more likely to offer constructive and useful feedback to each other (Belbin, 1993; Cooper 1998). The redefinition of group norms'[13] through peer 'modelling' of desired behaviours has been shown to be a very powerful way of improving safety performance, e.g. Cohen and Jensen, (1984). Sometimes, however, work teams lack cohesion or a common objective and it may be difficult to influence safety related behaviour through an approach such as the one outlined in this report. In such circumstances it may be necessary to provide additional training in team behaviour, e.g. to avoid groupthink - where the

[13] Norms are rules or standards established by group members to denote what is acceptable and unacceptable behaviour.

views of the dominant individuals become the combined view of the whole team. Also, intervention may be necessary to prevent the development of obstructive relationships (either consciously or unconsciously, to protect the group from 'outsiders'). Such protection can take the form of particular practices, conventions or communication styles. It can also take the form of rejecting external criticism and suppressing internal criticism. In addition, teams can sometimes start to self-destruct when team cohesion is lost and team members start to attack or criticise each other's performance.

Using the case study firm as an example, the unwillingness of certain work teams to report vehicle defects or damage to plant and equipment may indicate that not all shifts share a 'common objective' and may lack 'cohesion'. This situation could be improved through the provision of suitable training in team behaviour along with guidance on necessary communication skills.

### 4.6.3 Using workplace transport safety performance measures to improve safety culture

Research indicates that clear and visible leadership is vital for establishing a positive safety culture. Furthermore, safety culture will be enhanced in organisations where senior management actively demonstrate their personal commitment to health and safety (CB1, 1990). By developing workplace transport safety performance measures, senior management can demonstrate their commitment in the following ways:

- Promoting safe working practices: actions speak louder than words (*facta non verba)* and by participating in the active monitoring process (e.g. carrying out behavioural observations, delivering observer training, contributing items for the safety performance inventory) management can visibly demonstrate that health and safety 'matters' to them.
- Leadership: in health and safety, it is generally accepted that the 'democratic approach to leadership is preferable to that of the 'authoritative' figure. Or in other words, leadership through 'example' is better than leadership through 'fear'. This is especially important in organisations trying to foster an environment of openness and trust where concerns can be discussed and learning points identified. Participation in the development of safety performance measures can provide a good opportunity for managers to show how committed they are to high standards of behaviour, e.g. by wearing the appropriate personal protective equipment on the shop floor or crossing vehicle points at designated pedestrian-crossing points etc.
- Positive regard: research into human motivation indicates that a humanistic approach to leadership will have more of an impact on behaviour than an authoritarian style (Argryis, 1976). In other words, individuals are more likely to respond to a manager that treats them in a respectful and mature fashion. The introduction of a measure to actively gauge workplace transport safety will give out a message to workers that management are taking a personal interest in their safety and welfare. Furthermore, by providing feedback (e.g. praising desired behaviours) managers can demonstrate a positive regard for their employees. Showing a positive regard also includes making it clear about where the line must be drawn between acceptable and unacceptable behaviour – a process that is reinforced by the identification of unsafe behaviours to appear on the safety performance inventory.

In addition to raising the profile of senior management's commitment to safety, workplace transport safety performance measures can enhance safety culture in terms of what HSG 65 describes as the building blocks of a positive safety culture (the 4 C's), namely:

- **C**o-operation – as a means of securing co-operation between individuals, safety representatives and groups;
- **C**ommunication – by reducing the number of assumptions people make in interpreting directions and actions;
- **C**ompetence – as a means of enhancing the skills and knowledge of individuals in terms of the 'desired knowledge template', training and supervisor effectiveness;
- **C**ontrol – as a way of assessing the risks arising from transport activities, plus the establishment and maintenance of suitable control measures.

Finally, given the high morbidity and costs associated with having a workplace transport accident, the need to establish a strong safety culture and an effective safety management system is clear. In this section of the report, an approach has been outlined which involves the development of an active 'measure' to gauge how well the safety management system is controlling the risks posed by the 3 factors known to be associated with workplace transport causality, namely: (safe) site, vehicle and driver. Observing Drucker's maxim of '*what gets measured, gets done*' it is hoped that organisations following this approach will contribute to a reduction in the 70 or so lives claimed each year by vehicle accidents in the workplace.

# 5 CONCLUSIONS

The report has identified a number of workplace transport causation factors, which have been discussed in terms of ‘safe site’, ‘safe vehicle’ and ‘safe driver’. An approach to managing these three factors has been outlined. With reference to case study findings, a methodology for improving active monitoring (using unsafe behaviours and unsafe conditions as the unit of performance measurement) has been advanced. The main findings from the research can be summarised as follows:

- The layout and design of the work site appear central to the causality of workplace transport accidents. More specifically, the following issues were examined: pedestrian & vehicle separation; vehicle routes; reversing & traffic management; signage; lighting; conspicuity; loading bay and ground conditions.
- Issues relating to vehicle selection and maintenance were also identified as being important in the causation of workplace transport accidents. In particular, the degree of ‘fit’ between the driver and the vehicle was identified as warranting careful consideration along with the following issues: control compatibility; driver access/egress; driver protection; driver comfort and vehicle maintenance.
- The role of the driver and the pedestrian were also considered. The following themes were explored: driver selection, driver training; refresher training; pedestrian training; safe operating procedures; workload; supervision & monitoring; time-on-shift effects; shift patterns; and shift handovers;
- It was identified that safe driver issues such as driver selection, shift work and driver fatigue merit further study;
- It was suggested that the development of an effective safety management system is the best way of controlling the risks posed by workplace transport activities.
- The following elements of the safety management system were identified as being important:
- Policy & Organising (allocating roles, responsibilities and accountabilities at appropriate levels; establishing formal lines of communication; mechanisms for gaining worker co-operation; and exhibiting learning behaviour);
- Planning & Implementation (the process of putting policy into effect to manage safe site, vehicle and driver factors);
- Measuring performance, audit and review (information relating to how well the SMS is controlling risk including active and reactive measures);
- It was observed that safety culture plays a vital role in the control of transport risks. The following factors were listed as being positively associated with a strong safety culture: genuine and visible commitment from senior management; worker ownership of health and safety; organisational learning and sustained commitment.
- The importance of collecting SMS performance data was noted (especially upstream or active measures) along with the difficulties that organisations have in collecting such data;
- A method for improving active monitoring activity was proposed that specifies using unsafe behaviours and unsafe situations as the unit of workplace transport safety performance measurement.
- Details of how to identify key behaviours were outlined along with worked examples (using the case study company) of how to score, collate and manage the results;

- It was observed that other benefits can accrue from measuring workplace transport safety performance such as improving worker involvement in the risk control process;
- It was noted that the process of identifying unsafe behaviours and situations can be used to inform workplace transport risk assessments;
- The approach of documenting unsafe situations and unsafe behaviours was also recognised as being beneficial to the supervision of workplace transport activity;
- Elements of good supervision practice were outlined and included giving positive feedback (praise to reinforce desired behaviours). The influence that team dynamics can have on safety related behaviour was also highlighted.
- The potential for enhancing organisational safety culture was recognised in terms of securing co-operation, improving communication, contributing to competence and exerting control over workplace transport risks.

Finally, the need to be proactive in the management of workplace transport risk was noted especially as workplace transport is the second largest cause of fatal accidents in the UK workplace.

# 6 MAIN FINDINGS

(1) A number of workplace transport accident causation factors have been identified and are described in terms of safe site, safe vehicle and safe driver.

(2) The following controls for preventing workplace transport accidents have been identified:

- **Pedestrian and vehicle separation:** where possible, pedestrians should be segregated from vehicle traffic through the provision of protective barriers and clearly marked separate gangways. Routes used by vehicles such as forklifts inside buildings should be indicated by lines drawn on the floor to inform pedestrians, as should walkways designated for pedestrian use only.

- **Vehicle routes:** route planning should take into consideration the path and ultimate destination of the pedestrian flow (e.g. location of time clock, canteen, toilets etc) and vehicle traffic should be minimised at times of peak pedestrian activity, e.g. meal breaks, shift hand-over etc.

- **Reversing & Traffic Management:** the need for reversing can be minimised through the use of one-way traffic systems that incorporate drive-through loading and unloading positions. One-way systems can also keep traffic away from vulnerable plant and equipment. Speed limits and speed humps are also an effective means of controlling site traffic although thought should be given to forklift trucks and load stability.

- **Signage:** signs should be clear and unambiguous for both drivers and pedestrians For example, drivers need to know in advance about hazards such as sharp bends, junctions, crossings, blind corners, steep gradients and limited headroom.

- **Lighting**: adequate lighting is important to assist drivers detect hazards such as pedestrians, machines and other vehicles

- **Conspicuity**: the extent to which objects ‘stand out’ from their background is affected by a number of factors including ‘adaptation’, ‘disability glare’ and ‘veiling effects’. These factors can be controlled by avoiding large changes in levels of illumination (e.g. between the inside and outside of premises) and the provision of sun visors etc. High visibility clothing can increase conspicuity and assist drivers detect the presence of pedestrians.

- **Loading Bay**: the Loading Bay has been identified as being a ‘high risk’ area due to the limited manoeuvring space available for forklifts and other powered industrial vehicles. Unauthorised trailer departures pose another problem and control measures, such as wheel restraints, may be necessary.

- **Ground Conditions**: attention should be paid to the gradient, quality and frictional characteristics of the floor upon which forklifts and other vehicles travel. Gangways should be clearly demarked with non-skid paint and oil, grease and fluid ‘spill kits’ should be easily accessible so that any spillage is quickly cleaned up.

- **Vehicle selection**: the degree of fit between the driver and the vehicle was identified as being important. The following issues in particular warrant careful consideration when selecting a vehicle:

- **Control compatibility:** the vehicle controls of powered industrial vehicles can vary and the potential for human error (slips) will increase if operators are required to drive more than one type of vehicle (with different controls) in the same workplace (especially during the same shift);

- **Driver access/egress** the design and layout of some vehicles make it difficult for operators to enter and exit the cab safely. Vehicles that include well-designed steps and conveniently located hand grips can reduce the need for drivers to jump from their cabs;

- **Driver protection:** the use of Roll-Over-Protective-Structures (ROPS) is not fully effective unless the driver is wearing an appropriate seat belt or other restraint. Arrangements should be in place to monitor compliance with this requirement. Workers are more likely to use protective equipment, such as a seat restraint, if they have had some degree of involvement in the selection of the safety equipment.

- **Driver comfort:** driver comfort can be enhanced by the inclusion of vibration damping equipment, noise reduction measures, adjustable seating, good ventilation and weather protection.

- **Maintenance:** good vehicle maintenance management is key to the prevention of workplace transport accidents. A competent mechanic should inspect the mechanical condition of each workplace vehicle at specified intervals. Drivers should also carry out basic safety checks before using vehicles and arrangements should be in place for fault-finding and defect reporting. Preventative maintenance programmes need to be properly managed in terms of planning what work needs to be done and in what order.

- **Driver selection:** Forklift truck driving requires a high degree of psychomotor skill, therefore, potential lift-truck operators should be selected carefully.

- **Driver training:** Training should reflect the actual conditions that the operator will meet at work and provide the driver with information and knowledge needed for safe operation of the vehicle. Training should also include a familiarisation stage. The previous experience of drivers new to the organisation should be checked and their performance assessed to ensure they are competent before receiving authorisation to drive.

- **Refresher Training:** Refresher training is an important mechanism for enhancing competence levels and also as a necessary check and balance against the development of informal procedures. Refresher training should be provided at set intervals for all drivers and also following incidents, the introduction of new vehicles or significant changes in site layout (including modes of production);

- **Pedestrian Training:** pedestrians represent a high-risk group in the workplace therefore, training programmes should be developed that aim to familiarise pedestrians with the unique operating characteristics of powered industrial vehicles. Emphasis should be given to the main operating differences that exist between a car and a powered industrial vehicle, e.g. manoeuvrability, visibility and load stability.

- **Safe Operating Procedures:** Compliance will be enhanced by ensuring that procedures are practical, easy to follow and fully understood by staff.

- **Workload:** workload should be controlled to prevent drivers and other employees from having to rush to complete their work on time. Work design and driver incentive schemes require careful management so that they don't inadvertently encourage unsafe driving behaviour.

- **Supervision and monitoring:** close supervision of newly qualified drivers is identified as being very important as to is the monitoring of experienced drivers to ensure that they continue to operate vehicles in a safe fashion. Supervisors need support and training in line-management skills so that they can encourage and support high standards of driving behaviour and good teamwork. Managers also need to ensure that supervisors have sufficient training and experience in the desired working practices to enable them to identify poor working methods.

- **Time-on-shift effects:** research indicates that working long hours will impact negatively on driver safety performance. Key to managing time-on-shift effects is the provision of adequate rest breaks and a good working environment. At present there isn't any regulation that limits the number of hours a driver of a forklift truck or other powered industrial vehicle can work. This is at variance with regulations governing drivers of commercial goods vehicles.

- **Shift patterns:** forward rotation of shift patterns is currently considered better than reverse rotation. Research indicates that true adjustments to shift patterns rarely occur and that changing shift patterns about once a week is likely to cause more difficulties than a faster or slower changing pattern. Three days can be required to change from day to night shifts and vice-versa. Using appropriate lighting levels can help adjustment from day to night shifts.

- **Shift handovers**: shift handovers should receive high priority, be seen as a two-way process with shared responsibly and be given the necessary resources (e.g. sufficient time).

(3) It is concluded that workplace transport accidents can be prevented by establishing an effective safety management system. The constituent elements of an effective safety management system include policy and organising, planning and implementation and measuring performance, audit and review (POPMAR).

(4) The importance of collecting data and information relating to how well the safety management system is controlling workplace transport activities has been identified. The difficulties that organisations have in obtaining such data, (especially upstream or 'active' measures) was also acknowledged.

(5) A method for improving active monitoring activity has been proposed that specifies using unsafe behaviours and unsafe situations as the unit of workplace transport safety performance measurement.

(6) Details of how to identify key behaviours have been outlined along with worked examples of how to score, collate and manage the results.

(7) It has been observed that other benefits can accrue from measuring workplace transport safety performance such as improving worker involvement in the risk control process;

(8) The approach of documenting unsafe situations and unsafe behaviours was also recognised as being beneficial to the supervision of workplace transport activity.

(9) Elements of good supervision have been outlined and include giving positive feedback (to reinforce desired behaviours). The influence that team dynamics can have on safety related behaviour was also identified.

(10) The potential for enhancing organisational safety culture has been recognised in terms of securing co-operation, improving communication, contributing to competence and exerting control over workplace transport risks.

# 7 RECOMMENDATIONS

- Encouraging employees to identify unsafe behaviours and unsafe situations represents an effective means of involving employees in the risk control process. The approach outlined in this report could be broadened to include other aspects of workplace transport activity such as delivery/collection vehicle movements or visitor driver behaviour etc. Consideration should be given to providing advice and guidance on how to develop (and extend) workplace transport safety performance measures, e.g. they could be made available in an electronic format so that organisations can access the methodology and gain access to the safety performance inventories.

- The issue of driver selection has been identified as being an issue that merits further study. Research indicates that forklift truck driving requires a high degree of psychomotor skill. However, it would appear that many organisations rely on the process of natural selection to recruit drivers. Therefore, it is recommended that work be commissioned to develop an aptitude test (or battery of tests) that will assist employers identify 'suitable' individuals to receive forklift truck driver training.

- The effects of shiftwork and driver fatigue are known to be associated with workplace transport risk; however, the relationship between these factors is unclear. Further research would be beneficial in establishing the extent to which fatigue and shiftwork contribute to the causation of workplace accidents.

# 8 APPENDICES

## 8.1 APPENDIX A: SAFETY PERFORMANCE INVENTORIES

| | LIFT TRUCK DRIVER BEHAVIOUR | Safe | Unsafe | Not seen |
|---|---|---|---|---|
| A | Look to ensure that the driver is correctly seated with limbs inside the confines of the truck. | | | |
| B | Look to ensure that the forklifts are not travelling at excessive speed (no faster than a person running, i.e. 6 mph). | | | |
| C | Look to see if the driver is holding the steering wheel assistor correctly. | | | |
| D | Look to ensure that forklifts are sounding their horns when coming to blind corners, intersections and through entrances. | | | |
| E | Check to see if the driver is looking in the direction of travel (1-second glance rule). | | | |
| F | Check to see if lift trucks are moving or cutting across pedestrian walkways. | | | |
| G | Check whether the driver has a clear line of sight. | | | |
| H | When the driver dismounts the truck, check to ensure that the truck is stationary and the driver is using the handholds and checking to see that the way is clear. | | | |
| I | Check to see if the driver is using the controls from outside the truck. | | | |
| J | Look to see if the driver is wearing the appropriate PPE | | | |
| K | Check to make sure that the load is shifting as a result of the driving style (i.e. through braking, accelerating or sudden changes in direction). | | | |
| | TOTAL | | | |

| LIFT TRUCK STACKING/DE-STACKING | | Safe | Unsafe | Not seen |
|---|---|---|---|---|
| A | Look to ensure that the driver looks upwards, raises forks until even with pallet, inserts fork arms slowly until heel of forks touch load. | | | |
| B | Look to ensure that the forks are fully inserted and are not in contact with other pallets/stacked goods. | | | |
| C | Look to see that the loads are tilted back to stabilise. | | | |
| D | Look to ensure that drivers check behind before reversing (slowly and without dislodging adjacent loads). | | | |
| E | Check to see if pallets are evenly spread on forks. | | | |
| F | Check to ensure that forks are no more than 6” off the floor when travelling. | | | |
| G | Check whether the driver travels with load facing uphill on slopes and reverses down. | | | |
| H | Look to ensure that driver lowers mast (load) before turning the truck. | | | |
| I | Look to ensure that the driver is carrying a balanced and well-stacked load (i.e. not double load, height should not exceed the longest base dimension of the pallet). | | | |
| J | Look to see if the driver is wearing the appropriate PPE | | | |
| K | Check to make sure that the driver is using the hydraulics smoothly (without jerking the load). | | | |
| | TOTAL | | | |

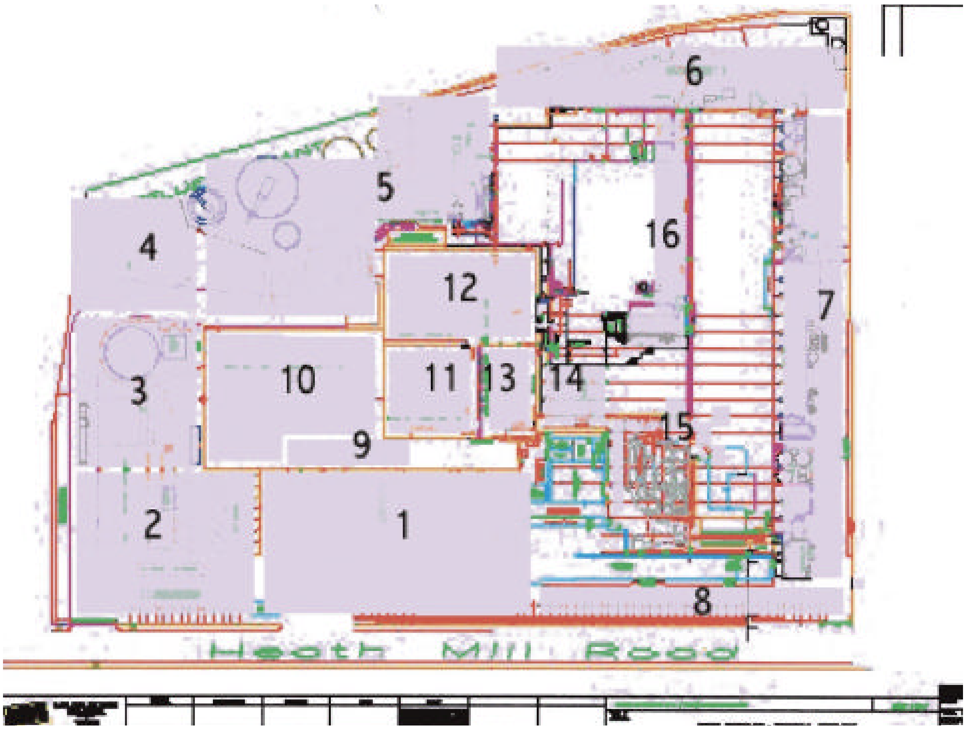
| PEDESTRIAN ACTIVITY (PEOPLE & PRODUCT) | | Safe | Unsafe | Not seen |
|---|---|---|---|---|
| A | Look to ensure that the person is paying attention when working in the vicinity of traffic, paying attention to vehicle movement (hit man rule). | | | |
| B | Look to ensure that pedestrians are not walking under raised loads. | | | |
| C | Look to ensure that the person is walking not running. | | | |
| D | Check to see if pedestrians cross behind the lift truck when it is stacking/de-stacking. | | | |
| E | Check to see if lift trucks are moving or cutting across pedestrian walkways. | | | |
| F | Check whether people are looking in the direction they are walking (1-second or 3-step rule). | | | |
| G | Look to see that pedestrians are not walking within segregated vehicle zones. | | | |
| H | Check to make sure that the pedestrian is not distracted, i.e. using mobile phone, reading etc. | | | |
| I | Look to see if the driver is wearing the appropriate PPE | | | |
| | TOTAL | | | |

| | HOUSEKEEPING | Safe | Unsafe | Not seen |
|---|---|---|---|---|
| A | Look to ensure that pallets are stacked on a firm and even surface. | | | |
| B | Look to ensure that plastic pallets are free from cracks and mechanical damage. | | | |
| C | Look to ensure that pallets are in good condition (i.e. deck, stringer and base boards all in tact). | | | |
| D | Look to ensure that all the lights are working (i.e. check for damaged lighting or lights that need replacing). | | | |
| E | Check to ensure that the ground conditions are good, i.e. firm, even and free of potholes. | | | |
| F | Check to see if there are any obstructions on the floor and in the aisles. | | | |
| G | Check whether the pallets are stacked neatly. | | | |
| H | Check whether pallets are stacked in the appropriate locations (i.e. not obstructing aisles). | | | |
| I | Check to ensure that shrink-wrap and other material has been removed from pallets (i.e. trip hazards). | | | |
| J | Look to see that pallets are stacked with the heaviest load at the bottom. | | | |
| K | Check to make sure that stored goods/equipment is not leaning against the wall (Achilles rule). | | | |
| L | Check whether lift truck is parked with forks resting on the ground and mast tilted forwards. | | | |
| M | Look to see if the lift truck is parked with the handbrake fully on (if not wheels are chocked) and the gears are in neutral. | | | |
| N | Look to see if the lift truck is parked with the ignition keys inserted. | | | |
| | TOTAL | | | |

- Observation of ‘active behaviours’, i.e. driving and pedestrian activity, should be based upon the 30 second rule or the completion of an activity or until the vehicle is out of sight
- To aid the reliable scoring of active items, if the individual transgresses any of the behavioural standards then given them one mark unsafe. If they carry out activity or drive for 30 seconds without transgressing any of the standards then give them one mark safe
- Housekeeping items are to be score by zone (map the worksite). If anything unsafe then one mark unsafe if nothing unsafe then one mark safe. Just give one mark per zone regardless of how many reasons for failing you can see.

**% Safe = (Total safe/ (Total Safe + Total Unsafe)) * 100**

## 8.2 APPENDIX B: EXAMPLE OF WORKSITE MAP




- In this example the worksite is divided into 16 zones.
- Housekeeping items are scored zone by zone.

# 9 REFERENCES


Agryis, C. (1976). *Increasing leadership effectiveness*. New York: Wiley-Interscience.

ACSNI *Study Group on Human Factors. 3rd report: Organising for Safety.* HSE Books 1993.

Astley, R.W. and Lawton, R.H. (1971). *The ergonomic aspects of forklift truck design – a review of current practice.* Research Report of the Department of Engineering Production, University of Birmingham. National Materials Handling Centre, Cranfield Institute of Technology.

Auguston, K. (1996). Industrial lift truck accidents: why they happen? How can they be prevented*? Modern Materials Handling,* 5 (2): 42-47.

Belbin, R.M (1993). *Team Roles at Work*. Butterworth-Heinemann, London.

Booth, R.T. (1979). Making factories safe for forklift truck drivers. *Occupational Health (April)*

Booth, R.T. (2001). *Accident investigation and its interaction with risk assessment and safety management systems*. IBC Conference on Practical Accident Investigation, 12-13th July 2001. London.

CBI (1990). *Developing a safety culture: Business for safety*. London: Confederation of British Industry.

Chhokar, J.S. (1987). Safety at the workplace: a behavioural approach. *International Labour Review*, 126(2), 169-178.

Cohen, A., Smith, M.J. and Anger, W.K. (1979). Self-protective measures against workplace hazards. *Journal of Safety research*, 11(3), 121-131.

Cohen, H. H. and Jensen, R.C. (1984). Measuring the Effectiveness of an Industrial Lift Truck Safety Training Program. *Journal of Safety research*, 15(3), 125-135.

Collins, J.W., Smith, G.S., Baker, S.P., Landsittel, D.P., Warner, M. (1999). A Case-Control Study of Forklift and Other Powered Industrial Vehicles. American Journal of Industrial Medicine. 36(5): 522-531.

Cooper, M.D., Phillips, R.A. Robertson, I.T. & Duff, A.R. (1991). *Improving safety on construction sites by changing personnel behaviour.* HSE Contract Research Report No. 51/1993

Cooper, D. (1998). *Improving Safety Culture: A Practical Guide*. John Wiley & Sons, London.

Cox, S. and Flin, R. (1998). Safety Culture: philosopher's stone or man of straw. *Work and Stress*. 12(3): 189-201.

Clarke, S. (1998). Safety culture on the UK railway network. *Work and Stress*, 12(3): 285-292.

Dickety, N. (2001). Workplace Transport Accident Scoping Study: Literature Review. *HSL Report RAS/01/15*.

Dickety, N. (2002). Analysis of workplace transport accidents. In D. De Waard, K. Brookhuis, J. Moraal, and A. Toffetti (Eds.), *Human Factors in Transportation, Communication, Health and the Workplace*. Maastricht, The Netherlands: Shaker Publishing.

Drucker, P. (1954). *The practice of management*. Butterworth-Heinemann, London.

Fowler, C. (2002). *Review of workplace control measures to reduce risks arising from the movement of vehicles*. RR38 HSE Books.

Geller, E.S. (1984). A Delayed Reward Strategy for Large-Scale Motivation of Safety Belt Use: A Test of Long-Term Impact. *Accident Analysis and Prevention*, 16, 457-463.

Glendon, A.I and McKenna, E.F (1995). *Human Safety and risk management*. London: Chapman and Hall.

Heinrich, H.W. (1959). *Industrial Accident Prevention.* McGraw-Hill: New York.

*Improving compliance with safety procedures: Reducing industrial violations.* HSE Books, 1995.

*Improving maintenance – a guide to reducing human error.* Human Factors in Reliability Group (HFRG). HSE Books, 2000.

*Improving the safety of workers in the vicinity of mobile plant*. CRR358/2001 HSE Books, 2001.

Komaki, J., Barwick, K.D., & Scott, L.R. (1978). A behavioural approach to occupational safety: Pinpointing and reinforcing safe performance in a food manufacturing plant. Journal of Applied Psychology, 63(4):434-445.

Kraiss, K.F. and Moraal, J. (1976). *Introduction to Human Engineering*. Verlag TUV Rheinland GmbH.

Krause, T.R. (1998). *The Behaviour-Based Safety Process*. Van Nostrand Reinhold: New York.

Lagerlof, E. (1982). Accident reduction in forestry through risk identification, risk consciousness and work organisation change, in *Proceedings of the 20th International Congress of Applied Psychology,* July, Edinburgh.

Larsson, T.J. and Rechnitzer, G. (1994). Forklift trucks – analysis of severe and fatal occupational injuries, critical incidents and priorities for prevention. *Safety Science* 17: 275-289.

Latham, G.P., Erez, M. & Locke, E.A. (1988). Resolving scientific disputes by the joint design of crucial experiments by the antagonists: Applications to the Erez-Latham dispute regarding participation in goal setting. *Journal of Applied Psychology.* 73, 753-772.

Lighting at work. *HS(G)38. HSE Books, 1997.*

*Lighting Guide 1. The industrial environment.* Chartered Institute for Building Services Engineer (CIBSE) 1989.

Locke, E.A. (1980). Latham versus Komaki: a tale of two paradigms. *Journal of Applied Psychology,* 65, 16-23.

MacMillan, K., Curran, J. and Downing, S. (1992). Government consultation with small business owners: empirically evaluating communication strategies. *International Small Business Journal.* 8(4): 14-32.

Male, G.E. (2003). Safety of Industrial Lift Trucks: A Survey of Investigated Accidents and Incidents (April 1997 – March 2001). *Specialist Inspector Reports Number 60*. HSE Books.

Marsh, T., Davies, R. Phillips, R., Duff, R., Robertson, I, Weyman, A. and Cooper, D. (1998). The role of management commitment in determining the success of a behavioural safety intervention. *Journal of the Institution of Occupational Safety and Health*. 2(2):45-56.

Marsh, T. (2003). Behavioural safety. An overview of key theory, recent controversies and the findings of the 3rd annual European users conference. *The Safety and Health Practitioner,* (February). pp 22-24.

Monk, T.H. and Folkard, S. (1992). *Making shiftwork tolerable*. London: Taylor and Francis.

O'Hara, R., Dickety, N. and Weyman, A. (2000). Good practice by SMEs in assessing workplace risks. *Health and Safety Laboratory Report*. RAS/00/12.

O'Mara, N. (1989*). A study of forklift truck accidents in South Australia*. Southern Australian Health Commission, Occupational Health and Radiation Control Branch.

Ostberg, O. and Svensson, G. (1973). Forklift trucks, drivers and safety at the warehouse: an analysis of critical incidents. *Goteborg Psychological Reports* 3(1).

Pidgeon, N. (1998). Safety Culture: Key Theoretical Issues. *Work and Stress*. 12(3): 202-216.

*Provision and Use of Work Equipment Regulations 1998* (PUWER 98) HMSO: London.

Reason, J. (1997). *Managing the Risks of Organisational Accidents*. Aldershot: Ashgate Publishing Limited.

Reber, R.A., Wallfin, J.A. and Duhon, D.L. (1989). Safety programs that work. *Personal Administrator* 34(9): 66-9

*Reducing error and influencing behaviour* HS(G)48, HSE Books, 1999.

Robertson, J. (1969). Forklifts can kill. *Mechanical Handling* (August).

Rasmussen, J. (1980). What can be learned from human error reports? In K.D. Duncan, M. Gruneberg and D. Wallis, (eds), *Changes in Working Life*. London: Wiley, 1980.

*Rider operated lift trucks: Operator training Approved Code of Practice and Guidance* L117 HSE Books 1999.

Riley (2003). HSL Ergonomics Reactive Support Work. *HSL Internal Report. JS20031387*.

Rockwell, T.H. (1959). Safety Performance Measurement. *The Journal of Industrial Engineering*, 10, 12-16.

Rogers, J. (1988). Adults Learning (3rd Edition). Open University Press.

*Safety guidelines for writing effective operating and maintenance procedures.* Centre for Chemical Process, American Institute of Chemical Engineers, 1996.

*Safety in working with lift trucks.* HS(G)6 HSE Books, 2000.

Senge, P.M. (1990). The Fifth Discipline: *The Art and Practice of the Learning Organisation.* London: Century Business.

Skinner, B.F. (1953). *Science and human behaviour.* New York: Macmillan.

Smith, D. Workplace Transport Accident Analysis and Measurement of Workplace Transport Risk Control at Site Inspections during 2000/01. *hhttp://intranet/operational/fod_rhs/supporting/transport/info.htm at.*

Stout-Wiegand, N. (1987). Characteristics of work-related injuries involving forklift trucks. *Journal of Safety Research* 8: 179-190

*Successful health and safety management* HS(G)65 HSE Books 1997.

Swartz, G. (2000). The industrial pedestrian: danger is just around the corner. *Professional Safety* 44(3):33-36.

Templer, A. (1999). Hectic warehouse activity increases the potential for loading dock mishaps. Occupational Health and Safety. 62(9): 111-115.

*The costs of accidents at work.* HS(G)96 HSE Books 1997.

U.S. Dept. of Labor. (1986). Injuries to warehouse workers. *Bureau of Labor Statistics Bulletin* 2257:24

Warburton, R.M. (1986). Training of workpeople in health and safety. In R.C Clarke (Ed), Education and Training in Health and Safety: Current Problems and Future Priorities. *Proceedings of the British Health and Safety Society, London.* June 1986, BHSS, Birmingham.

Waterhouse, J.M., Folkard, S. and Minors, D.S. (1992). *Shiftwork, health and safety: An overview of the scientific literature 1978-1990* CRR 31 HSE Books.

White, J. and Beswick. J. (2003). Working Long Hours. *HSL Report*. WPS/02/10

Williams, E.A. and Priestley, S.E. (1980). Forklift truck injuries. Journal of the Society of Occupational Medicine 30:149-152.

*Workplace (Health, Safety and Welfare) Regulations 1992.* HMSO: London.

*Workplace Transport Safety*. HS(G)136 HSE Books, 2000.

Zohar, D. (1980). Promoting the use of personal protective equipment by behaviour modification techniques. *Journal of Safety Research*, 12, 78-85