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Crane Operator Training Delivery : Is the Current System the way to go?

Ian Douglas
Edith Cowan University

Edith Cowan University

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Crane operator training delivery – is the current system the way to go?

By

Ian Douglas.

A Thesis submitted in partial fulfilment of the requirements for the award of
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Edith Cowan University

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Abstract

There are over 20,000 people certificated to operate cranes in West Australia and there are currently approximately 2000 construction cranes operating in the state of West Australia. The safe operation of these machines in the workplace is critical to safety on the job. As is often the case when machinery is involved in an accident or event, when something goes wrong there is the possibility of people being injured or for damage to occur to the machine and the surrounding infrastructure. The number of events that have been reported in the media during recent months highlights this fact. To help minimise the likelihood of accidents occurring on the work-site, it is crucial that the people responsible for the operation of these machines are fully trained in all aspects of the task. This includes the provision to these people during their training phase, of all of the relevant warning signals that not only the machines would present in the lead-up phase of an accident, but also those of the surrounding environs. The aim of this study was to try and ascertain if crane operators who were certificated prior to 1994 are involved in more crane accidents than those operators who were certificated after 1994. To help answer this question data was collected from government departmental records, committee reports, questionnaires and published literature. The SPSS statistical package (version 10) was used for the analysis of the data that was collected.

Prior to 1994 a crane operator would need to gain their experience and training on-the-job under the direct supervision of a certificated operator. This training could take several months and would often involve the trainee operating many different types, makes and capacities of construction cranes. In 1994 as part of the national economic reform agenda, the delivery of crane operator training changed to a classroom-based system with minimal practical operation of a crane (as little as 2 hours). This new certification system has seen the market over the last 10 years (1994/2003) flooded with people with certificates of competency, with figures suggesting that over 14,000 people have gained certification in that period. Figures relating to this research may reveal that there could be more accidents occurring amongst the group of crane operators who were certificated prior to 1994, under the old training regime than those certificated post 1994. These figures may at first glance reveal that this could be the case, however the critical variable in relation to each group, their exposure patterns,

were not able to be established. The other crucial variable that could not be measured and which has the potential to have the most profound effect on the continuation of learning, was the employers attitude to the current system of training delivery. If the employer, as the gatekeeper, takes a negative view to the current method of training delivery, then the new trainees will not be able to reinforce their training and the skill will be lost in a short time. Worksafe need to alter their "Occupational Safety and Health Regulations" (1996) reporting requirements in relation to accidents, so as to reflect the same requirements that are set down in the West Australian "Mines Safety Inspection Act" (1994) for the reporting of such events. The intention of this study was to add to the body of knowledge in the area of crane operator training in the construction and mining sectors of industry and if possible, to identify if there is a need for further research in this field.

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24/6/03

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CONTENTS

CHAPTER 1. Background and Significance of the Study.

1.1 Background to the study.

As part of the national training reform agenda the method of crane operator training in Australia was changed in July 1994 in an attempt to ensure the delivery of a reliable competency based system of training. The current system is called the "National Occupational Health & Safety Certification Standards for Users & Operators of Industrial Equipment" [NOHSC: 1106 (2001)]. Appendix B of the standard applies to crane and hoist operation.

Prior to 1994 a person who wanted to become a crane operator had to follow a training path that was more like a trainee-ship/mini-apprenticeship. The trainee would first need to obtain a "learners permit" from the relevant state or territory government department.

After trainee operators had obtained their permit they were allowed to operate cranes, but only under the direct supervision of a certificated crane operator. Depending on the classification of certificate that was being sought, the trainee then had to build up to 300 hours of solo operation of a crane "on-the-job", before they could be considered for a competency assessment. The accumulation of 300-hrs experience could take as long as 24 months as the training was complemented with learning other tasks that are associated with the operation of cranes including dogging and rigging.

This method of training delivery produced operators who were not just skilled in the direct operation of cranes but also in the role of support staff. This system also allowed for a safety culture to be instilled in the operator during their training. However with the moves especially in the construction industry, for more and more work to be carried out off-site the ability to conduct on-the-job training is being greatly reduced.

Under the new system, crane operator training is delivered via the direct operation of a crane (which would average out at 4-6 hrs per trainee for the course) combined with classroom theory (McCamic, 2002). As it is a competency based system there is provision within the standard for a person to be examined on the practical portion of the assessment only.

Training for most classifications of crane operator certificates of competence are carried out over a 5-10-day period, after which the training providers are then often responsible for assessing the competency of the trainees. If trainees are passed as having met the performance criteria for each competency element involved in being certificated, they are issued an interim 60-day certificate. Before that 60-day period expires, the certificating authority (WorkSafe) will issue them with their permanent national operators' certificate.

A major flaw with the new standard would appear to be that there are no requirements included within it for the training program to be the subject of either internal or external auditing. Although the training delivery organisations are subjected to external auditing from the body responsible for their certification as training providers, which is the Department of Training.

Section 2.4 of the Western Australian Occupational Health and Safety Regulations (1996) requires the notification by the employer, of certain accident types and accidents in the workplace that involves an employee being injured and not being able to return to work for at least the next ten days. Apart from this section there are no other requirements for the reporting of accidents to WorkSafe, whether they involve cranes or not. This could tend to indicate that a majority of crane accidents and incidents would not be reported to WorkSafe, which inturn must make it difficult if not impossible for them to be able to identify any recurring events, trends or patterns that may be common to many crane accidents/incidents.

However, this is not the case in the Western Australian Mines Safety & Inspection Act (1994), where there are several sections that relate to all accidents/incidents, which are;
Section 11 "Reporting of dangerous situations and occurrences".

Section 76 "Notice of accidents to be given".
Section 77 "Recording of accidents in accident log books".
Section 78 " Recording of occurrences in the record book."
Section 79 " Manager to report potentially serious occurrences."

The reporting of accidents to a central authority must make it easier for the mining group to be able to identify and monitor industry trends that may be occurring. Even though the Department of Industry and Resources, which is the government department responsible for the administration of the Mines Act and Regulations, are informed of accidents that are occurring in their industry they are under no obligation to pass this information on to the certificating authority, WorkSafe.

1.2 Significance of the study.

When a crane is involved in an accident on a work site there is a danger that workers could be injured or killed, the crane can be damaged or totally destroyed and the damage to the surrounding infrastructure can be catastrophic. The cost of these accidents to industry can range into hundreds of millions of US dollars but more importantly they often result in the loss of the lives of workers (Ritchie, 2002; Johnson & Rautiainen, 2003).

If crane operators are not trained to a standard that allows them to be able to make the correct decisions when faced with an emergency, then accidents will occur. A certificate of competency should only be seen as a minimum requirement that then needs to be built on with the practical application in the workplace of those new skills. If the current system of training delivery is not producing "competent people" then the system is failing the trainee, industry and the certificating authority.

1.3 Purpose of the study.

The purpose of the proposed research is to attempt to find if there is a correlation between the year of the operator's certification (prior to or after July, 1994) and the number of crane accidents that have occurred in Western Australia since.

1.4 Research Question.

The current method of crane operator training delivery and accidents, is there a connection?

It is hypothesised that the current classroom based pedagogical modular style system for crane operator training, is a factor in the incidence rates of crane accidents in Western Australia. The research proposes,

- *To determine the competence of crane operators certificated prior to 1994 as measured by the accident incidence rate among this group.*
- *To determine the competence of crane operators certificated after 1994 as measured by the accident incidence rate among this group.*
- *Ascertain if crane accidents are not being reported to WorkSafe.*

1.5 Research Definitions.

Assessment.

The process of judging competency against a prescribed standard of performance.

Andragogy.

An adult learning style that emphasises the importance of self-direction in learning.

Certification.

Is the provision of formal recognition that competency has been achieved or demonstrated.

Cognition.

How one acquires knowledge.

Conceptualisation.

How a person processes information regarding concrete experiences.

Competent.

Having shown the ability to apply the skills and knowledge learned to a required/prescribed standard/level.

Competent person.

The statutory definition found in section 4 of the Western Australian Mines Safety and Inspection Act 1994 is:

"**Competent person**" means a person who is appointed or designated by the employer to perform specific duties, which the person is qualified to perform by knowledge, training and experience;

In regulation 1.3 of the Western Australian Occupational Health and Safety Regulations 1996 the definition is:

"**Competent person**" in relation to doing anything, means a person who has acquired through training, qualification or experience, or a combination of those things, the knowledge and skills required to do that thing competently.

(When this study mentions a competent person it implies the use of the definition that is to be found in the Mines Safety and Inspection Act (1994). This is because that definition requires all of the three elements, training, qualification and experience be present. Where as the WorkSafe definition, uses the word OR when referring to these three elements).

Crane.

Regulation 4.1 of the WA OH&S regulations defines a crane as;

plant that is used for the raising and lowering of a freely suspended load and moving a load horizontally and – includes the supporting structure of the crane and its foundations; does not include any industrial lift truck, industrial robot, building maintenance equipment, suspended scaffold or lift;

Dogman/Dogging.

Is a person who is responsible for giving directions to a crane operator, for the purpose of lifting, lowering and positioning of loads.

Kibble.

An accessory used by a crane for the purpose of carrying loads of sand or concrete.

Hook radius.

The distance of the cranes lifting hook from the machines centre of rotation.

Load.

Any object or material that is suspended from the lifting hook of a crane.

Modular training.

Training that is delivered to the trainee by a preset group of modules and is predominantly classroom based.

Pedagogy.

A teacher directed approach to training/learning that is most often used with children. Literally means "the art and science of teaching children."

Rigger.
A worker who is often required to assist a crane operator.

Safe Working Load (SWL).

The weight of a load that is within the scope of the manufacturer's recommendations for that particular machine which will not cause the machine to either fail structurally or become unstable. Crane manufacturers are responsible for establishing the SWL for their machines and they will often maintain safety margins of between 25% & 33.3%. For example, if a crane is rated by the manufacturer to have a SWL of 6 tonnes when operated at a hook radius of 20 metres, then the crane would not become critically unstable until a load weighing 8 tonnes was placed at that radius, if 33.3% is used as the safety margin.

Structural capacity.

The SWL capacity of the crane in relation to its structural integrity. If these limits are exceeded the end result is most likely going to lead to a structural failure of the machine. A crane will not necessarily overbalance and tip when structurally overloaded.

Two-block (Anti).

When the running line or hoisting rope on a crane is raised to a point that the lifting hook strikes the sheave that the rope runs over. This situation may cause the rope to fail (break), damage to the sheave or the lifting hook may dislodge and fall to the ground.

CHAPTER 2 Theoretical Framework.

Accident prevention is one of the key components in any successful occupational health and safety system. Gavin & Taylor (2001) found that there were between thirty and forty accident prevention models that can be utilised in the workplace to help prevent accidents from occurring.

A foundation of accident prevention for any worker to be able to perform a task safely, would be that of Klein's' "Task Demand Model" of 1973 (Gavin & Taylor, 2001). This is a human factor theory which is based on the general behaviour of humans in the decision making process. The paradigm states that the demands of the task itself must at all times remain within the scope and range of the abilities of the person performing the task.

The model suggests that if there is a sudden increase in the demands of the task that goes beyond the scope of the person carrying out the tasks' capabilities, then an accident will occur. An example may be increasing the speed of a production line conveyor belt so that the pace becomes so fast for the workers that they cannot carry out their jobs safely.

Not only can an unexpected increase in the demands of the task cause accidents to happen, but also if there is a sudden or severe decrease in the human performance being applied to the task then an accident can occur. An example would be a worker having their attention distracted by the presence of a bee hovering in their face, thereby distracting them from the task at hand (Keough, 2002).

Another general behaviour human factor theory of accident prevention is Surrys' "Decision Model" of 1974 (Figure 1). As can be seen by the model there are two different sections to the figure, which are 1. The danger build up period and 2. The danger release period. The paradigm suggests that the workers initial responses to the warning signs or clues being presented in the perception phase of the build up are important to the events' continuation.

In the perception stage of Surrys' accident prevention model, the worker can either misunderstand or fail to detect the initial clues that are being presented which in turn allows the danger to continue to build. When the event reaches the imminent danger phase the accident has already begun to take place and the model moves into the danger release period.

The model indicates that even though the worker may have failed to recognise the initial signs of the danger build up prior to the accident, their actions during the danger release phase can still have a direct result on the outcome of the event. For it is still possible to stop the accident from becoming a major event. Therefore it would seem logical that workers should be trained to a level that permits them to be able to recognise and identify these warning signs as they occur on the job and the corrective actions needed to be taken to control the release of the danger.

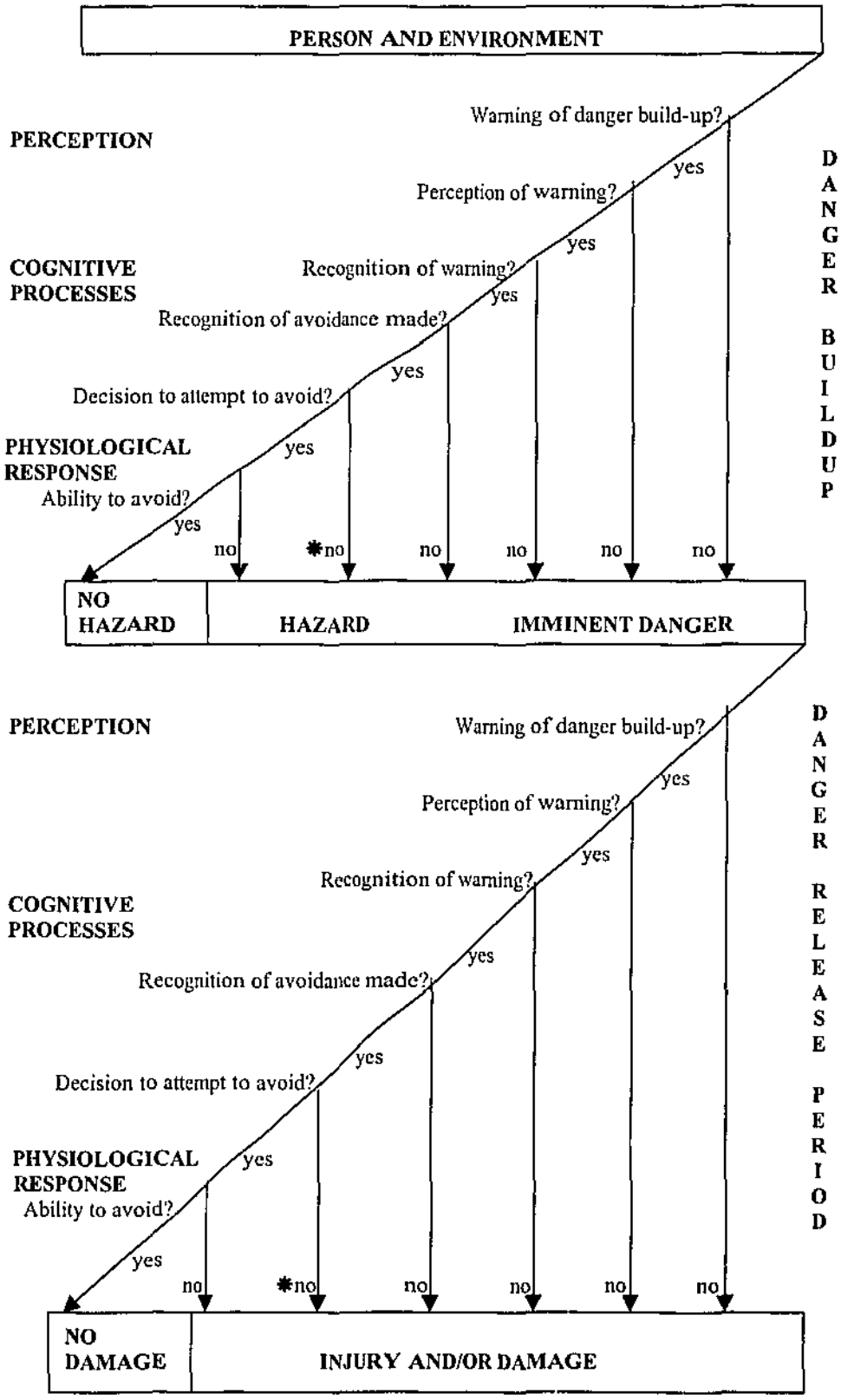

Figure 1. Surrys' decision model of the accident. Reproduced from p. 34 of D. Viners' "Accident Analysis and Risk Control"
Note: * = Risk taking

When discussing the safe operation of a construction crane it is important to also look at the machine person interface that occurs during the operation of these machines. The machine/person interface empirical model (Figure 2) shows the different elements that are involved between the worker and the machine. The three main groups in the model are 1. Machine. 2. Human. 3. Environment. These groups are further sub-divided into different elements, however the inter-relationship between the elements contained in the model is clear, with most of the elements having the ability to impact on each other. An operator needs to be aware of the possible build up of danger from not only the task that is being undertaken but also from the surrounding environs.

It is incumbent on the training providers to ensure that trainees are given ALL of the necessary information required to be able to safely operate a construction crane. This information must include all of the warning signs that are presented to an operator by both the machine and the surrounding environment in the danger build up phase of an accident along with the correct remedial actions that are needed to address the situation.

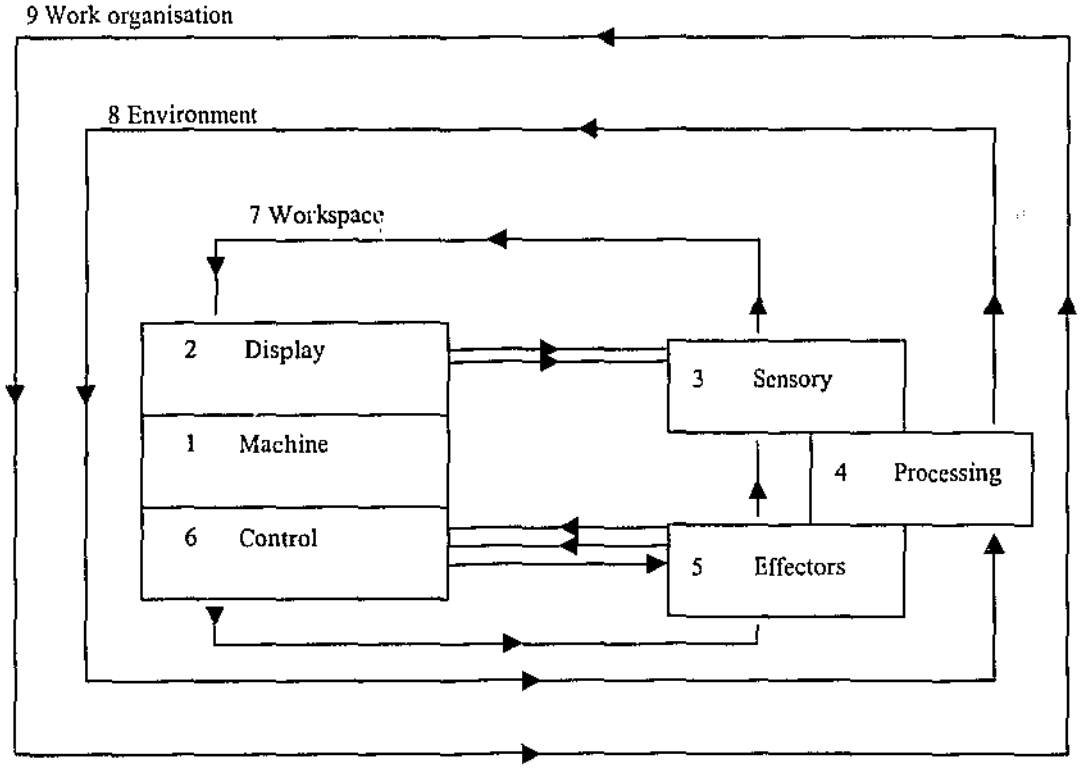

Figure 2. Machine person interface (empirical model). reproduced from p.6 of T.B. Leamons' "Introducing Ergonomics"

Elements groups;

1. Machine.	4. Human.	7. Environment.
2. Machine.	5. Human.	8. Environment.
3. Human.	6. Machine.	9. Environment.

Sensory elements. 1. Sight. 2. Hearing. 3. Touch. 4. Smell. 5. Taste.

Main effector elements. 1. Hands. 2. Feet. 3. Voice. 4. Body mass.

If this information is not provided to the trainee along with the provision of practical demonstrations of what is meant, then their training is incomplete, as all they have been taught is how to pull some levers.

An example to tie the accident models together in relation to the safe operation of a construction crane could be as follows;

The task at hand is to remove a large ($60m^2$) formwork shutter from the outside of a completed concrete pour and to relocate it in a holding yard. The weight of the shutter is just on the limit of the cranes SWL (stability), however the lift can be carried out safely. Whilst the shutter is being freed for hoisting by the crane by other workers, there is a marked increase in the strength of the wind. The crane operator had only recently obtained their competency certificate and had not been trained to or had to operate a crane in strong winds before.

The formwork shutter was finally released and readied for removal by the crane. The operator was directed to go ahead and start the lift. When the shutter was clear of the completed concrete and was being hoisted into the air, the wind force created was enough to be able to "push" the load outside of the cranes hook radius and SWL limits, thereby causing the crane to overbalance and fall.

The wind is an environmental factor that needs to be considered in the machine/person interface, however considering it and knowing what to do about it are two different things. If trainees are not trained in the cognition of all of the danger signs presented during the danger build up phase including feedback from gauges and the machine itself, then accidents are going to occur.

CHAPTER 3. Literature review.

3.1 Introduction.

A search for literature that would be directly related to the research question has revealed that no such studies have been conducted at this stage, or at least which can be identified. WorkSafe, the state government department responsible for the issuing of certificates of competency, may have carried out internal research that has not been published or disseminated to interested parties.

When a crane is involved in an accident on a work-site, workers can be injured or killed, the crane can be damaged or totally destroyed, also the damage to the surrounding infrastructure can be catastrophic. Apart from the loss of human life, with one accident alone claiming the lives of 36 workers, the cost of these accidents to industry, because of poor training, can be more than $US100,000,000 from a single event (Ritchie, 2002; Peeks, 2003).

During the three years 2000-2002, there have been at least 300 deaths reported worldwide that were directly attributed to lifting crane accidents. These figures would only indicate part of the problem as they are only the accidents that were reported to one inter-net site called Crane Accidents.com, during the same three year period there were a total of 516 crane accidents reported to the same site. (Ritchie, 2002). This equates to the death, on average, of one worker for every 1.72 accidents that were reported to the site.

At a recent meeting of the Construction Forestry Mining & Energy Union (CFMEU) crane operators in the metropolitan area of Perth, which was attended by 200 members, concerns about the competence of persons assisting crane operators in their duties (dogmen) were raised (Murphy, 2002).

A motion was passed at the same meeting by these operators and reported by Murphy, (2002, p. 27) which states, "...there was a unanimous show of hands resolving that no driver would exceed their cranes limits from this day onwards". It is felt that the proposing and passing of this motion tends to indicate that there is a

culture currently amongst this group of operators of regularly overloading their cranes.

The researcher clearly recalls a similar motion being moved and passed during a meeting of a group of crane operators that had been convened by the researcher when working as an organiser for the CFMEU during the early 1990's. Thus it would appear to the researcher that nothing has changed in the last 10 years amongst this group of operators.

In Western Australia recently there has been several major accidents involving lifting cranes. Although there was some property damage involved in these accidents fortunately nobody was injured or killed (Phillips & Pratley, 2002). These accidents prompted the Minister for Consumer and Employment Protection (Mr. J. Kobelke. MLA) to commission a report into crane safety which led to the formation of the Crane Safety Standards Working Party.

The working party tabled their report findings to parliament on the 5th of August 2002. The report indicated that the demographics of the industry are, the operators, generally speaking, were middle-aged workers with an average age of around 45 years. The committee reported that the current trend in the crane industry is for operators to stay in the occupation until retirement. (Cooke, 2002). This would indicate that the current batch of operators still has on average a further 20 years of crane operating before they leave the industry.

Two recommendations made to the government by the working party which involved operator training were, 1. Work experience of crane drivers to be assessed through the use of logbooks and 2. Crane operators to undertake refresher training every five years (Harvey, 2002).

Experience is difficult to measure and some researchers would suggest that experience should not be measured by its' quantity or length but rather by the quality of the variety and intensity of each experience (Brookfield, 1995).

For example if a crane operator with 20 years experience on the same job is compared to an operator who has operated several different types and makes of cranes over only a five year period, the first operator should not be seen as being more experienced. It could be argued that the first operator is a more "competent person" at that particular task, but it should not be said that they are more experienced than the latter operator is.

The working party also reported that the current Australian Standard, "AS 1418.1 – 1994 Cranes – General Requirements" suggests a design life for the machinery of twenty-five years. Incidental evidence presented in the Crane Safety Report suggests that the current trend overseas is for a reduction in the design life of cranes which is significantly below the current twenty-five years applicable in Australia (DeCesare, 2002).

What is important with machines that are nearing this age is that they need to be kept in top operational order through the implementation of regular inspection and maintenance programs. This includes ensuring that all of the operational safety features on the cranes are working for the purpose of training delivery and assessment. The researcher raised concerns about a missing safety feature from one of the cranes used for crane operator training provision and assessment in the Perth area with WorkSafe. The missing safety device, an anti two-block, is to prevent the operator from creating what is known as a two-block situation.

3.2 Training.

Worldwide billions, if not trillions, of US dollars is expended on training across a broad range of industries during any given year (Tucker, Glover, Long, Haas & Alemany, 1999; Robinson, 2002). For an organisation to reap the benefits of training, it is important that the training is delivered in the most effective manner that is available.

The constant introduction and development of new materials and products onto the market along with the emergence of new technologies has seen workers no

longer able to rely on the skills that they were originally taught in their initial training (Construction Industry Training Board, 1998).

Training delivery can either be by an on-the-job method, where the skills are learnt in the workplace, under working conditions or the other popular method of delivery is via a classroom setting, where trainees are given theoretical information and simulated problems to solve. However, Docherty (1996) & Smith (1999) found that skills are learnt better through a workplace setting as opposed to a classroom setting.

All training programs must meet the learning objectives that have been set for the program. This is whether learning is referring to a behavioural change or to cognitive development. This may entail, in some areas of training, teaching to only small groups of trainees, and in some cases training may best be delivered on a one-on-one basis on-the-job (Hanson, 1998). It is important that training, as near as possible, imitates real workplace problems which shows cogency with actual workplace conditions.

Other important factors that are often overlooked in training is the trainees capacity to undertake the training, for instance their hand-eye, eye-foot co-ordination skills and also their personality (Cabahug, Edwards, & Nicholas, 2003).

3.2.1 Adult training and learning styles.

Whilst not espousing that there is any clearly exclusive theory as to the effectiveness of any of the specific adult learning paradigms it is important to look at some of these styles in brief.

3.2.2 Andragogy.

This learning paradigm focuses on the process of the adult learner taking control of his or her own learning. The word first appeared as a training terminology in 1833, when used by Alexander Knapp, a German teacher, when he referred to Platos' educational theory (Dover, 2003). However it was not popularised until 1970 when the word was coined again by the modern adult educational theorist Malcolm

Knowles (1913 – 1997) in his book called *The Modern Practice of Adult Education: Andragogy vs Pedagogy.*

Knowles theorised that although adult learning is complex he found that their style could be summarised into four main points, which are 1. Adults need to know why they are learning something. 2. Adults have a repository of a lifetime of experiences on which to draw. 3. Adults are more likely to want to use a hands-on approach to learning. 4. Adults want to be able to apply what they have been taught immediately. (Dover, 2003).

Eventually, in 1985 after criticism from other authors, like Davenport & Davenport, Knowles came to see pedagogy and andragogy as being likened to a pair of bookends within which all learning falls, and not as the original dichotomous paradigms he had first theorised. In fact learning can be seen as a continuum from one to the other (Knowles, 1970; Brockett, 2003).

Knowles 1970, p.50 described adults by saying they "*are* what they have *done*", and found that they needed to have the experiences that they bring to the class recognised or they will feel a sense of rejection (Knowles, 1970; Brookfield, 1995). Research by authors like Savicevic, (1991) & Vooglaid & Marja, (1992) also found that the emphasis on experience is central to the development of the concept of andragogy and should be seen as the main difference between learning as a child and as an adult. A person's life experience needs to be seen as a critical component to their ongoing evolution as an employee.

3.2.3 Critical reflection.

Brookfield (1991) saw this style of adult learning as being "purely adult" with its origins in developmental phycology. Several researchers have all agreed that this type of learning is context or domain orientated (Collard & Law, 1989; Elkpenyong, 1990; Clarke & Wilson, 1991). The paradigm itself relates to the way adults are able to take a personal belief that they have long held as being true and, with the use of their capacity to reason, accept that there may be other ideologies and values that in reflection makes that belief obsolete.

Mezirow is probably the researcher most responsible for the development of this learning paradigm through his theory of transformative learning (Clark, & Wilson 1991).

3.2.4 Action Learning.

This is a form of on-the-job training, which has all of the benefits that this type of training offers which is; 1. One-on-one training (mentor system). 2. Provide exposure to specific events and occurrences. 3. Job rotation with which to acquire ALL of the skills required for the task. 4. Provide specific problems that need to be solved. 5. Safety behaviour modelling of the employee is possible.

3.2.5 Humanism.

This is yet another form of on-the-job training that Elias & Merriam (1980) stated had three critical elements and they are 1. Each person is different and has different needs. 2. The trainer should be a partner. 3. The training must be important to the learner. Shapiro (1986) later expanded this list to 16 elements, which he developed after conducting a survey of 89 other researchers in the field of learning, however Elias & Merriams' three elements were still central to that list.

When noting some of the challenges currently facing humanism, Brocket (2003), sees strong opposition from the competency based training systems and also religious groups because often the major criticisms directed at humanism is the emphasis that is placed on an individuals development.

3.3 Barriers and motivation factors that influence learning.

Cantor (1992) says that adult learners could be said to be autonomous, goal orientated, practical problem solvers who largely bring their own motivational reasons for learning to the classroom. Some of the variables that motivate adults to learn are,

1. To make and maintain personal relationships.
2. To meet the external expectations of others.
3. Learn how to better serve others (employer).
4. Escape or stimulation.
5. Personal interest.

Cantor (1992) also listed the following variables as barriers to adult learning,

1. Other responsibilities (family, career, social commitments).
2. Lack of time.
3. Lack of money.
4. Lack of child-care.
5. Poor scheduling.
6. Transportation.
7. Insufficient confidence.
8. Having to learn.

Apart from the variables that are listed by Cantor, there are others that can have an effect on peoples' abilities to learn, some of which are; 1. Social upbringing. 2. Risk taking attitude. 3. Ethnicity. 4. Gender. As well as the factors just mentioned, Cabahug, etal (2003) found that there are at least fourteen (14) other personal factor variables that can be measured when establishing operator proficiency.

3.4 Judging training effectiveness.

Cohen & Colligan (1998) noted that there were many possible problems found in their research when it came to evaluating training. This was mainly because of the multitude of contributing/effecting variables that can be used, especially if workplace injury rates are one of the variables to be assessed. In a report which investigated almost 160 crane accidents in the United States during 1997-1999, lack of training was found to be one of the major secondary causes behind most of these accidents (Yow, Rooth, & Fry, 2000).

In some cases once training has been delivered it is then important to be able to measure the effectiveness of that training. A major problem that exists within the current standard for crane operator training (NOHSC: 1106 (1995) is that there are no requirements for the training programs to be audited, either internally or externally (Bradley, 2002). If auditing of training was compulsory then the quality of the training program could be assessed to find establish its' efficacy.

Auditing would also help to prevent a recurrence of the situation that was reported under the story title of "Work Cover" by reporter Adene Cassidy and which went to air on Tuesday the Twenty-fifth of February, 2003 on channel sevens "Today

Tonight" program. It was revealed during the program that a registered crane trainee assessor in New South Wales had been caught fraudulently issuing hundreds and possibly thousands of certificates of competency to people who showed up with the right amount of money. Fortunately the assessor has since had the registration as an assessor cancelled (Cassidy, 2003).

It is important to be able to differentiate between the different types of training delivery methods when it comes to the assessment of competence. Skills are much easier to judge when they are assessed under actual workplace conditions as opposed to a classroom system of assessment (Thomson, 2002). Also, when using the classroom delivery method there can be a tendency for the trainer to move from one module to the next without ensuring that the group as a whole has a full understanding of the last module.

Unfortunately they, the trainers, often do not revisit those modules to ensure trainee knowledge. The duplication of workplace conditions for the purpose of delivering training by a training establishment, is extremely difficult if not impossible, which in turn makes it difficult for the trainee to be assessed under actual conditions that they would find in the workplace (Thomson, 2002).

The value of doing, rather than just passive learning, can be seen in the percentage of information that is retained by each specific training activity. An American study conducted by Potter (1999) found that students retained the following % of information by activity;

- Reading 10 %
- Hearing 20 %
- Looking at pictures 30 %
- Viewing exhibits. 50 %
- Talking 70 %
- Doing the real thing 90 %

Another researcher (Smith, 1999) found that a combination of both on-the-job and classroom training can be the most effective depending on the skill. She went

on to say that research would suggest that we learn over 75% of the skills needed to carry out a task if shown how to do it by someone else.

Thompson found that the immediate reinforcement and practice of any new skills learnt in the workplace is critical to the overall retention rate of these skills (Thompson, 2002). Other researchers have also found that the longer the delay in applying newly acquired skills in the workplace, the less likely that the gaps that are present in the work system are going to be joined through training (Foxon, 1994).

This supported a study by Sitterly, Pletan & Metaftin in 1974 when they found that depending on the complexity of the skill learnt, the capacity to do that task can be lost in as little as one month if not reinforced immediately through practical application.

Tomkins, (1997) identified 10 reasons why training may not be effective, the most relevant of these would be the concept of Just-in-Time (JIT) training. JIT is delivered only after there has been a training need identified within the organisation which in turn allows the trainee to be able to immediately apply the new skills that they have learnt directly to the workplace, as the need for that skill has already been identified.

Smalley, (2001) developed a six-step framework to evaluate training effectiveness. The system relies on the person receiving the training to have a base level of competence established before training is delivered and then having that level measured against their competence after training.

Another researcher, Kirkpatrick (1967) listed four steps that can be used in the evaluation of the training's effectiveness, and they are 1. Trainee reaction. 2. Knowledge/Skills acquired by assessment. 3. Behavioural change. 4. Results/Benefits to the company.

Cohen & Colligan (1998) found that many different authors all agreed that there are five critical elements that need to be observed for training to be effective and they are; 1. A need assessment should be carried out (If the skill is not going to be

used then it will be lost. 2. Establishment of a firm training objective. 3. Course must have a specific content. 4. Need to take into account people's individual differences. 5. The training environment/conditions must be conducive to learning.

Studies conducted by the National Institute for Occupational Safety & Health (NIOSH) and the Bureau of Mines (BOM) in the United States of America produced three observations in relation to the evaluation of training which were; 1. An organisations' safety record is linked to their training commitment. 2. The difference is relevant to the commitment. 3. Supervisors need to play a role in reinforcing training (Cohen, Colligan, 1998).

A descriptive analytical American study into Return-On-Investment (ROI) made by a company into training and which relied on base measurements being established before training, found it was difficult to give an actual monetary value to training because of the many unmeasurable variables (Tucker, et al. 1999). One of the major difficulties that this group of researchers faced was to isolate the actual effect of training. Because of the fragmented nature of labour in the construction industry there is the possibility of contamination to be taken into account.

This can occur when a member from the trained group moves to another location and interacts with others who have not been trained and passed on information that they had learnt. This would allow the person from the control group to pick up these new skills without having undertaken any formal training themselves. Another difficulty is that the effects of the training may take a while to show any monetary gain to organisations (Tucker, et al. 1999). Other areas of concern for future research into ROI studies were also identified. The most important appears to be the consideration needed to be given to the broad range of variables that could possibly have an impact on training benefits and outcomes (Tucker, et al. 1999).

Chan, (1994) was elated in the conclusion of his report by the fact that so many people have been trained as workplace health and safety officers (WHSOs) since the self-regulation of the Queensland training industry in 1989. The report also goes on to extol the quality of the training that was delivered to these WHSOs, this is despite there being no evidence introduced by the report to support that assertion

(Chan, 1994). Although increased numbers of health and safety officers can only be a good thing for industry what is more important is the quality of the training delivered and the trainee that is produced by these training facilities.

In Cohen & Colligans' review on the effectiveness of occupational health & safety training, they found that the reason most often given for the lack of evaluating of training programs was the "unquestioned" belief that "training works". They also found that the attempts to establish internal validity, was often carried out with the use of key performance indicators, which did nothing to establish program validity.

The current position of not auditing training programs would seem to go against the principles on training and education that are found in guideline Z 1.11 of ISO 9000, a standard that Australia has adopted. Two of the five major principles contained in ISO 9000 are:

1. To be successful training programs need more than just good trainers.
2. Training and educational deliveries must be subjected to ongoing auditing of standards to ensure that objectives are being met and the quality maintained (Rosso & Rosso, 1996).

By failing to audit the training programs that the training organisations are delivering the Department of Training, the group responsible for their registration, is missing the opportunity to identify and address any weaknesses within these courses, which may be occurring on a consistent basis.

WorkSafe is intending, according to the head of the certification department, to commence a program in the near future of reassessing trainees who have recently completed their certificate of competency assessments in Western Australia. The plan is to issue any person who fails this assessment with an improvement notice requiring them to undergo further training and assessment (A. Bowen, personal communication, May 23, 2003).

Whilst the department should be applauded for taking an interest in the validating of the assessment process of crane operators that is occurring in Western Australia, the issuing of improvement notices on the trainees will not address the

problem. Any improvement notices should be issued to the training delivery organisations themselves and not on the trainees, for the trainees can only learn what they have been taught by the training group. By requiring the trainees to return to the training organisations for further training WorkSafe will be indirectly rewarding the training organisations for failure, by creating more work for them

3.5 An international perspective.

In both the United States and the United Kingdom crane operator-training systems have developed in a very ad-hoc fashion up until this point in time (Cohen, Colligan, 1998; Cabahug, etal, 2003).

In the United Kingdom there are around twenty main training bodies that are responsible for crane operator training, some of these training bodies form co-operatives that are made up of groups of up to 200 independent companies. These cooperatives supply operator training to a number of different industries and not just construction. The Construction Industry Training Board (CITB) runs one of the major schemes which is called the Construction Skills Certification Scheme (CSCS). They operate this scheme in cooperation with the Main Contractors Group (MCG) with their overall aim being to provide industry with a consistent approach to the Construction Plant Competence Scheme (CPCS).

Within the CPCS there are a group of five independent training providers who all work to similar standards in an attempt to provide the MCG with a highly skilled/competent workforce. A major flaw with the CITB scheme is the prohibitive costs that are involved, which leads to a situation where only the larger sized organisations are able to afford to participate. This has the effect of creating a two-tiered training strategy within the construction industry. Certificated operators of cranes who operate offshore are re-assessed every two- (2) years; this reassessment takes three days. The operators, when attending these reassessment courses, are also required to produce a logbook of their crane activities for the prior two years.

Although their system of training is far less prescriptive than many other developed countries North America is the only country whose government provides the funding to support occupational safety and health training (Heath, 1982).

In the United States there were no requirements for the operator of a lifting crane to be certificated as being competent prior to 1999, they were just designated as being competent by the employer. Now that there is a requirement for the certification of crane operators in the United States there is a move to make the training delivery methods for crane operators to be the "on-the-job" type of delivery (Ritchie, 2002).

The Occupational Safety & Health Administration (OSHA) formally recognises the current certification program that is operated by the National Commission for the Certification of Crane Operators (NCCCO) when it comes to recognising their own (OSHA) competency training requirements. NCCCO itself was formed in late 1995 to establish and develop performance standards for operators of cranes. Their certification program is formally accredited by the National Commission of Certifying Agencies (NCCA) and recognised by the National Skills Standard Board (NSSB).

The OSHA guideline is of a voluntary nature and one that encourages trainee participation. The guideline also invites the use of andragogical principles of learning when delivering the training (Cohen, 1998).

3.6 The Australian perspective.

The Commonwealth, State and Territory Governments deregulated crane operator training delivery methods in Australia in 1994 as part of the training reform agenda's contribution to micro-economic reform. The new system of certification and competency assessment is now to be found in appendix B of the National Occupational Health and Certification Standard for Users of Industrial Equipment [NOHSC: 1006 (2001)].

This was the first competency based national Occupational Health and Safety Standard to be released in Australia. Although the standard was legislated in

December 1992 it did not come into effect until the middle of 1994 (Gutteridge, 1998).

Under the new national competency system, crane operator training is delivered in a modular format by some direct operation of a crane in a training facility in combination with some classroom work. This training, depending on the classification of the certificate being sought, is carried out over a 10-day period.

The training providers are often then responsible for assessing of the competency of these people. This is because most of the trainers are often registered assessors also. Thomson, 2002, p. 1 however, believes that "assessing workplace competence is not a job for training colleges." Also the possibility of a conflict of interest arising must be very real.

If the training provider passes the trainee as having met the performance criteria for each competency element involved in being certificated, the trainee is then given an interim 60-day certificate. Before that 60-day period expires, the certificating authority (Worksafe) will issue them with their national operators' certificate which is valid for life and is not the subject of any further tests or examinations (NOHSC, 2001).

The employers' attitude to the method of training currently being used in West Australia in relation to crane operators was not possible to gauge because of the non-participation of those groups in the study. Their attitude to the training provided is crucial to the possibility of a new operator being able to gain experience and thus retain the new knowledge and skills. This can be seen schematically in Appendix G

The Building and Construction Industry Training Council (WA), reports that although training is usually given on-the-job, entry to the occupation can also be gained through the "New Apprenticeship in Civil Construction (Plant)". However they do point out the fact that the employment demand for crane operators is low (Building Construction Industry Training Council, 2002). The report's assertion that training is usually delivered on-the-job when clearly the main method of training

delivery is through the use of training providers in a classroom setting, is a puzzling and misleading one.

3.7 Simulator training.

An alternative approach to training that is starting to gather pace in industry overseas is the use of crane simulators. Not only can simulators be used for assisting in the training of first time operators they can also be used for concurrent, remedial and procedural training. It is important to note that the use of simulators as training aids should be seen as just that, an aid to training and under no circumstances should simulator training replace the direct operation of the crane during training.

There are currently many different crane simulator models on the market which cover a large variety of crane types and configurations with new models being released onto the market on a regular basis through trade exhibits overseas and which can cost up to $A1,000,000 for a complete package (Rudolph, 1999; Cheslin, 2002).

For a simulator to be effective the operation of the machine must be realistic, that is to say the use of a full motion simulator would be the preferred option. There are many benefits that can be achieved through the use of simulators in training, some of which are,

1. Eliminate safety risks to other personnel.
2. The ability for an operator to make a serious mistake without there being any risk or injury to anyone or damage to the machine or surrounding infrastructure.
3. Can train an operator safely in dangerous or emergency conditions.
4. Able to provide a wide variety of rare encounters and conditions.
5. Available on a year long basis.
6. Identify areas where the trainee may be weak and practice in those areas (IADC, 1999).

It may be appropriate at this stage to give some comparisons with the hours of training that is required for some other occupations, for instance to qualify to become the pilot of a Lear jet a trainee must accumulate 150 – 200 hours total solo

flight time. A total of 170 hours, without prior experience, to become qualified as a US army pilot and the hours needed for F-14 & F16 pilots in the US airforce are 375 and 305 hours respectively (Hedrick, 1999).

3.8 Training expenditure in Australia.

During 1996 it was estimated that employers in Australia spent around $4.3 billion on training delivery (Robinson, 2000). The amount expended on training during the September quarter of 1996 (July-September) was $A1,178,800,000. Although this was an increase of 7% over the 1993 figures, the actual expenditure per employee fell by 3% (Robinson, 2000).

Of the amount expended during the September quarter of 1996, the construction industry, which is an industry of interest to this study, spent only $A28,500,000 on training, or $A100 per employee @ 1.25% of gross wages in the industry. This ranked them as the third lowest expending industry group behind retail trade and accommodation/cafes/restaurants. [$A78,200,000 ($A88. per employee) $A18.400, 000 ($A55. per employee) respectively.] (Robinson, 2000).

When the mining industry (who are also an interest group of this research question) is compared to the construction industry, it would show that the mining industry expended a total of $A65,300,000 ($A896 per employee) on training. This placed them, on the basis of dollars invested per employee, at almost double the amount expended by the second highest industry group [(electricity/gas/water supply) ($A481.per employee)] and almost nine times that of the construction industry (Robinson, 2001).

3.9 The future of crane operator training in Australia.

A 1991 report commissioned by the Victorian Minister for Industrial Relations looked into the coordination of training in the areas of cooperation and consistency of delivery. The report recommended that the National Occupational Health and Safety Commission (NOHSC) should influence others to achieve key

OH&S competencies, including key workplace workers like the operators of plant/equipment (Else, 1992).

The Department of Education and Training's construction planning advice indicates that industry trends are leading towards initiatives such as continuing compulsory education of certificate holders in the construction area (Department of Education and Training, 2001).

The Western Australian Crane Safety Standards Working Party that recently reported to parliament recommended that even after crane operators have been working in the industry for five (5) years they should then be required to undergo refresher-training (Harvey, 2002). At the recent Crane Industry Safety Forum the chairman of the working party, Mr Tony Cooke, repeated his assertion that appeared in the report... " It would be easier for me to obtain my crane operators certificate than it would be for me to get a passenger vehicle drivers license in the state of WA. *This is an appalling state of affairs*" (Cooke, 2002).

The WA Construction Industry Training Board has presented some possible new pathways for entry into the construction industry. There are five possible models represented in the report and it is important to note that all five of the models include a combination of both classroom and on-the-job training delivery methods. The paper calls on the construction industry to increase their expenditure and support for training in the industry (Construction Industry Training Board, 1998). However the training expenditure figures produced earlier in this report would tend to indicate that this would not be the case.

A recent editorial by Hall (2002, p. 1) asks the question, " Is Australia's printed materials approach to training the most appropriate way to go?" He goes on to argue that even though there may be evidence of training commitment in the tonnes of printed material that has been generated on training, there is nothing to say whether this material is either being used correctly or if at all (Hall, 2002).

3.10 Summary.

According to recent research, providing training which includes an on-the-job component in its' delivery, is emerging as one of the most preferred methods of transferring new skills to a trainee (Tomkins, 1997; Hanson, 1998; Skaar, 1998; Mayhew, 2000). Attempts were made to determine the existence of research findings that would support, or de-bunk, the current pedagogical training delivery style that is being used in industry to-day in a bid to avoid any possible bias from occurring. No such supportive literature was found.

The current competency based system of crane operator training in Australia has seen the requirements to become qualified fall from a level that was on par, in number of hours of solo operation required, with that of a fighter pilot. To a system now that requires as little as 2 hours of practical operation of a crane before an assessment. As with many competency based training systems, there is an expectation by the trainee that everyone attending a crane operator-training course will pass the assessment.

The employers' attitude to the method of training being provided is crucial in the training loop as they take on the role of gatekeepers. This is displayed in a schematic way in Appendix G. The model would suggest that when a positive attitude is applied by the employer to the method of training being delivered then there is every chance of that the training will be reinforced and retained by the worker. If, however on the other hand the employer takes a negative view the new skill will be lost in a very short space of time.

The dangers presented by the incorrect operation of a construction crane can be devastating. Property and infrastructure damage can run into millions of dollars for any one singular event and there is also the potential for loss of life for the operator of the machine, other workers and the general public. The combining of an improperly trained operator and a sophisticated, technically advanced piece of machinery, is the brining together of the ingredients of a recipe for failure (Ritchie, 2001).

Although the Australian national competency standards allows for uniformity across industries of the skills to be delivered in training, what they do not provide for is the standardisation of the delivery of this information to trainees. By failing to take the opportunity to audit their training programs, the training bodies are missing out on the opportunity to identify and address any weaknesses that may be occurring within their course. Without the use of program auditing to establish the courses' efficacy, the ongoing delivery of that training may mean the ongoing teaching of an improper procedure.

Forecast employment growth for the construction industry (3.9%) and the mining industry (2%) tends to indicate that there will be a need for continued growth for competent people in both of these areas. If current trends and initiatives are implemented, then there is little doubt that the continued training and re-training of the employee in the workplace may soon become compulsory throughout Australia (Department Education and Training, 2001).

Vast amounts of money are regularly expended on training throughout a variety of industries within Australia in any given year. Therefore the need to be able to efficiently deliver that training is critical (Gibb, 1998). For industries to be able to reap the full benefits of the monies that they expend on training each year it is crucial, for the retention of these skills, that once learnt the skills are applied immediately and directly into the workplace. If the trainees are not given the opportunity to practice the new skills that they have just acquired then those skills will be lost in a very short period of time.

If simulators are to be used to supplement crane operator training then it is crucial that the correct style of machine be used, one that will replicate actual workplace conditions and transmit all of the motions and feelings that are associated with the actual operation of a crane. Without the use of full motion simulators the psychological effect of the cranes operation will not be able to be replicated and this in turn will not produce a sense of reality which is required.

Cohen and Colligans summary on the findings of the modes of training delivery used by several researchers, tended to indicate that training which is

delivered on-the-job is the preferred method when compared to a classroom based lecture style (Cohen & Colligan, 1998). He also stated that a major concern in evaluating training is ascertaining what is required to gain the most out of the training through the adequacy of the procedures in use when the training is delivered (Cohen & Colligan,1998).

For example the trainee may have been given their practical assessment on a lattice jib crane and then be given their reassessment on a hydraulic crane or vice-versa. What is more relevant to the trainees' training, is the logistical infrastructure that is used by the training delivery establishments in the practical delivery section of their training. It is of little use to train people to operate cranes that are on the limit of, or if not past, the design life of the machine as recommended by Australian Standard "AS:1481.1 – 1994 Cranes – General Requirements" which is currently twenty-five years.

CHAPTER 4. Methodology.

4.1 Study design.

The study was designed to be of a descriptive analytical nature, which was chosen to give a snapshot of the situation which currently exists and was intended to cover crane operators in the construction and mining sectors of industry. The variables to be measured were,

- Year of certification (pre or post 1994) of operators involved in crane accidents in Western Australia as determined by official government figures.
- Age of operators involved in crane accidents in Western Australia as determined by official Western Australian government departmental figures
- Number of crane accidents in Western Australia since 1994 that were reported to the appropriate government departments.
- Number of crane accidents that may have occurred in Western Australia as reported by the operators of the cranes themselves through the completion of a questionnaire.

- Number of crane incidents that may have occurred in Western Australia as reported by the crane operators themselves through the completion of a questionnaire.
- Number of years spent operating cranes (overall).
- Number of years/months spent operating current crane.
- Preferred method of training delivery for operators of construction cranes, as determined by the completion of a questionnaire.
- Method of training undertaken by operators involved in crane accidents in Western Australia since 1994.
- Average number of hours worked by crane operators in Western Australia.

4.2 Letter to interested groups.

A pro-forma letter (Appendix A) was sent out to state government, industry and employee groups informing them of the study and inviting them to participate. Meetings were then arranged and held with representatives of the groups who replied and indicated that they wished to take part in the study. These meetings were to clarify what type of information assistance or data collection was being sought from their group/organisation.

Numerous attempts were made to make this study tripartite by including all three sectors of industry, (government, employer peak bodies and employee peak bodies). Whilst the government and the unions involved chose to participate in the study, the groups which represent the employers, which are the Chamber of Commerce and Industry, Chamber of Minerals and Energy and the Crane Hirers Association all declined the invitation. It must be said that the non-participation of the employer groups created several limitations to the study not the least being the lack of the opportunity to measure their attitude to the type of training currently in operation throughout the state.

4.3 Data collection instruments and techniques.

The researcher was required to give undertakings and to provide assurances that the confidentiality of any of the data that was inspected or supplied by the government departments would remain confidential.

4.3.1 Questionnaire development.

The questionnaire (Appendix B) that was used for this study is an original design. The ideas for the structure and the layout were developed from examples found in books by Davies & Kempnich (1991) and Frazer & Lawley (2000). The purpose of the questionnaire was as an adjunct to the study in an to attempt to gather a further indication, from the crane operators themselves, of the number of crane accidents and incidents that may be occurring and that which may not be reported to Worksafe.

The original questionnaire (Appendix C) was pilot tested with fifteen (15) crane operators. Ten of the questionnaires were completed by the operators without any assistance from the researcher whilst the other five were filled out with the assistance of the researcher. The reason that the researcher assisted in completing five of the questionnaires was to help to immediately identify and address any problems that may be occurring in interpretation with the person who was filling out the form.

The data from the 15 completed sample questionnaires was entered into the Statistical Package for Social Scientist (SPSS) program, version 10, for analysis. The data was cleaned and checked for normality in accordance with the procedure laid out on pages 44-48 of the SPSS survival manual (Pallant, 2001).

During the analysis of the "pilot data" it was discovered that many variables being measured had no relevance to the hypothesis that was being tested or could not be measured. It was originally intended to attempt to establish trainees' impressions on the appropriateness of the training that they had just been delivered.

Unfortunately, because of the reluctance of the employer groups to participate in the study, it was going to be difficult to be able to obtain access to new trainees for the purpose of having them complete the section of the questionnaire (Section 3. Q17 – 29) that had been allocated to them in the original design. These questions were therefore omitted from the final study questionnaire.

It was through the pilot testing of the data that the questionnaire, which was finally used (Appendix B) was developed. The final questionnaire, which was printed on both sides of two pages, comprised of four pages in total including a Disclosure statement (Appendix D) on the front and a definition page (Appendix E) at the back.

4.3.2 Questionnaire distribution.

Questionnaires, including pre-paid return envelopes, were distributed through a variety of different methods, which were;

1. Union mailing lists. The union identified any member of these groups who had crane operator certificates.
2. Questionnaires were taken to mobile crane hire yards throughout the Perth, Kalgoorlie and Geraldton areas of Western Australia for crane operators working at these yards to complete. Spare questionnaires were left at the crane depots for operators who were not present at the time of the visit to complete and return by the pre-paid postal envelopes that were supplied.
3. Questionnaires were left at the offices of labour hire companies throughout the Perth metropolitan area, along with a brief explanation about the study and an invitation to crane operators to participate (Appendix F).
4. Questionnaires were also left at the offices of national job network members, with the same explanation (Appendix F) and invitation to participate.
5. Questionnaires were taken to the Burrup peninsular natural gas construction site for crane operators who are employed there to complete.
6. Several different mining sites in the Goldfields/Gascoyne areas of the state were visited, where crane operators were given an explanation of the purpose of the study and asked to participate.

The questionnaires were distributed for completion from the 20th of February 2003 through until the 30th of May 2003. A total of one hundred and twenty-five (125) completed questionnaires were returned by the above date and was included in the study. Once the returned questionnaires had been collected they were randomised as follows for the purpose of data entry:

1. Page 852 was selected at random from the 2001/2002 Perth White Pages commencing with Dohlad, B. (#2713) and concluding with Dolby, W. J. (6598).

2. The last four numbers appearing in the phone numbers, starting from the top and working to the bottom of each column and starting from the left and moving across to the right of the page, were placed on the envelopes which were gathered at random from the floor.

3. When each envelope had been allocated a number they were sorted into numerical order for the purpose of the data entry.

4.4 Other Data Collection.

The researcher attended the Western Australian Crane Industry Safety Forum that was held in West Perth on the 5th September 2002 where the researcher explained the upcoming study and its' purpose. The verbal presentation was accompanied with contact details of the researcher and an open offer to any interested parties to participate.

Meetings were held during February, March, April and May 2003, with representatives from different government departments and the relevant unions, with the purpose of gathering statistical data that related to crane accidents in Western Australia. The data being sought included information on the number of accidents that were reported to WorkSafe since 1994 and also the age and the year of certification of the crane operators involved in those accidents. Similar information was gathered from the Department of Industry and Resources in relation to crane accidents in the mining industry for the same period of time, 1994 – 2003.

4.5 Data checking and manipulation.

Data collected from the questionnaires that related to the categorical and continuous variables were checked after they had been entered into the SPSS program for outliers and normality. These checks were carried out in accordance with the procedures laid out on pages 44 to 48 in the SPSS survival manual and were conducted before any statistical calculations were carried out (Pallant, 2001).

The age variable from the questionnaire question two (2) was collapsed into three different groups for the purpose of some analysis. The collapsing of the variable took place in accordance with the instructions given for the procedure which can be found on pages 80 through to 84 of the SPSS survival manual (Pallant, 2001). The new variable created was called AGEGP3 (age grouped into three)

The variable that related to the certification year of the operator, question three (3), was collapsed into just two values for the data analysis. The two new variable measures created by the use of the preceding procedure, were 1. pre 1994 and 2. post 1994. The new variable was given the code YOCERT(1).

Question number four (4), the variable that measured time spent operating cranes since initial certification, was also manipulated for the purpose of statistical analysis. The variable for years was collapsed into months and combined with the number of months that had been indicated in the responses. The new variable created was TOTMONTH (total time spent operating cranes (months).

Question nine (9), which is in relation to the reporting or non-reporting of accidents, was also collapsed into just two categories from the original four that appear in the questionnaire for the purpose of statistical analysis. The two new variables created were; 1. Yes or 2. No. The new variable was called WASREPC.

For the purpose of being able to carry out some statistical analysis, the variable for the non-reporting of incidents question fourteen (14) was manipulated using the same technique, into just three responses from the original list of five that

appeared in the questionnaire. The name of the new variable was REPINC (not reported incident).

4.6 Limitations.

There were several limitations of which the researcher became aware as the study went on. These limitations and what actions were taken in an attempt to address them are listed below.

1. It was not possible to quantify the exposure rates for each group of operators, thus the incidence rates and relative risks could not be calculated. Employer groups may have been of assistance in providing the data necessary to answer this question, however despite an invitation to join in the study, they chose not to participate in the research.

2. The inadequate reporting and recording requirements that currently exist in the West Australian "Occupational Safety and Health Regulations 1996" is a major cause for concern in the reporting of all accidents, not just ones involving cranes. The current situation, which only requires notification when a accident results in an employee having to be absent from work for a minimum period of 10 consecutive days or sustains a specific type of injury, obviously would limit the number of accidents reported to WorkSafe. This would mean that a vast majority of accidents that occur in the construction industry are currently going unreported. Questions were included in the questionnaire in an attempt to establish if more realistic crane accident figures could be established through more accurate data.

3. The distribution of the questionnaire had the potential to be exposed to selection bias through the use of the union movement to assist in its dispersion. If the questionnaire were only to be given to members of unions then this would have been the case. However the researcher chose to distribute the data collection instrument through a variety of other sources in an attempt to avoid this bias occurring. The groups used included job network members, labour hire organisations and also crane hire companies whose operators were not members of any unions.

4. The fact that only one operator certificated post 1994, who filled out a questionnaire, claimed to have been involved in a crane accident, made any comparisons in relation to differences between the two groups in relation to accident figures impossible. A new variable was created in an attempt to gather an indication as to what the attributable risk was, however data from this analysis proved useless because of the biased figures.

5. The questionnaire design, which was used as a data collection instrument, made the gathering of all of the relevant information required to answer the research question difficult. In an attempt to overcome the design flaws in the questionnaire several of the measured variables were collapsed into new values for the purpose of conducting the data analysis with what was available.

6. The exposure rates to the different types of cranes (lattice or hydraulic, truck-mounted or crawler-mounted) was not determined.

CHAPTER 5. Results.

5.1 Official government data.

The official data supplied, see Figure 3 & Figure 4, indicates that of a total of 201 crane accidents have been reported to or investigated by the construction and mining sectors of government since 1994. Out of this total there have been twenty-five (25), or 12.5%, which can be attributed to operators who were certificated after 1994. Nineteen of the post 1994 came from mining, the other six from construction. The other 176 (87.5%) of the accidents occurred with operators who were certificated prior to 1994 in control of the machine.

Although the data from the mines sector of industry was useful to establish the operators' certification year, the same cannot be said about the data that was supplied by WorkSafe.

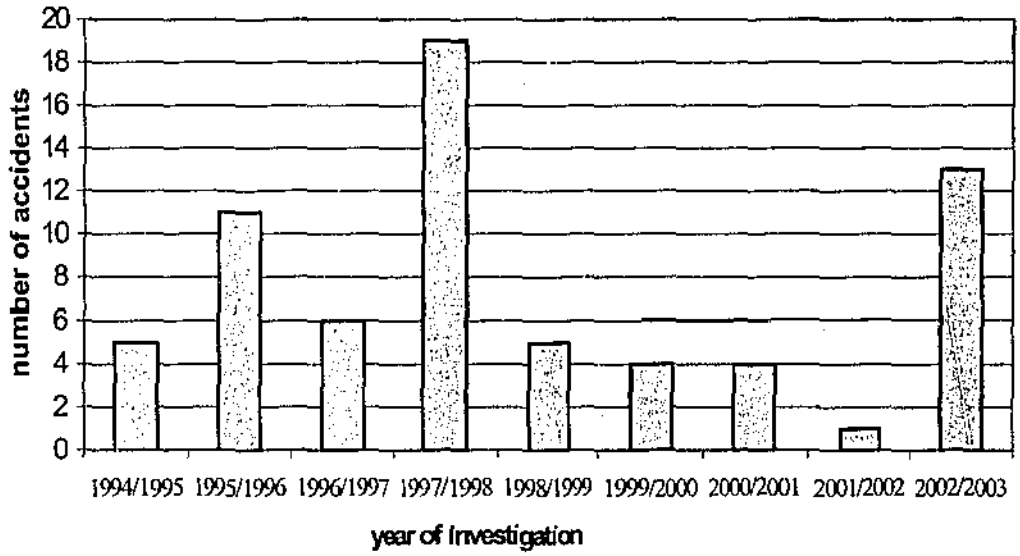

Figure 3. Number of accidents involving lifting cranes and which was the subject of accident investigations by WorkSafe for the period 1994 – 2003.

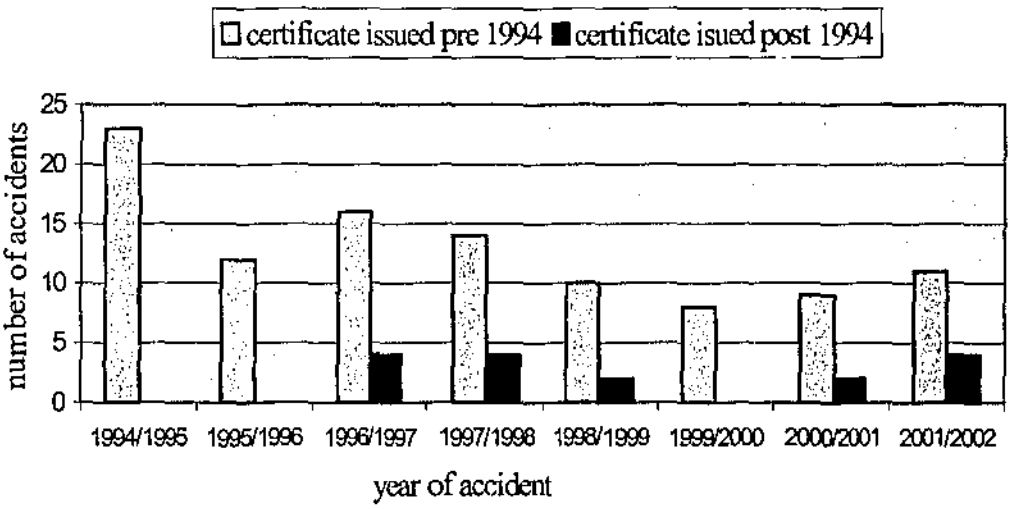

Figure 4. Number of accidents that involved lifting cranes in the mining industry 1994 – 2002 by certification year of operator (pre or post 1994).

In the nine years that have elapsed since the deregulation of the certification process in 1994, from figures supplied by the certificating authority, there have been a total of 14,254 crane operators certificates issued to approximately 10,000 individuals in Western Australia for various classes of construction cranes. The breakdown of the different classes of certificate can be found in Figure 5.

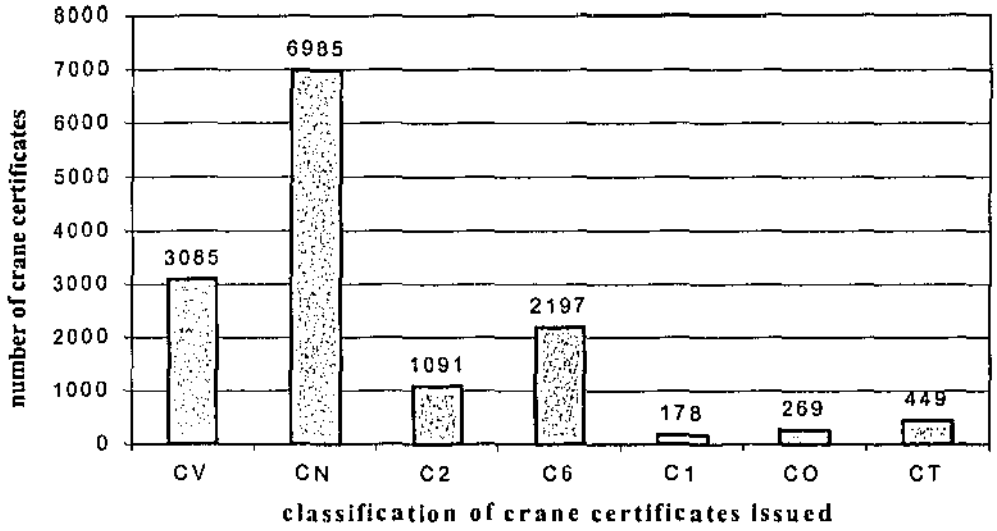

Figure 5. Certificate classifications and the number issued in West Australia since 1994.

Where CV = Vehicle loading crane. CN = Non-slewing mobile crane. C2 = slewing mobile crane up to 20 tonnes lifting capacity SWL. C6 = slewing mobile crane up to 60 tonnes SWL. C1 = Slewing mobile crane up to 100 tonnes SWL. CO = Slewing cranes open/over 100 tonnes. CT = Tower crane.

According to figures presented at the Crane Industry Safety Forum, which was held in September 2002, there are currently around 2000 construction cranes serving the state of West Australia (Cooke, 2002). Anecdotal evidence presented in the report would suggest that a majority of these newly certificated operators were young people under the age of twenty-five who would appear to have limited opportunities to gain employment in the crane industry in the near future (Bradley, 2002; McCamie, 2002).

5.2 Questionnaire data analysis.

There were a total of eighteen (18) people who responded and made use of the comments section of the questionnaire. A large majority (15) of these respondents were of the opinion that the current training arrangements for crane operators need to be reviewed. Fourteen (14) of those who responded were of the opinion that the current crane operator training being provided needed to include a larger portion of practical crane operation.

5.2.1 Demographics of the respondents.

There were a total of 125 crane operators who responded to the questionnaire, out of those operators only two were female. Ninety-four (94) of the respondents indicated that they had gained their crane operators certificates prior to 1994 with the other thirty-one (31) obtaining their certificates post 1994. Sixty-six (66) of the operators admitted to having been involved in a crane accident at some time during their working life, whilst fifty-nine (59) indicated that they had never been involved in an accident. The mean age of the operators was 43.14 years (M=43.14) with a minimum of 21 and a maximum of 71 and a range of 50.

The types of training undertaken by the respondents when gaining their certificates were, classroom based-training thirty-one (31) respondents (24.8%), on-the-job ninety (90) respondents (72%) and a combination of both with four (4) respondents (3.2%). The classifications of the certificate classes held by the respondents were, CO = 85 (68%), C6 = 29 (23.2%) and the remaining 8% being made up by the other three (3) classes (CN, CV, CT). Three (3) respondents worked in the Central Business District (CBD), Fifty-two (52) civil construction and Thirty-six (36) in general hire.

Table 1 shows that in regarding their preferred method of training, on-the-job was the most favoured method for eighty-one (65%) of the operators. There were a total of forty-two operators (33.5%) who preferred a combination of both classroom and on-the-job training. With the current classroom based system favoured by only two operators (1.5%).

Table 1. Crane operators preferred method of training.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	classroom	2	1.6	1.6	1.6
	on-the-job	81	64.8	64.8	66.4
	a combination of both	42	33.6	33.6	100.0
	Total	125	100.0	100.0	

The descriptive statistics for the total time spent operating cranes by the operators who responded to the survey can be found in Table 2 and Figure 6. As can be seen from the table, the original mean of 156.60 compares favourably with the 5% trimmed mean of 152.39 and would tend to indicate that the extreme values that have been recorded are not having a profound impact on the data. Therefore the extreme values were not eliminated for the purpose of carrying out the analysis.

Table 2. Descriptive statistics for operators overall time spent operating cranes.

			Statistic	Std. Error
Total time spent operating cranes (mnths)	Mean		156.60	10.27
	95% Confidence Interval for Mean	Lower Bound	136.28	
		Upper Bound	176.93	
	5% Trimmed Mean		152.39	
	Median		144.00	
	Variance		13079.168	
	Std. Deviation		114.36	
	Minimum		0	
	Maximum		420	
	Range		420	
	Interquartile Range		198.00	
	Skewness		.455	.217
	Kurtosis		-.635	.431

The average time spent operating cranes for the respondents is 156.6 months with a standard deviation of 114.36. The median measure is 144. The range of the data was from 0 - 420 months. The skewness figure of .445 indicates a cluster of

scores at the higher end of the scale, which is supported by the bar graph presented as Figure 6.

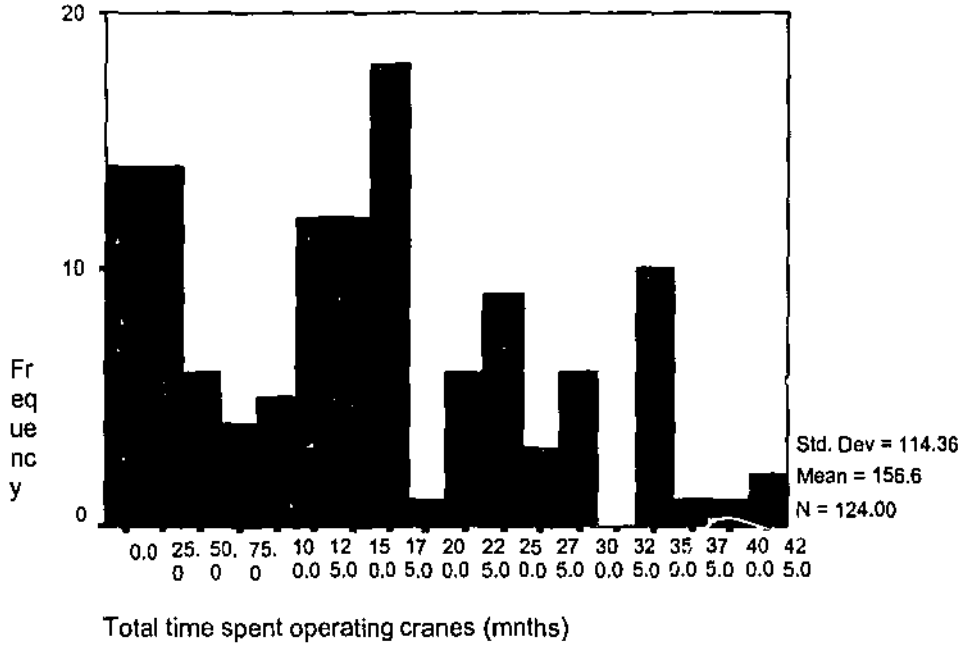

Figure 6. Frequencies of months spent operating construction cranes since certification.

5.2.2 SPSS output.

Parametric and non-parametric statistical tests were conducted with the use of the SPSS (Version 10) data analysis system. The tests included Chi-square to test the null hypothesis, Pearson Correlation to describe the strength and direction of the linear relationship between two variables and Logistic Regression to measure the influence of each variable on one another. For the purpose of the significance testing of the null hypothesis a P-value of <0.05 was used as a measure.

A Chi-square tests for independence was conducted between the variables year of certification and ever had a crane accident. The information from this test is presented by the data in Table 3 and Table 4 The results of the test can be summarised as $\chi^2(1, N=125) = 38.05, P = .000$

Table 3. Chi-square tests ever been involved in a crane accident * year of certification.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	40.65[b]	1	.000		
Continuity Correction[a]	38.05	1	.000		
Likelihood Ratio	47.89	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	40.33	1	.000		
N of Valid Cases	125				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.63.

Table 4. Cross tabulation. Ever been involved in a crane accident * Year of certification.

			ever been involved in an accident		
			yes	no	Total
year first gained certificate	prior to 1994	Count	65	29	94
		Expected Count	49.6	44.4	94.0
		% within year first gained certificate	69.1%	30.9%	100%
		% within ever been involved in an accident	98.5%	49.2%	75.2%
		% of Total	52.0%	23.2%	75.2%
	post 1994	Count	1	30	31
		Expected Count	16.4	14.6	31.0
		% within year first gained certificate	3.2%	96.8%	100%
		% within ever been involved in an accident	1.5%	50.8%	24.8%
		% of Total	.8%	24.0%	24.8%
Total		Count	66	59	125
		Expected Count	66.0	59.0	125.0
		% within year first gained certificate	52.8%	47.2%	100%
		% within ever been involved in an accident	100%	100%	100%
		% of Total	52.8%	47.2%	100%

The next question was to establish if there was a relationship between the certification year of the operators (post or pre 1994) and whether they have been involved in a crane incident before. As with the previous question a chi-square test for independence was conducted between the two variables. The output from the test of independence is presented in Table 5 and Table 6. The results of the chi-square test can be summarised as $\chi^2(1, N = 124) = 43.37, P = .000$

Table 5. Cross tabulation between year of certification * ever been involved in a crane incident.

			year first gained certificate		
			prior to 1994	post 1994	Total
ever been involved in an incident	yes	Count	84	9	93
		Expected Count	69.8	23.3	93.0
		% within ever been involved in an incident	90.3%	9.7%	100%
		% within year first gained certificate	90.3%	29.0%	75.0%
	no	Count	9	22	31
		Expected Count	23.3	7.8	31.0
		% within ever been involved in an incident	29.0%	71.0%	100%
		% within year first gained certificate	9.7%	71.0%	25.0%
Total		Count	93	31	124
		Expected Count	93.0	31.0	124.0
		% within ever been involved in an incident	75.0%	25.0%	100%
		% within year first gained certificate	100.0%	100.0%	100%

Table 6. Results of chi-square tests between the variables year of certification and ever been involved in a crane incident.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	46.58[b]	1	.000		
Continuity Correction[a]	43.37	1	.000		
Likelihood Ratio	42.97	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	46.20	1	.000		
N of Valid Cases	124				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 7.75.

A chi-square test for independence was conducted on the variables year of certification and the reporting of accidents using the newly created variable WASREPC. The results of the cross tabulation table from the test have not been included as they appear to violate the assumption of independence for chi-square tests with all of the cells having an expected count of less than five at .12 per cell. This can be seen from the chi-square test result table, which appears as Table 7.

Table 7.Chi-square test results for WASREPC * year first gained certificate.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.135[b]	1	.713		
Continuity Correction[a]	.000	1	1.000		
Likelihood Ratio	.252	1	.615		
Fisher's Exact Test				1.000	.882
Linear-by-Linear Association	.133	1	.715		
N of Valid Cases	68				

a. Computed only for a 2x2 table

b. 2 cells (50.0%) have expected count less than 5. The minimum expected count is .12.

The next test was to see if there is an association between the reporting and the non-reporting rates of crane incidents by the crane operators when they are involved and is this connected to their year of certification? To help gather an indication as to the answer to the question a chi-square test for independence was carried out between these variables. The data from these tests are presented in Table 8 and Table 9. The results can be summarised as $\chi^2(2, N = 115) = 31.1, P = .000$

Table 8. Cross tabulation of not reporting crane incidents * year of certification.

			year first gained certificate		
			prior to 1994	post 1994	Total
reported incidents	None	Count	12	12	24
		Expected Count	19.6	4.4	24.0
		% within Not reported incidents	50.0%	50.0%	100.0%
		% within year first gained certificate	12.8%	57.1%	20.9%
	1-5 times	Count	18	8	26
		Expected Count	21.3	4.7	26.0
		% within Not reported incidents	69.2%	30.8%	100.0%
		% within year first gained certificate	19.1%	38.1%	22.6%
	6+ times	Count	64	1	65
		Expected Count	53.1	11.9	65.0
		% within Not reported incidents	98.5%	1.5%	100.0%
		% within year first gained certificate	68.1%	4.8%	56.5%
Total		Count	94	21	115
		Expected Count	94.0	21.0	115.0
		% within Not reported incidents	81.7%	18.3%	100.0%
		% within year first gained certificate	100.0%	100.0%	100.0%

Table 9. Chi-square table for not reporting crane incidents * year of certification.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	31.10[a]	2	.000
Likelihood Ratio	33.62	2	.000
Linear-by-Linear Association	30.52	1	.000
N of Valid Cases	115		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 4.38.

The influence of each variables relationship to one another was determined by conducting a logistic regression between the new variables year of certification (YOCERT(1)) and total time spent operating a crane (TOTMONTH). The results of these tests appear in Table 10 and Table 11 and can be presented as (TOTMONTH) odds ratio (OR) of 0.985 with a 95.0% C.I. of 0.975, & 0.995 and YOCERT(1) odds ratio (OR) of 0.249 with a 95.0% C.I. of 0.055, 1.118.

As these figures were actually reflecting the chances of not being involved in an incident they were inverted for re-calculation so as to create new OR (odds ratio) and upper and lower confidence intervals (C.I. 95.0%) to measure the odds of being involved in an incident. The new values for being involved in an incident are now (TOTMONTH) OR = 1.015 (1.01, 1.026) and (YOCERT(1) OR = 4.02 (0.89, 18.18).

Table 10. Classification table.

			Predicted		
			ever been involved in an incident		Percentage Correct
	Observed		yes	no	
Step 1	ever been involved in an incident	yes	85	7	92.4
		no	7	24	77.4
	Overall Percentage				88.6

Table 11. Variables and outcome of the equation for logistic regression.

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	TOTMONTH	-.015	.005	8.156	1	.004	.985	.975	.995
	YOCERT(1)	-1.390	.766	3.293	1	.070	.249	.055	1.118
	Constant	1.459	.453	10.379	1	.001	4.302		

a. Variable(s) entered on step 1: TOTMONTH, YOCERT.

A similar logistic regression test was conducted between the variables YOCERT(1) and REPINC to determine the influence that each variable was having on the other. The data from this analysis can be found in Table 12 and Table 13.

Table 12. Classification table for logistic regression TOTMONTH * YOCERT(1).

			Predicted		
			Not reported inc		Percentage Correct
	Observed		1.00	2.00	
Step 1	Not reported inc	1.00	12	12	50.0
		2.00	7	83	92.2
	Overall Percentage				83.3

Table 13. Outcomes from the logistic regression TOTMONTH * YOCERT(1).

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	TOTMONTH	.007	.004	3.570	1	.059	1.007	1.000	1.014
	YOCERT(1)	1.384	.712	3.774	1	.052	3.990	.988	16.117
	Constant	-.629	.477	1.737	1	.187	.533		

a. Variable(s) entered on step 1: TOTMONTH, YOCERT.

The results of the data presented in the two previous tables are very similar to those of the previous logistic regression test and can be expressed as OR (odds ratio) (TOTMONTH) = 1.007 (1.000, 1.014) & OR (odds ratio) (YOCERT(1)) = 3.990 (0.998, 16.117)

The responses given to the question of being involved in a crane accident and the reporting or non-reporting of the same, showed that 68 (54.4%) admitted to

having been involved in a crane accident as per the definition which formed part of the questionnaire. Of the accidents that were reported 55 (44%) were reported to the owner/employer, 5 (4%) were reported to WorkSafe and a further 8 (6.4%) were not reported to anyone. Twenty-two (25.6%) reported that they failed to report an accident on more than at least one occasion.

Responses received by the operators in the general hire sector of industry tended to indicate overall that the ordering of under-sized cranes for the task at hand by the hirer is not a large one, with only Twenty-two (22) or 15% replying that they had ever had the problem arise. The crane operators on average worked approximately 10 hours per day (M=10.36, Median=10).

CHAPTER 6. Discussion.

Having a multi-skilled workforce in Australia is a concept that has been around since the early 1980's. While the principle of a workforce that is skilled in more than just one task in the workplace is an admirable one and one that is readily accepted by the employers, what is important is the retention rate of the new skills learnt. Research has suggested that, depending on the complexity of the skill learnt, up to ninety percent of a skill can be lost in a very short period of time if they are not applied in the workplace immediately.

The existing pedagogical style of crane operator training that is being used in Australia when delivering crane operator training is far from appropriate when conducting education or training courses with adults. This style of teaching is more appropriate when children are involved not adults. Adults have the need to be able to play a part in the gaining of knowledge through the reflective contributions of their own life experiences in the classroom or workplace.

The current situation which exists in West Australia sees the crane industry being flooded with newly certificated crane operators, with over ten thousand (10,000) new operators gaining their certificates in the past ten years. When these figures are coupled to the fact that there are only two thousand (2,000) construction

cranes currently operating in the state it is clear to see that there is a huge oversupply of operators occurring.

What needs to be remembered is that all of these cranes had operators prior to 1994 and even with natural attrition many of these operators are still active in the industry. There are large numbers of recently certificated crane operators with limited, if any, opportunities of being able to gain employment in these areas, because of the small numbers of machines available.

The holding of a certificate of competency by a person is not an indication of that individuals ability to be able to apply the skills and knowledge learnt to do a particular task. Similarly the lack of a certificate of competence should not be seen as an indication that the person lacks the skills and knowledge to be able to carry out a task safely. The ability to be able to safely operate a crane in the workplace is critical to the workplace safety. Ergo crane operators need to be trained adequately in the first place.

This fact was highlighted on Channel Sevens "Today Tonight" current affairs program during February of 2003. Reporter, Adene Cassidy, exposed an assessor in New South Wales who was issuing crane operator certificates of competency to people even though they (the assessor) knew that the people never sat an assessment. For one to think that this may be an isolated incidence would be idealistic, what is hoped is that the problem is not widespread.

WorkSafe are proposing to shortly introduce a program to audit recently assessed trainee crane operators with the view of issuing them with improvement notices if they fail the WorkSafe competency assessment. It is intended that these improvement notices will require the trainee to undergo further training, unfortunately WorkSafe has got it wrong with its intended plan. What the department is going to be doing will be indirectly rewarding the training facilities for failing the trainee in the first place by forcing them back for further training.

The initiation of the audit program would appear to mean that WorkSafe must be aware that there is a problem currently existing in the area of crane operator

training in West Australia. Otherwise, why instigate a audit program in relation to the assessment of recently assessed trainees? If there is a problem, or has been a problem, then this raises the question as to what are they going to do about the 10,000 people who have already been assessed as being competent since 1994, as there would be nothing that could be done retrospectively?

The current situation gives the impression that there are far too many operators in the industry with certificates now. It is now a case of the training industry no longer training operators to supply or provide for industries needs, but moreover they are now training for the economic survival of their businesses. What WorkSafe will be doing is indirectly supporting their survival.

Furthermore it should be noted that even the most highly skilled crane operator has the potential to fail a training program or assessment depending on the variables involved. For instance the type of exam that is set, the condition of the crane that is being used for the assessment, the experience of the operator on that particular type of machine being used and also the personal experiences of the operator.

The two different definitions of a competent person, which appear in the West Australia Mining Act (1994) and Occupational Safety and Health Regulations (1996), make the potential to obtain employment as a crane operator in the two different industries both easy and difficult at the same time.

Limited opportunities would have to exist for a recently certificated crane operator looking to find work in the mining industry. If an employer follows the Mining Act to the letter, then they would not be able to employ any operator until they first gained operating experience on a crane in some other industry. This then leaves the construction industry for these people to be able to locate employment as crane operators.

The employers attitude to the type of crane operator training that is currently being used is crucial to the opportunities that these newly certificated operators have in finding employment within the crane industry. By looking at the schematic diagram of the possible knowledge and skill retention percentages for trainees (Appendix G)

this can be supported. What can be seen from the diagram is that if the employer, as the gatekeeper, takes a negative approach to the current modular style of training delivery then there is little chance that the trainee will retain what was taught.

6.1 Government data collection

Data collection and supply from the government departments involved in the study in relation to the research question was both pleasurable and frustrating. The attitude taken towards the provision of accident data for the mining industry was one that reflected the cooperation and interest of the people involved. Their organisational approach to the research needs should be applauded, along with the fine record keeping facilities that they employ. This made the collection of data from the mining group a pleasurable assignment and one which required a minimum amount of meetings and time.

The official government figures relating to crane accidents which were supplied by WorkSafe reveals that there were a total of 82 crane accidents in West Australia during the period 1994/2003. Of these accidents the department claims that there were a total of six which could be attributed to operators who had gained their crane operators competency certificates after 1994. This equates to around 4.9% of the total number of accidents that have occurred during that period and which were reported to WorkSafe.

The official figures for the year 2001/2002 would tend to indicate at first glance, that there was only one accident reported to, and investigated by the department (WorkSafe). These figures presented by WorkSafe for 2001/2002 are confusing and are not truly reflective of the actual situation that was present in the state (WA) at that time. All that these figures do is to highlight the inadequacies that exist in the current reporting arrangements contained within the West Australian Occupational Safety and Health Regulations (1996).

If this was truly the case and there had only been one accident in the industry during that entire year then these figures would tend to indicate, to the uninitiated, that the industry has had a very good operational safety record for the year. Whereas from

the data presented in the research, this was not the case. It is clear that the department needs to take a more active role in the investigation of crane accidents within the state.

Data gathered from the Department of Industry and Resources was able to attribute accident rates to the certification year of the operator, however the data supplied by WorkSafe was of no use at all in helping to allocate a certification year to the operator involved in the accident. This made the answering of the research question impossible from using the data gathered from these two sources and therefore no conclusions have been reached in relation to the information.

It should be said that although the data from the mining sector was of excellent quality for the purpose required by the researcher, the inability to establish the exposure rates for each group of operators would make the drawing of any conclusions on this data alone unwise.

These figures come under further scrutiny when you consider that the Minister for Consumer and Employment Protection (Mr J. Kobelke MLA), when establishing the Crane Safety Working Party, voiced his concern about the high number of crane accidents that had been occurring recently in the construction industry. This included three accidents that had occurred in the preceding month of April (Kobelke, 2002).

The plan by WorkSafe to implement a program to audit the competency of the new trainees who have just completed their training and then issuing anyone who fails that assessment with an improvement notice appears to have its' problems. Not the least of them being the fact that there will need to be a practical reassessment carried out. This will have the potential to expose the trainees to machines types that they may not have seen or operated before.

WorkSafe needs to take a more pro-active role in ensuring that the machines being used for the purpose of providing crane operator training and assessments are kept to at least the minimum safety standard required for these machines. If those machines are not kept in a fully operational condition, especially having fully

operational safety features, then the validity of any training or assessments carried out on the machines must come into serious question.

The researcher is of the opinion that the machines currently being used by many of the training delivery organisations in Perth are nearing or are over their recommended design life. It is important to realise however that just because the machine has passed twenty-five years of age it does not mean that it is not permitted to be operated any more, what it reflects is just an indication of the machines' intended operating life.

However it would be fair to say that the controls used to operate a machine that is nearing the end of its' design life are outdated or superseded by the ones that are used on more modern machinery. This in turn creates the real situation of providing training to people on machines, and with controls and safety features that they may never see again.

The department has so far failed to take any action in relation to the matter regarding the missing safety feature on the crane used for the provision of training. Even though there must be a genuine question as to the validity of any assessments carried out on this machine with the omission of this safety feature.

The matter was raised with WorkSafe three (3) months after the first report. The researcher was told that no one had attended the problem at the training facility as the inspectors responsible for these problems were intimidated and frightened by the people at the facility and so therefore had not attended (A. Bowen, personal communication, May 23, 2003).

When it comes to the recommendation made by the crane safety standards working group to introduce remedial training to current certificate holders, there would be a real need to get this type of training right. This is where the use of a suitable, full motion simulator will come into its' own. Not only can these machines be programmed to replicate any number of dangerous situations or scenarios but also for different crane types of crane configurations.

Data from the mining industry was easy to gather, interpret and to analyse. This was mainly because of the stringent reporting requirements that exist in the mining industry in relation to the reporting and the recording of accidents and dangerous situations as they occur. This system needs to be adopted by WorkSafe.

The data from the mining industry is indicating that, similar to those figures presented by Worksafe, the group of operators that are involved in most accidents in mining is the group of operators who were certificated prior to 1994. The figures indicate that out of a total of 139 accidents that have occurred in the mining industry since 1994 only 20 or 14.38%, have involved operators who were certificated post 1994.

Official accident figures reported by both of the groups for the years 1995/1996 and 1997/1998 are very similar numerically, however the intervening year 1996/1997 saw the mining industry record over 300% more accidents (20 and 6 respectively) than those reported to WorkSafe. No clear indication as to the reason for this is presented in the data, however these figures are similar to the spike that occurred the following year in the WorkSafe accident rates (97/98).

Not being able to gather an indication as to what the actual numbers are in relation to how many on-the-job trained compared to competency based trained crane operators are actually currently working in the state makes the drawing of any conclusions difficult.

The figures from the government departments are indicating that, contrary to the research hypotheses which says that operators certificated post 1994 are more prone to be involved in crane accidents than those certificated pre 1994, the operators who are currently responsible for the most crane accidents are the latter group. However these figures must be treated with extreme caution because of the inability of the data to determine the exposure rates for each individual group involved in the operation of these cranes.

The current approach to crane operator training in West Australia needs to alter from the passive pedagogical system that it currently is to one that involves more

active learning for the trainee, *supported* by a sound knowledge base. This will better prepare them to be able to make the correct decisions when faced with an emergency or an unusual condition.

It can be safely said that if training does not bring about permanent improvements in the way work is undertaken in the workplace then in reality that training can only be seen as a waste of time. Ideally any workplace training should have as its' major goal a permanent change in the safety culture of all in the workforce (Broadbent, 2001).

6.2 SPSS data.

6.2.1 Demographics.

The figures in relation to the total time spent operating cranes since certification in regards to both the normal mean (M = 156.60) and the 5% trimmed mean (5%TM = 152.39) are very similar and give an indication as to the average time spent by each operator. A truer indication of the estimate of the average may be to use the median score, which has a given value of 144 months. This may be more reflective of the measure.

6.2.2 Year of certification and accident rates.

The results from the first chi-square test involving the possible relationship between the variables year of certification and whether an operator had been involved in a crane accident or not can be summarised as $\chi^2(1, N=125) = 38.05$, P =.000 The output in Table 3 shows that the lowest expected cell count is 0 (0%) cells having an expected count of less than five and with a minimum expected cell count of 14.63. So it can therefore be safely assumed that the minimum expected cell count for chi-square tests had not been violated.

As both of the variables used in the analysis are dichotomous the data can be presented in a 2 x 2 table. Therefore the (Yates) continuity for correction figure should be used when interpreting the data. The continuity correction figure was used in an effort to reduce the likelihood of making a **Type 1** error in rejecting the null hypothesis when it is true.

The correction value in the table can be seen to be 38 .05 and with an associated Asymp. Significance (2-sided) of .000. These figures tend to indicate that there is an association between the year of certification and being involved in an accident. However the figures do not indicate the strength or the direction of the association.

This association between the variables may further be supported by the percentages presented in the cross tabulation output table. Where it is shown that ninety-eight and a half percent (98.5%) of the respondents who admitted to having been involved in a crane accident were certificated pre 1994 and the other one and a half percent (1.5%) as being certificated post 1994.

6.2.3 Year of certification and incident rates.

The figures that appear beneath the chi-square tests in table 6, show that there are 0 (0%) cells which have an expected count of less than 5. With the minimum expected count for each cell being 7.75. Therefore the minimum expected cell frequency count for chi-square tests had not been violated. As with the previous two variables, both of the ones to be used for this calculation are dichotomous so once again the (Yates) continuity for correction figure is the one that will be used in this analysis.

The continuity correction figure has a given value of 43.369 and with an associated Asymp. Significance (2-sided) of .000. The results of the chi-square test can be summarised as $\chi^2(1, N = 124) = 43.37, P = .000$

These figures indicate, as with the previous variables, that there may be an association between the year of certification of the operator and whether they had been involved in a crane accident, although the strength and direction of the association is not indicated. The percentages reveal that there were ninety percent (90%) of operators who acknowledged being involved in a crane incident and who were certificated pre 1994, compared to ten percent (10%) certificated post 1994.

A logistic regression was also conducted between the variables year of certification, incident rates and time spent operating a crane since certification, with

the latter being the variable that was controlled for, to determine if there was an association between the other two. The data that was generated however was of little use, as no firm significance or odd ratio levels could be determined because of the low number of affirmative responses from the post 1994 group of operators. For example the OR for the test came back with a result of .000 and an associated significance value of .741 which would make no sense at all.

6.2.4 Year of certification and reporting accidents.

The data generated from this analysis indicated that the minimum cell frequency count for chi-square tests was being violated so the data was not used. A possible reason for the poor quality data may be the fact that only one (1) operator who was certificated post 1994 had admitted in the questionnaire to being involved in a crane accident.

This would present very biased data for interpretation and this can be seen in the figures for the significance values of the tests which appear in table 7. The figures are suggesting, contrary to all other statistical findings, that there is no association between the variables with a significance value of 0.713

6.2.5 Year of certification and reporting incidents.

The notes which appear at the bottom of the chi-square tests in table 9, indicate the minimum expected cell count is only 4.38 and with two cells (33%) having a count of less than five. However as the figure was close to cut off point of five (5) the decision was made to retain and accept that the minimum expected cell frequency count conditions for chi-square tests had not been violated. The results from these tests however will need to be treated with caution.

The results from table 9 can be summarised as $\chi^2(2, N = 115) = 31.1, P = .000$ With a Pearsons' Chi-Square value from the table of 31.100 with 2degrees of freedom and an associated Asymp. Significance (2-sided) of .000. The associated low significance level (2-sided) of .000 tends to indicate that there is the possibility of a trend developing between the year an operator is certificated to operate a crane (pre or post 1994) and whether or not they report being involved in crane incidents.

The Pearsons' Chi-Square value was used on this occasion in the analysis as the variables being compared had more than two values which made the use of a continuity correction figure impossible, because as can be seen by the table there was no value calculated for this formula.

The results of the logistic regression test that was conducted on the variables TOTMONTH & YOCERT(1) are found in Table 10 and Table 11. The new figures for the OR (odds ratio) and the 95.0% upper and lower C.I. (confidence intervals) were calculated because the old ones being presented in the SPSS print out were for the odds of not being involved in an incident. Whereas the odds of being involved in an incident was the one that was required.

After converting the respective results they can now be expressed as, variable one (TOTMONTH) = OR 1.015 (1.01, 1.026) 95% C.I. and variable two YOCERT(1) = OR 4.02 (0.89, 18.18) 95% C.I.

The new value for the OR of 1.015 for the TOTMONTH variable would be tending to indicate that the longer a person has been operating a construction crane then the more likely they are to have been involved in an incident. As the variable is continuous this ratio will increase proportionate to the total length of time spent operating cranes (in months). With the categorical variable (YOCERT(1)) the OR = 4.02 is indicating that the group who were certificated pre 1994 may be up to four times more likely to be involved in an incident than those certificated post 1994.

A logistic regression analysis was also conducted between the variables YOCERT, TOTMONTH and REPINC. Unlike the previous output the data generated for this calculation did not need to be manipulated, as the measured outcome was correct. The results of the test appear in Table 12 and Table 13 and reveal figures similar to those that were generated for the previous calculation. The operators who were certificated post 1994 would appear to be up to four times more likely to be involved than those certificated post 1994 with an OR = 3.990 (C.I. 1.000, 1.014: .988, 16.117).

6.2.6 Preferred method of training.

When it came to assessing current operators preferences in relation to what type of training that they considered to be the most appropriate a vast majority (98.5%) of the responses favouring the use of on-the-job (65%) or a combination of on-the-job and workplace training (33.5%). This is compared to only 1.5% who favoured the current classroom based approach.

7. Conclusion and Recommendations.

7.1 Conclusions.

As with all training that involves adults there is a need for the trainee crane operators to feel comfortable with the style of training that they are undertaking. If the trainees are not comfortable with the style of training delivery then there is the likelihood that the retention rates for the curriculum being taught will be low. Out of the adult training and educational paradigms mentioned, it is worth noting that all contain at least some of the elements of andragogy, which many researchers see as the preferred method of training delivery when dealing with adults.

Retention rates are crucial if you consider the fact that people are prone to forget much of what has been taught if that skill is not applied as soon as possible in the workplace. If the trainee is not confident with the type of training being delivered and present their own barriers, then there is every possibility that those retention rates will be even poorer and the skill and knowledge taught to the person will be lost in an even shorter time. Although the author of the saying is unknown to the researcher it is worth remembering that; "To hear is to forget, To see is to remember, To do is to learn, To practice is to know"

The age and the overall condition of the cranes currently being used for the purpose of providing the practical section of crane operator training is crucial to the chances of the training being successful. If the machines that are to be used are not either well maintained or are so old as to not have basic safety features then they should not be used for this purpose and to do so is being unfair to the trainee.

If the trainee is taught on a machine that is nearing the end of its' design life then by the time that the new employee gets to operate a crane that type of machine may no longer be around. Not only is there the likelihood that the crane they were taught on will no longer be around but also the cranes being operated now in the workplace may no longer be here.

The only way to monitor these machines is through the use of regular safety inspections by WorkSafe. These safety inspections are not to be just a cursory glance over the machine, but should involve the person doing the testing operating the crane themselves to determine its' functional capacity. The operating of the crane by the inspector will allow for the testing by the inspector themselves, of all of the safety features that are supposed to be present on the machine.

Although presently there are none in Australia, the use of crane simulators for both the assisting of the original training and for remedial or special training needs to be encouraged. Industry groups or the government should investigate the possibility of either purchasing or leasing one of these machines. The initial costs involved in the acquisition of one of these simulators can be easily justified when the replacement cost for a crane destroyed in an accident can run into millions of dollars.

The results from the statistical tests conducted on the questionnaire data revealed some possible trends. Although all results gathered from the data collected through this source need to be treated with extreme caution, as once again the exposure rates for each group of operators could not be established.

The initial tests that were conducted on the data were a series of chi-square analysis for independence between variables. These tests decide whether the null hypothesis was going to be accepted or rejected. The results from the four chi-square tests on the variables suggest that on this occasion the null hypothesis should be accepted.

The individual logistic regression tests, which were conducted on the variables of ever being involved in an incident and the reporting or non-reporting of incidents, were consistent. Both tended to indicate that there is a real likelihood that

the operators who were certificated prior to 1994 are actually up to four (4) times more likely to be involved in one of these two events that their post 1994 counterparts, with odds ratios of 4.02 and 3.990 respectively.

As has been mentioned on several occasions throughout this paper the inability to establish the exposure patterns of the two different groups in the workplace makes the drawing of any concrete conclusions fraught with danger.

It is clear that there is the need for further research to be carried out in the area of crane operator certification training and the methods used to deliver it. Also there would appear to be a need to investigate the current culture that appears to exist amongst a certain group of operators.

7.2 Recommendations.

1. A review of the current crane operator-training program needs to be conducted as soon as practicable. This is a review of the program and not the training delivery establishments themselves.

2. The training delivery organisations themselves need to be audited on a regular basis by the Department of Training.

3. WorkSafe needs to take a far more pro-active role in the inspection process of the machines used for the provision of the practical application section of the crane operator training courses.

4. The current West Australian, "Occupational Safety and Health Regulations" (1996) need to be reviewed with the view of changing the existing requirements in relation to the reporting of crane accidents within their area of control. The system needs to be brought into line to reflect the requirements which appear in the west Australian "Mines Safety and Inspection Act" (1994) in relation to these events.

5. The employers' attitude to the current method of crane operator training needs to be established.

6. The West Australian Department of Industry and Resources need to be compelled to inform the certificating authority (WorkSafe) of ALL accidents and incidents that occur within their jurisdiction.

7. The definition of a "competent person", that appears in the "Occupational Safety and Health Regulations (1996) needs to be altered to reflect the wording that is contained in the mining legislation, thereby removing the word OR and replacing it with the word AND.

8. The apparent culture of consistently overloading cranes that exists amongst a certain group of operators, need to be investigated to determine the root causes and solutions.

9. The acquisition, by purchase or lease, of a full motion crane simulator should be investigated immediately for the purpose of assisting with crane operator training and retraining.

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Appendix A

Pro-forma letter to industry & interested parties.

Mr. I. Douglas.

Date. 8/8/2002

My Ref. idughons

Email: idouglas@student.ecu.edu.au

Dear -------,

I am writing to you to seek your "in principle" support in relation to the supply of some statistical data that I may need.

I am a post graduate student and my major field of study is in Occupational Health and Safety, with a minor in Environmental health.

I am currently enrolled for an Honours degree in OH&S, which requires the submission of a Thesis at the end of my second semester. My proposed topic & area of research is to investigate the potential correlation between the number of accidents/incidents involving lifting cranes and the decentralising of the training and assessment process which occurred in 1994.

Information that you or your organisation might supply for the purpose of the research, will not be used in any way to identify:

- Your company.
- Any individual.
- Any organisation.
- Any event

My research supervisors for my thesis are:

Dr. J. Oosthuizen, PhD, M Med Sci. HDE. Joondalup campus.
(Lead Supervisor)
Professor. N. Thomson, BSc, M B BS, MPH, MD, FAFPHM. Joondalup campus.
(Co-supervisor)

What I am seeking from your organisation at this stage is conformation of your "in principle" support and willingness to provide the following data:

- # of crane accidents/incidents before 1994.
- # of crane accidents/incidents after 1994
- # of people certificated as crane operators before 1994.
- # of people certificated as crane operators after 1994.
- # of years the operator involved in any one of these accidents/incidents has had their certificate of competency.

Upon receipt of your letter indicating your "in principle" support for the project, I would then like to arrange to meet with you, or one of your representatives, to discuss exactly how your organisation and I can work together in gathering the information that will be needed. It is important to the progress of my thesis that in principle support from your organisation is achieved as early as is practicable.

Regards

_____

Ian Douglas

_____

Dr Jacques Oosthuizen

Appendix B

Questionnaire used for main study.

QUESTIONNAIRE

Topic. Is current crane operator training delivery methods a factor in the incidence of crane accidents in WA?

IMPORTANT: ***This is an anonymous questionnaire. Please ensure that you do not write your name, or any comments that will make you identifiable, on the attached. By completing the questionnaire you are consenting to take part in the research. As such you should first read the Disclosure Statement carefully as it explains fully the intention of this project.***

This questionnaire forms part of a research study into crane accidents and training delivery methods in WA, and is being conducted by a student studying Occupational Health & Safety at the Joondalup campus of the Edith Cowan University in WA.

Would you please complete the questions on the following pages by marking the appropriate box with a tick or with figures where required. If you have any additional comments to make about the delivery of crane operator training in WA, then you can make these comments on the back page of the questionnaire under "other comments".

If you do not understand any of the questions or have any queries regarding this questionnaire, the researcher conducting this study can be contacted on the following phone numbers;

Edith Cowan University 10am – 3pm weekdays 94005196 (ask for Ian).
Mobile phone (other times) 0415788725

Once you have completed this questionnaire place it in the reply paid envelope that has been provided and send it back via return mail as soon as possible.
Thank you for taking the time and showing the interest in your occupation to complete this questionnaire.

Question 1. (Place a tick in a box)
What is your gender?

Male 1 ☐

Female 2 ☐

Question 2. (place numbers in box)
What is your age?

☐

Question 3 (place year in box)
In what year did you first obtain your crane operators certificate ?

☐

Question 4 (place numbers in boxes)
How many years/months have you spent operating cranes since you obtained your certificate ?

☐ years ☐ months

Question 5. (place a tick in box)
How were you trained to become a crane operator ?

a) classroom. 1 ☐

b) on-the-job. 2 ☐

c) a combination of both. 3 ☐

Question 6. (place numbers in box)
How many months/years have you been operating the crane that you are currently operating ?

a) Years 1 ☐

b) Months 2 ☐

Question 7. (place a tick in box/boxes)
What would you consider to be the best method of delivering crane operator training ?

a) Classroom ? 1 ☐

b) On-the-job? 2 ☐

c) A combination of both ? 3 ☐

Question 8. (place a tick in the box)
Have you ever been involved in a crane accident? (*see definition page*)

a) Yes 1 ☐

b) No 2 ☐

Question 9. (place a tick in the box)
Was the accident reported to-

a) Owner/employer ? 1 ☐

b) WorkSafe ? 2 ☐

c) Dept of minerals energy and resources? 3 ☐

d) accident was not reported. 4 ☐

Question 10. (place a tick in a box)
If you have failed to report a crane accident, on how many occasions could that have occurred ?

a) Just the once. 1 ☐

b) 2 to 5 times. 2 ☐

c) 6 to 10 times. 3 ☐

d) 10 to 15 times. 4 ☐

e) 15 to 20 times. 5 ☐

f) More than 20 times. 6 ☐

Question 11. (place a tick in one box only)
What industry would you spend most of your time operating cranes in ?

a) CBD construction ? 1 ☐

b) Civil construction ? 2 ☐

c) Mining ? 3 ☐

d) Resources sector ? 4 ☐

e) General hire ? 5 ☐

f) Other ? 6 ☐

Question 12. (please circle highest ticket)
What is the highest class certificate that you have?

1CN. 2CV. 3C6. 4CO. 5CT. 6CB.

Question 13. (please tick a box)
Have you ever had an incident when operating a crane? (see definition page)

a) Yes. 1 ☐

b) No. 2 ☐

Question 14. (place a tick in a box)
On how many occasions would you have not reported being involved in a crane incident?

a) None 1 ☐

b) 1 to 5 times 2 ☐

c) 6 to 10 times 3 ☐

d) 10 to 20 times 4 ☐

e) more than 20 times 5 ☐

Question 15. (place a tick in a box)
How often would you go to a job only to find that the hirer has ordered a crane with the wrong SWL capacity?

a) once per day 1 ☐

b) once per week 2 ☐

c) once per month 3 ☐

d) more than once per month 4 ☐

e) never 5 ☐

Question 16. (place a tick in a box)
How many hours per day, on average, would you spend operating cranes? (please include time spent driving the crane to and from the workplace).

a) less than eight hours 1 ☐

b) more than eight but less than nine 2 ☐

c) more than nine / less than ten 3 ☐

d) more than ten / less than eleven 4 ☐

e) twelve hours per day. 5 ☐

If you have any other comments about current crane operator training delivery methods that you would like to make please use the space that has been provided below.

Other comments.

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Thank you again for taking the time to fill out this questionnaire, your participation may have helped to identify if there are areas of crane operator training that may need to be changed to benefit industry by providing a more complete training package.

Appendix C

Questionnaire used for pilot study.

QUESTIONNAIRE

Topic. Is current crane operator training delivery methods a factor in the incidence of crane accidents in WA?

IMPORTANT: ***This is an anonymous questionnaire. Please ensure that you do not write your name, or any comments that will make you identifiable, on the attached. By completing the questionnaire you are consenting to take part in the research. As such you should first read the Disclosure Statement carefully as it explains fully the intention of this project.***

This questionnaire forms part of a research study into crane accidents and training delivery methods in WA, and is being conducted by a student studying Occupational Health & Safety at the Joondalup campus of the Edith Cowan University in WA.

Would you please complete the questions on the following pages by marking the appropriate box with a tick or with figures where required. If you have any additional comments to make about the delivery of crane operator training in WA, then you can make these comments on the back page of the questionnaire under "other comments".

If you do not understand any of the questions or have any queries regarding this questionnaire, the researcher conducting this study can be contacted on the following phone numbers;

Edith Cowan University 10am – 3pm weekdays 94005196 (ask for Ian).
Mobile phone (other times) 0415788725

Once you have completed this questionnaire place it in the reply paid envelope that has been provided and send it back via return mail as soon as possible.
Thank you for taking the time and showing the interest in your occupation to complete this questionnaire.

SECTION 1. (Q.1 – 10) ABOUT YOU.

Question 1. (Please tick one box)
What is your gender?

Male 1☐

Female 2☐

Question 2.
What is your age?

☐

Question 3.
In what year did you first obtain your crane operators certificate ?

☐

Question 4.
How many years have you spent operating cranes since you obtained your certificate ?

☐

Question 5. (Place a tick in box)
How were you trained to become a crane operator ?

a) classroom. 1☐

b) on-the-job. 2☐

c) a combination of both. 3☐

Question 6. (place numbers in box)
How many months/years have you been operating the crane that you are currently operating ?

a) Years 1☐

b) Months 2☐

Question 7. (place a tick in a box.)

What type of crane would you operate most?

a) Hydraulic. 1☐

b) Lattice jib. 2☐

c) Crawler. 3☐

d) Mobile. 4☐

e) Tractor. 5☐

f) Tower 6☐

g) Other. 7☐

Question 8. (place tick in box)
What is the average time that you spend operating cranes each day ?

a) More than 8 hours ? 1☐

b) 6 to 8 hours ? 2☐

c) Less than 6 hours ? 3☐

d) None (unemployed) 4☐

Question 9. (place a tick in box/boxes)
What would you consider to be the best method of delivering crane operator training ?

a) Classroom ? 1 ☐

b) On-the-job? 2 ☐

c) A combination of both ? 3 ☐

Question 10. (place a tick in box/boxes)
What industry would you spend most of your time operating cranes in ?

a) CBD construction ? 1 ☐

b) Civil construction ? 2 ☐

c) Mining ? 3 ☐

d) Resources sector ? 4 ☐

e) General hire ? 5 ☐

f) Other ? 6 ☐

SECTION 2. (Q. 11 - 17) ACCIDENTS

Question 11.
Have you ever had an accident operating a crane ? (place a tick in a box)

a) Yes 1 ☐
(go to Q. 12)

b) No 2 ☐
(go to Q. 14)

Question 12. (place a tick in the box/s)
Was the accident reported to,

a) Owner/employer ? 1 ☐

b) WorkSafe ? 2 ☐

c) Department of Minerals Energy and Resources ? 3 ☐

OR

d) Accident was not reported. 4 ☐

Question 13. (place a tick in the box)
If you have failed to report a crane accident, on how many occasions could that have occurred ?

a) Just the once. 1 ☐

b) 2 to 5 times. 2 ☐

c) 6 to 10 times. 3 ☐

d) 10 to 15 times. 4 ☐

e) 15 to 20 times. 5 ☐

f) More than 20 times. 6 ☐

Question 14. (place a tick in the box)
Have you ever had an incident when you were operating a crane ?
(an incident: is an unplanned event that did not result in an accident. This may have been because of luck, or the lift was stopped. Please include any occasions where outriggers may have been floating.)

a) Yes 1 ☐

b) No 2 ☐

Question 15. (please tick a box.)
How many times a month would you be involved in a crane *incident* ?

a) None. 1 ☐

b) 1 to 5 times. 2 ☐

c) 6 to 10 times. 3 ☐

d) 10 to 20 times. 4 ☐

e) more than 20. 5 ☐

Question 16. (please tick a box.)
Do you report these incidents to anyone ?

a) Yes. 1 ☐

b) No. 2 ☐

c) Sometimes. 3 ☐

SECTION 3. (Q17-29) *only for operators certificated after 1994.*

Question 17. (please tick a box or boxes)

What different types of cranes were you trained on ?

a) Crawler crane pin jib. 1 ☐

b) Truck mounted pin jib. 2 ☐

c) Truck mounted hydraulic. 3 ☐

Question 17. (continued.)

d) Tower crane. 4 ☐

e) Tractor crane (BHB). 5 ☐

f) Franna. 6 ☐

g) Other. 7 ☐

Question 18. (please tick a box.)
Have you ever trained anyone else to operate a crane ?

a) Yes. 1 ☐

b) No. 2 ☐

Question 19. (please tick a box.)
How long did your operator training take ?

a) Less than 1 week. 1 ☐

b) 1 – 2 weeks. 2 ☐

c) 2 – 4 weeks. 3 ☐

d) 1 – 3 months. 4 ☐

Question 20. (Place a tick in the box.)
Are you currently operating a crane?

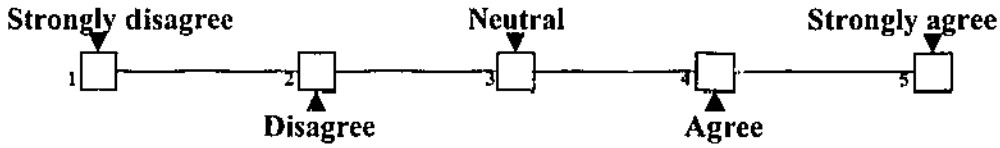
a) Yes. 1 ☐

b) No. 2 ☐

Pleases place a tick in a box for each of the following questions. Your answers should reflect your level of agreement or disagreement with the statements.

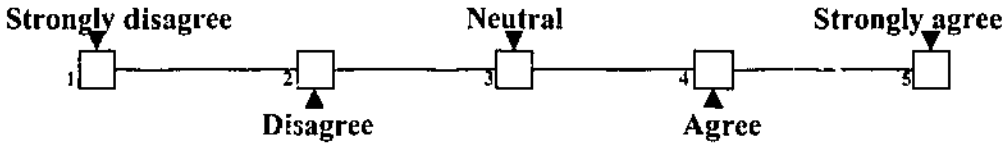
Question 21.

I feel that the crane operator training I received prepared me for most types of emergency situations that I will encounter when operating cranes.



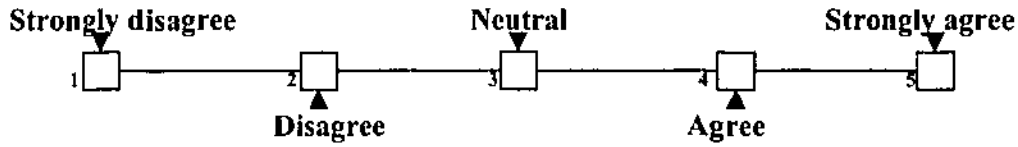
Question 22.

The crane training that I received gave me enough time to learn new skills by allowing me to put these skills to practical use via the direct operation of a crane.



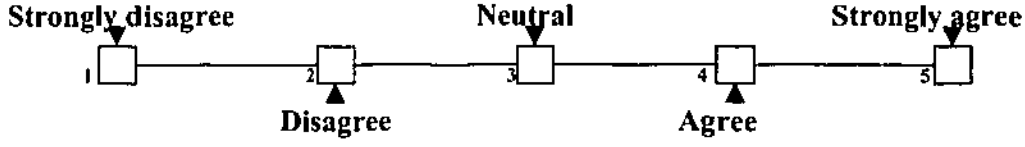
Question 23.

More time should have been spent on the direct operation of the cranes that we were being trained and assessed on.



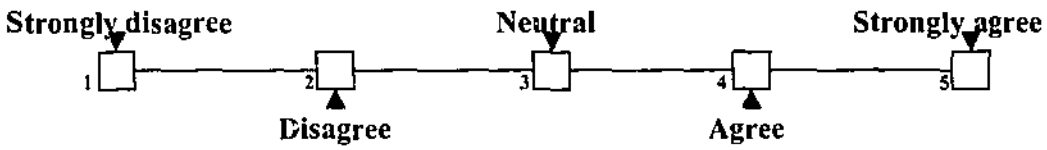
Question 24.

All of the modules that we were taught were clearly understood by everybody before the trainer moved on to the next module.



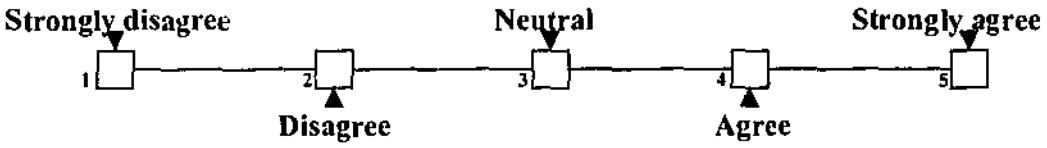
Question 25.

The importance of doing a "site inspection" to identify any potential electrical hazards on the job before any crane lift is undertaken, was always stressed upon the trainees.



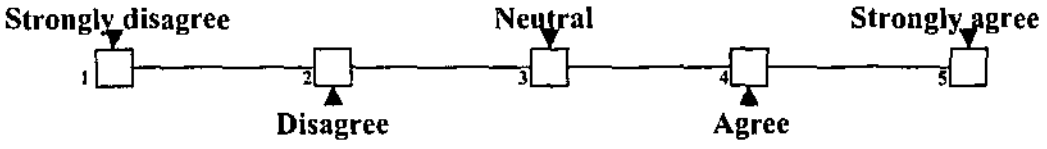
Question 26.

My training allowed me to be able to confidently apply for crane operators jobs with the knowledge that I would be able to safely undertake any task that was involved.



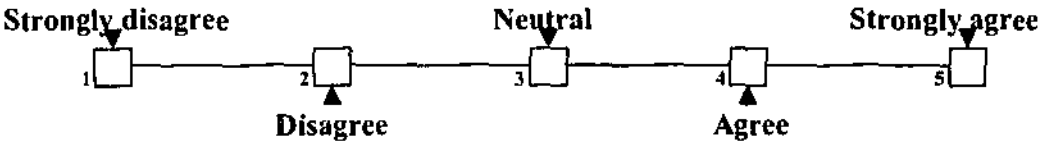
Question 27.

If there is any doubt about the safety of a lift on a job the crane operator should have the final say as to whether a lift proceeds or not and the decision should not be left for others on the job to decide.



Question 28.

Crane operators need to receive instructions from a certified dogman or rigger when they are carrying out a lift with their crane.



SECTION 4. (Q29 -) GENERAL
All participants please complete this section.

Question 29. (please tick a box.)
Having more certificated dogmen & riggers on the job will help to reduce the number of accidents/incidents that occur on site involving cranes.

a) agree 1☐

b) disagree 2☐

c) don't know 3☐

Question 30. (please tick a box.)
When you go to a job, how often would you find that the hirer has ordered a crane that does not have the SWL capacity to do the job?

a) once a day 1☐

b) more than once a day 2☐

c) once a week 3☐

d) more than once a week 4☐

e) once a month 5☐

f) more than once per month 6☐

Question 31. (please tick a box.)
How many jobs have you had in the last 10 years?

a) one 1☐

b) two – three 2☐

c) four – five 3☐

d) more than five 4☐

Question 32. (pleases tick a box.)
Should a crane operator have a log book in which to keep a record of their on-the-job experience?

a) yes 1☐

b) no 2☐

Question 33. (please tick a box.)
Do you feel that crane operators should have their skills reassessed on a regular basis?

a) yes (if yes go to Q 34.) 1☐

b) no (if no go to Q35.) 2☐

Question 34. (please tick a box.)
How often should these reassessments happen?

a) every one to two years 1☐

b) every two to five years 2☐

c) every five to nine years 3☐

d) every ten years 4☐

Question 35. (please tick a box.)

Still under development.

If you have any other comments about current crane operator training delivery methods that you would like to make please use the space that has been provided below.

Other comments.

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Thank you again for taking the time to fill out this questionnaire, your participation may have helped to identify if there are areas of crane operator training that may need to be changed to benefit industry by providing a more complete training package.

Appendix D

Disclosure Statement.

Disclosure Statement

The research currently being undertaken by this study is in the area of crane operator training delivery systems and crane accidents in West Australia. The purpose of the research is to assess employer and crane operators' attitudes to the current system of training.

The questionnaire is intended to be confidential and every effort will be made to protect the identity of the people completing the forms. No individual, event, organisation or event will be identified by this research and all efforts will be made to keep the information supplied in the questionnaires anonymous.

Data from the study will be collected through a variety of different methods and groups including;

1. WorkSafe WA.
2. Department of Minerals Petroleum and Resources.
3. WA crane association.
4. Unions
5. Employer groups.

The questionnaire has been designed so as to take as little of your time as possible. Information that is gathered will be analysed and then used to make recommendations about crane operator training needs based on your responses and experiences. All attempts will be made to have the results of the research published in the relative industry journals and publications.

If you have any questions at all about this study you can direct them to the researcher,

Mr. I. Douglas
Faculty of Computing, Health and Science.
Edith Cowan University
Mon-Fri 9.30am – 3.30pm Telephone 94005196 or Mobile 0415 788 725.

Appendix E

Definitions Page.

DEFININTIONS PAGE.

ACCIDENT - for the purpose of this questionnaire an accident means any of the following that involved a crane,

. an event or occurrence that lead to the injury or harm of a worker (self or other).

. an event or occurrence that lead to damage of the crane.

. an event or occurrence that lead to damage of the surrounding infrastructure.

. an event or occurrence that lead to any part of the load that is being lifted becoming dislodged and falling from the cranes lifting hook.

. an event or occurrence that causes the crane to become unstable, which inturn causes the machine to tip over.

. an event or occurrence that causes damage to the load that is being lifted.

. an event or occurrence that lead to the load that was being lifted, coming into contact with electrical power transmission lines.

. mechanical failure of the crane. ie brake failure, outrigger/stabiliser failure etc.

. an event or occurrence that leads to the injury of a member of the public.

. an event or occurrence that caused disruption to the job.

INCIDENT –for the purpose of this questionnaire an incident with a crane means,

. Any of the above that actually fell short of causing an accident. ie the lift may have been stopped before the accident actually occurred.

. the crane becomes unstable but does not actually tip over.

. The load that is being lifted slips or moves in the lifting equipment that is being used.

. an event occurs that involves another worker but without any harm or injury occurring to that worker.

. there is a failure in the lifting equipment (ie shackle or sling breaks) but without any injury, damage or harm occurring to any person or surrounding infrastructure.

. an event or occurrence that lead to the wrong information being given to the operator about the load. ie wrong weight, working radius from centre of rotation.

Appendix F

Information and invitation to participate for job network members.

CRANE OPERATORS SURVEY

DO YOU HAVE A CRANE OPERATORS CERTIFICATE OF COMPETENCY?

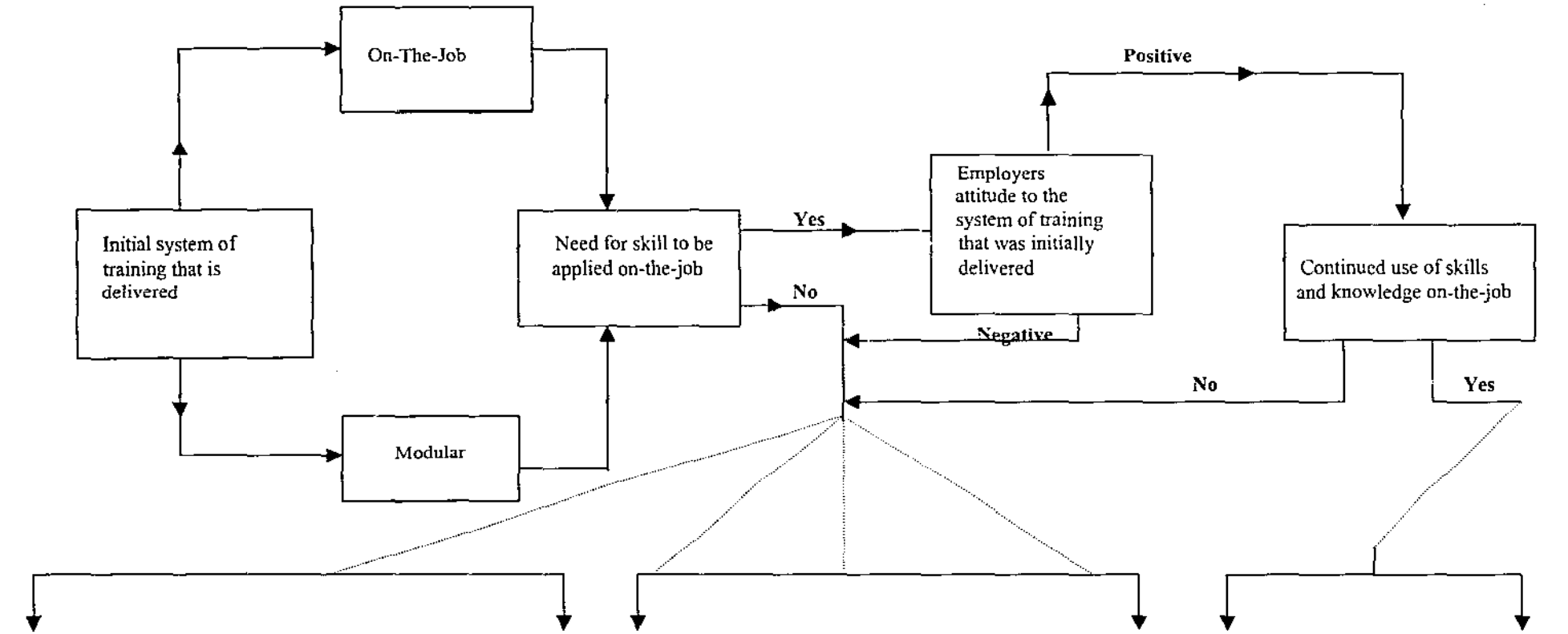
WOULD YOU LIKE TO ASSIST A STUDENT WHO IS STUDYING OCCUPATIONAL SAFETY AND HEALTH AT EDITH COWAN UNIVERSITY CONDUCT SOME RESEARCH?

IF SO, AFTER READING THE DISCLOSURE STATEMENT AND THE INSTRUCTIONS WHICH ARE ATTACHED TO THE QUESTIONNAIRES PLEASE FILL IN ONE (A QUESTIONNAIRE) AND PLACE IT IN THE REPLIED PAID ENVELOPE PROVIDED.

THE RESEARCHER WOULD LIKE TO THANK YOU IN ANTICIPATION OF YOUR CO-OPERATION AND INTEREST IN THIS STUDY.

Appendix G

Schematic view of the employers role in reinforcing the training loop.



Schematic view of how skills and knowledge can be maintained or lost through the employers attitude to the training system that was initially delivered.