

CONSTRUCTION OWNER'S ROLE IN CONSTRUCTION SAFETY
(PRIVATE SECTOR)

by

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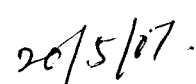
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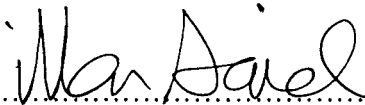
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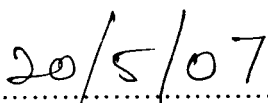
DECLARATION

I, KHOR BOON SIAN, declare that "Construction Owner's Role in Construction Safety (Private Sector)" is my own work and that all the sources I have quoted have been indicated and acknowledged by means of proper references.

Signature  Date 

Acknowledged by,


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Date:

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I am indebted to my wife, Ooi Hung Nee who rendered me her emotional support. Last but not least, I would also like to express my love to my parents who raise me up and educated me.

ABSTRACT

The construction industry has long been regarded as one of the most dangerous industries and still problematic areas that need to be addressed by all parties concerned. It has a history of poor safety performance in Malaysia and despite the fact that laws and regulations have been established and enacted in the past decades. The improvements are due, in part, to the concerted efforts of owners, contractors, subcontractors, and designers. The owners of construction projects are the primary consumers of construction services, the sources of project finances, and, in many cases, the end users of the facilities. They are often at the pivotal position of the project. Traditionally, owners have not been directly involved in construction safety, often in order to avoid economic losses and legal entanglements resulting from injuries. However, with the increase of accident costs and legal cases involving owners as the third-party defendants, owners have come to realize the importance of safety. In this study, the owner's role in construction safety was investigated. The relationship between project safety performance and the owner's influence was examined, with particular focus on the project context, selection of safe contractors, contractual safety requirements, and the owner's proactive involvement in safety management. It was concluded that the owner's involvement can significantly influence project safety performance. Owners can achieve better project safety performances by setting safety objectives, selecting safe contractors, and participating in safety management during construction.

ABSTRAK

Perindustrian pembinaan, salah satu daripada industri-industri yang lain mahu mempunyai pelbagai masalah yang berbahaya patut dibincangkan oleh badan-badan tertentu. Perindustrian pembinaan mempunyai rekod keselamatan yang agak membimbangkan walaupun akta atau undang-undang mengenai keselamatan and kesihatan tapak telah dikuatkuasakan selama sepuluh tahun dulu. Semua pihak yang terdiri daripada majikan, kontraktor, sub-kontraktor dan pereka. Majikan adalah sumber kewangan bagi projek-projek pembinaan, maka, merekalah yang memainkan peranan yang penting dalam menjalankan sesuatu projek. Secara tradisi, majikan tidak campur tangan dalam hal keselamatan tapak supaya dapat mengelak daripada kes-kes yang buruk terhadap majikan and juga kerugian yang akan ditanggung olehnya. Kos kemalangan semakin tinggi sesama kos keguaman, ramai majikan pembinaan sedar bahawa pentingnya keselamatan tapak.

Dalam kajian ini, peranan yang dimainkan oleh majikan pembinaan dikaji selidik. Pengaruh oleh majikan pembinaan terhadap pengurusan keselamatan projek ditentukan dengan menambil kira factor-faktor yang merangkumi projek konteks, pemilihan kontraktor, kehendak-kehadak keselamatan dari segi kontrak, dan keaktifan majikan pembinaan dalam pengurusan keselamatan tapak.

Kesimpulan bahawa majikan pembinaan memainkan peranan yang penting untuk mempengaruhi keselamatan projek.

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CHAPTER 1

INTRODUCTION

Traditionally, construction safety responsibilities have rested solely on the shoulder of contractors. Construction owners and designers have held the view that they should not get involved in construction worker safety for fear of incurring increased liability exposure. (Hinze, J., 1997). However, recently, more and more parties to the construction process have come to realize that zero accidents is an attainable objective, but only through the concerted efforts of all parties involved in the construction process. Owners, designer firms, contractors have different roles in preventing accidents to achieve an injury-free worksite. The contractors are undoubtedly the pivotal parties to control jobsite safety. Designers can reduce safety hazards in the working environment by considering worker safety issues in their design decisions. (Hinze, J., and Wiegand, F., 1992).

Today, more and more owners in Malaysia have come to realize that the costs of construction accidents are ultimately their own financial burden, and that they cannot with certainty shield themselves from the legal liabilities associated with worker injuries. Since the horrible incident happened in Kuala Lumpur in 2005 involving the death of a consultant who was crushed to death due to the fallen mould near to construction site which has signaled the alarm to all construction owners nation wide as well as the relevant government departments to implement strategies to minimize and control workplace safety, construction industry especially. Notwithstanding other construction site incidents which happened frequently in Malaysia that involved death of human lives and other major injuries. Owners are to select safer construction firms and to allocate safety provisions in the construction contract. Owners continue to influence safety

performance by the nature of their involvement during the construction process. These owners are of international manufacturing giants e.g. Intel, Motorola, JABIL etc that really set safety as their priority goal to safeguard their workers and others who work for or work with them.

Despite all the research that has been conducted with the various parties to the construction process, little prior work has examined the specific role played by project owners in promoting safety performance.

1.1 PROBLEM STATEMENT

Construction industry suffers a very high fatality rate not only in Malaysia but also in most countries throughout the world. The statistics published by SOCSO (Table 1.1) concerning the reported industrial accidents and deaths for year 1998 to 2004.

Although the deaths rate has been gradually decreased since year 2001 until 2004, the cases which resulted in major and near misses are still high. It has actually alarm us to seek further improvement to curb the accident rate in the construction industry.

It is apparent that although various recommendations exist, there is still no solid evidence in the previous research to describe how owners can efficiently promote construction safety on their projects and how to assess the relationship between safety performance and the owner's involvement in project safety.

Table 1.1 INDUSTRIAL ACCIDENT REPORTED (YEAR 1998 TO 2004)

Year	Construction Industry	
1998	3,543	Reported Cases
	104	Deaths
1999	4,747	Reported Cases
	146	Deaths
2000	4,873	Reported Cases
	159	Deaths
2001	4,593	Reported Cases
	89	Deaths
2002	5,015	Reported Cases
	88	Deaths
2003	4,654	Reported Cases
	95	Deaths
2004	4,445	Reported Cases
	81	Deaths

Source: SOCSO Reports (1998-2004)

1.2 RESEARCH OBJECTIVES

The primary objectives of this research project are:

- 1) To understand the construction safety issues, the current approaches and practices.
- 2) To identify several influential factors of the construction owner's involvement on project safety performance.
- 3) How owners can efficiently promote safety performance on their projects.
- 4) How contractors would like owners to facilitate construction safety management.
- 5) To make recommendations based on the findings of this research study on how building owner can influence and improve safety performance in the construction industry.

1.3 SCOPE AND LIMITATION OF RESEARCH

This research is confined to the study of building construction safety management as outlined in the organization and structure of the dissertation in section 1.4. For the field data collection survey, this research is limited to the study of selected construction owners and major contractor firms registered with CIDB in Penang and Butterworth.

1.4 ORGANIZATION OF RESEARCH

The first chapter comprises the introduction, problem statement, research objectives, scope and limitation of research, organization of the dissertation and research flow chart. In chapter 2 on literature review which deals with construction accident facts and how owners play their role in influencing and improving construction safety performance.

The methodology is in chapter 3 to show how the research is conducted. After that, discussion of findings is presented in chapter 4 which deals with the analysis and evaluation of the statistical data from the field data collection survey.

The final part of this dissertation that is chapter 5, a conclusion to prove or disapprove the research objectives shall be presented. The discussion and recommendations with regards to the construction owner's involvement in construction safety management shall also be presented to help improve the accident rate and create a better working environment for the construction workers and other construction related industries.

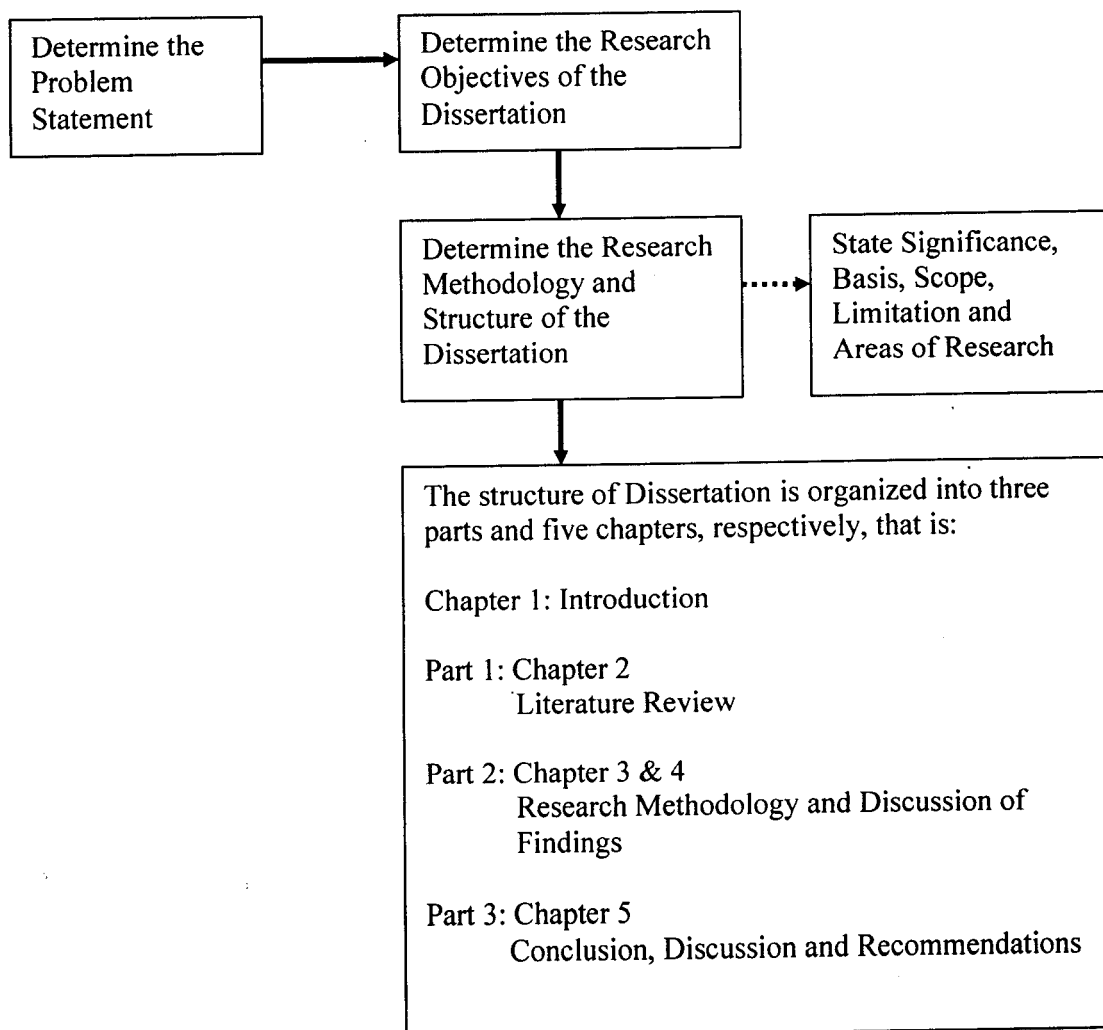


Fig. 1.1 ORGANIZATION OF RESEARCH Source: *The Survey Research Handbook (1995)*

CHAPTER 2

LITERATURE REVIEW

2.0

INTRODUCTION

In section 2.1, the construction facts and figures in terms of accident rate is presented and it is compared to the country gross domestic product (GDP) and numbers of registered construction personnel in Malaysia. In section 2.2 deals with owner's active involvement in construction safety can make an impact to improve the safety performance. The CDM (Construction, Design and Management) regulations, that is being implemented in United Kingdom is studied and cases relating to construction safety issues are revealed. This followed in section 2.3 which deals with how owners take their role in construction safety, i.e. establish and communicate attitudes towards safety, consider safety in contractor selection, contractual safety arrangements, address safety during design and constructability review, participate in safety during construction processes. Total safety culture and BBS (Behavior Base Safety) are studied further to inculcate knowledge and experience that would encourage construction team to actively involve in the construction safety management.

2.1

CONSTRUCTION ACCIDENT FACTS

Accident data obtained by the PERKESO (Pertubuhan Keselamatan Sosial) or Social Security Organization statistics (1995 - 2004) recorded that the construction industry has high fatality rate compared to major economic contributor sectors (see Table 2-1 and Figure 2-1). It was recorded the highest fatality happened in 1999 and 2000 at an alarming rate of 17%, second to Manufacturing sector which is quite unbalanced to compare with the average GDP growth by sectors. (see Figure 2-2). Although the

construction fatality rate has improved in year 2001 and subsequent years, yet it has scored quite high in death cases. The construction personnel registered with Malaysian CIDB (Construction Industry Development Board) shows that number of employees has increased over the years, which constitute about 3% to 4% of total workforce. (See table 2-2) In view of this condition, measures must be taken to minimize the alarming rate of death and injury cases by various parties involved which shall be discussed later.

Table 2-1: Fatality rate by industry

Sector	Fatality rate for each sector against total death cases (%)									
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Agriculture, Forestry and Fisheries	12.1	11.1	21.2	3.6	15.6	12.3	8.8	8.9	4.9	7.6
Mining	1.4	2.6	1.4	0.8	1.7	1.2	0.8	1.6	0.9	0.9
Manufacturing	41.4	41.7	30.9	23.9	27.5	30.3	28.5	27.8	25.9	26.9
Electrical, Gas & Cleaning Services	0.7	0.8	1.1	1.3	1.3	0.9	1.5	1.8	0.9	1.2
Construction Services	6.5	9.9	6.5	11	17.3	17	10.5	11	11.6	9.6
Commerce	12.4	9.5	10	14.6	15	16.2	22.5	17.4	18.4	17.9
Transportation	10.5	10.2	7	8.2	10.8	10.5	10.7	11.7	13	9.2
Finance & Insurance	1.3	0.9	0.6	1.6	0.9	1.2	0.7	1.2	0.9	0.8
Services	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	10.2	8.5
Public Services	13.7	13.4	21.2	35.1	9.8	10.4	15.9	18.3	13	17

Source: SOCSO Annual Reports (1995 – 2004)

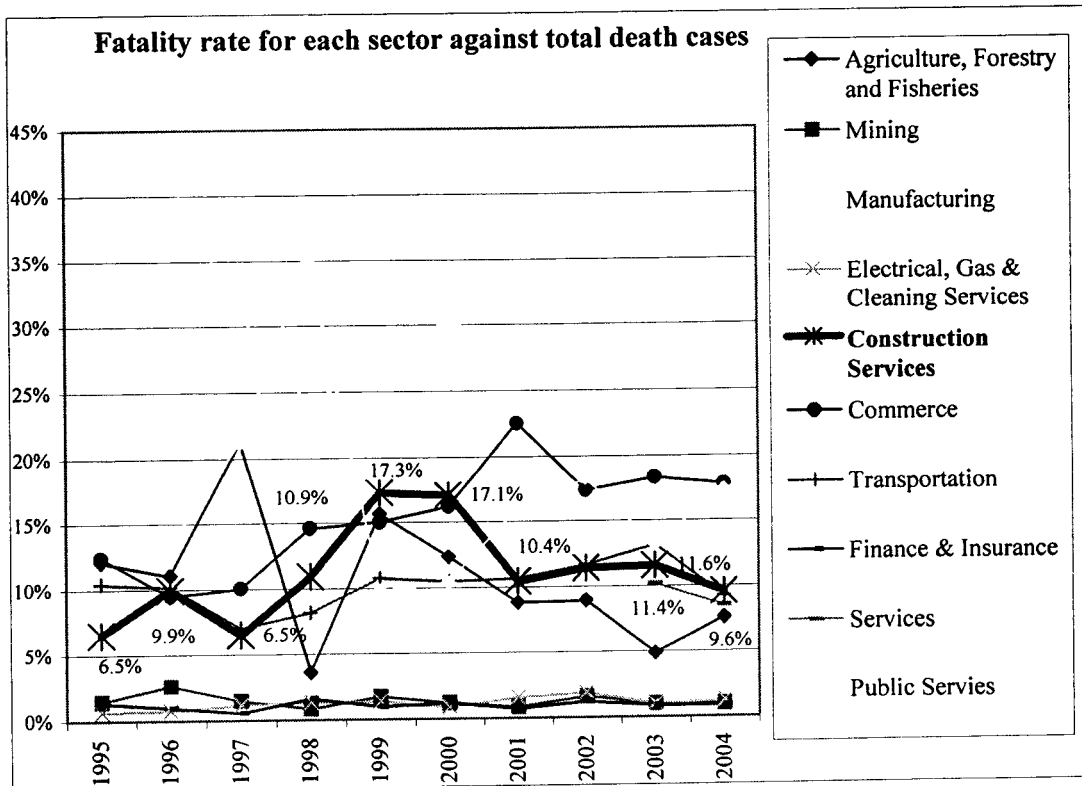


Figure 2-1: Fatality Rate by industry

Source: SOCSO Annual Reports (1995 – 2004)

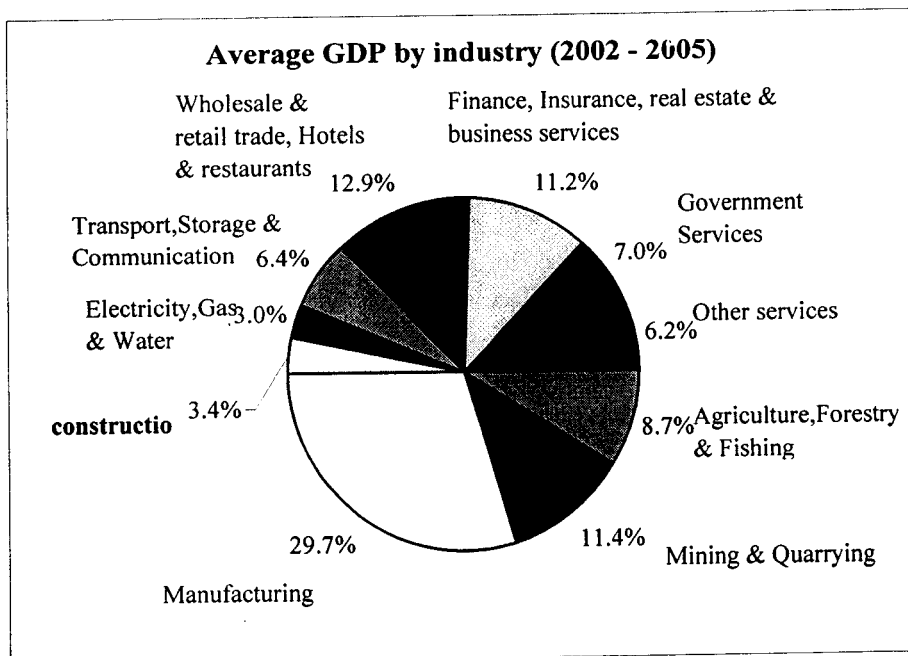


Figure 2-2: Average GDP by industry (2002-2005)

Source: Bank Negara

Table 2-2: Yearly Cumulative Construction Personnel Registration Statistics

Year	Local Construction Personnel	Foreign Construction Personnel	Total Registered Construction Personnel
1996	63,211	1,027	64,238
1997	68,825	2,257	71,082
1998	71,644	2,761	74,405
1999	73,660	3,251	76,911
2000	83,681	4,758	88,439
2001	170,683	14,644	185,327
2002	284,514	25,614	310,128
2003	373,787	68,140	441,927
2004	411,776	105,348	517,124
2005	470,346	127,916	598,262

Source: CIDB Yearly Statistical Information for Construction Business Development Program(1996-2005)

Malaysia has been achieving high economic growth in various economic sectors for many years, yet occupational safety needs to be improved especially for building construction projects. Besides the laws and regulation to be enforced, building owners are the maneuvering forces to effectively curb the construction incident rate in various means with the collaboration of the contractors.

With a higher proportion of injuries, the construction industry has long been regarded as a dangerous industry. With an average employment of approximately 4% of the total industrial workforce, the construction industry has generally accounted for averagely 11% of all industrial worker fatalities. The research conducted by Everett and Frank (1996) concluded that the total costs of construction accidents accounted for 7.9 – 15% of the total costs of new, non-residential projects. A more recent but unpublished research by Coble and Hinze (2000) showed that the average worker's compensation insurance costs could be conservatively estimated as constituting 3.5% of the total project cost.

Management has been motivated to make a greater commitment to safety, based on its increased awareness of the impact of the high costs of worker's compensation payments, the higher dollar value settlements in lawsuits, the increased amounts of OSHA fines for safety violations, and the adverse impacts of poor safety performance on the corporate image.

In order to reduce and eventually eliminate construction accidents, researches have explored techniques to fulfill the "zero injury objective" through the concerted efforts of all parties involved. The involvement of owners has been regarded as an essential requirement for this objective. For example, the research conducted by Liska et al. (1993), it was found that an important prerequisite attributed to excellent safety performance was the involvement of the owner not only in pre-project planning including financially supporting the contractor's safety program, but also in the day-to-

day project safety activities. In the construction accident causation model developed by Suraji et al. 2001, (Figure 2-3), construction accidents are caused by different responses to certain constraints and the environment on construction projects. In the model, owner (client) responses are the actions (or inactions) of the owner in response to constraints during the development of a project brief (Duff, 2000). These included, for example, reducing the project budget, adding new project criteria, changing project objectives, and accelerating the design or construction efforts of the project. All these elements will play an essential role in accident occurrences.

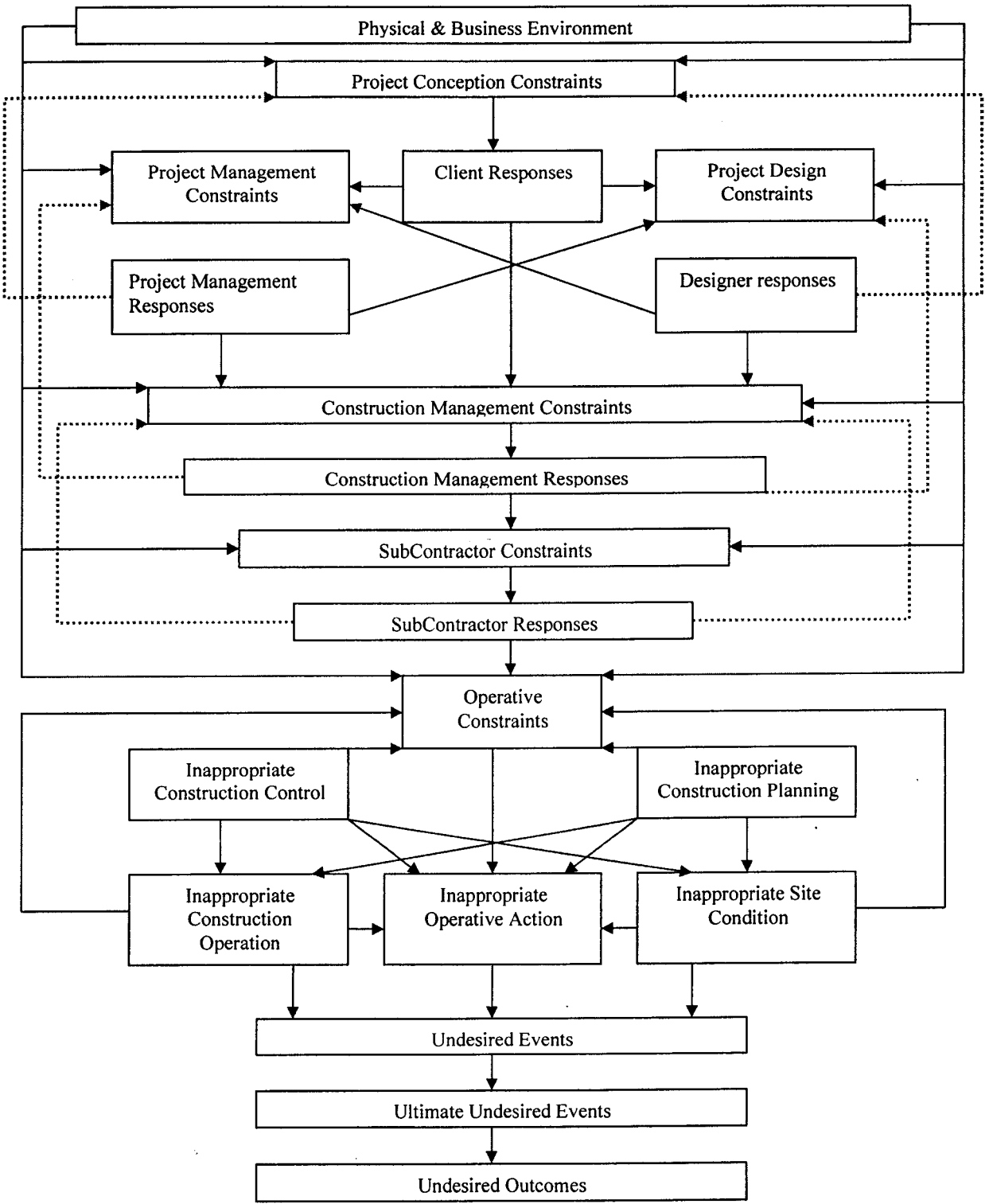


Figure 2-3. Construction Accident Causation Model: Constraints and Responses

Source: The Research, by Suraji et al. (2001)

In the past, there was a reluctance of owners to become involved in matters related to construction safety issues for the fear of added liability exposure (Sikes et al.,2000) In United States, more and more owners, especially owners with larger construction budgets, have voluntarily expanded their role in ensuring worker safety. A series of studies conducted at the University of Washington on the early 1990's demonstrated that owners' concern for construction safety was increasing. The major reasons include the following:

- i) The rising costs of health care and workers' compensation are not being ignored by owners (see table 2-3)

Table 2-3. Average cost of construction site injuries

Type of injury	Direct Costs	Indirect Costs	Estimated Liability Costs	Total Cost to Employer
Medical Only	\$520	\$440	\$240	\$1,200
Lost Work Day	\$6,900	\$1,600	\$16,500	\$25,000

Source: U.S. Construction Safety & Health Directory (2005)

- ii) Owners realize that the costs of injuries are ultimately reflected in the cost of construction (Gambatese, 2000 b)
- iii) Litigation involving third parties has escalated in the past three decades. For example, in the case of Philips v. United Engineers & Constructors, Inc., and Plasteel Products Corp., 500 N.E. 2d 1265 (1986), owner was sued but was not held responsible for a worker's fall from catwalk during steel erection. In another case Rigatti v. Reddy, 723 A.2d 1283 (1999), the owner was similarly cleared of being responsible for a roofer's fall. In the case of Stark v. Rotterdam Square, 603 N.Y.S. 2d 347 (1993), the owner of a mall was held liable for injuries suffered by a roofer when he fell through a hole cut into the roof.

Because of these types of lawsuits, many owners have come to realize that reducing the frequency and severity of construction injuries is the only way of reducing their potential liability for worker injuries (Levitt and Samelson, 1993)

Since the early 1980s, several efforts have been undertaken to formally require owners to participate in construction safety. A major effort to expand safety legislation resulted after 28 workers died in the tragic collapse of the L' Ambiance plaza Building in Bridgeport, Connecticut (Godfrey, 1998). This accident became the driving force behind U.S. Senate Bill 2581 to amend the Occupational Safety and Health Act to "require all construction projects to be supervised by A professional engineer-architect designated by the owner and registered in the state where the construction is to be performed" (ASCE, 1988). Opposition to this bill from a large segment of the construction industry ultimately resulted in its failure.

Although these legislation efforts failed in the U.S., the liability of owners in the United Kingdom was specified by the Construction (Design and Management) regulations 1994 (CDM), in which the owner's main duties are contained in Regulations 6,10,11 and 12 (Holt, 2001). In CDM, a owner is defined as "any person for whom a project is carried out, whether carried out by another person or in-house." CDM imposed criminal liability onto the owner who ignores construction safety and where this results in an accident. Each project owner has a responsibility for safety on the project. In cases where there are multiple owners, the owners can appoint an agent or another owner to carry out the owner's duties, and then have to make a declaration to the enforcing authority (the Health and Safety Executive) that the transfer of duties has been made.

Under CDM, the construction owner must do the following:

- i) Appoint a Planning Supervisor and a Principle Contractor for each project, being satisfied that these “duty holders” are competent and have the resources to perform their adequately.
- ii) Not permit the construction work to start unless a health and safety plan, which complies with the safety regulations, is in place for that project.
- iii) Provide the planning supervisor with information about the state or condition of the premises where the work is to be carried out. The information which is relevant, and which the owner either has or could get after making reasonable inquiries.
- iv) Verify that any designer or contractor that is appointed directly is competent for the task and has allocated sufficient resources to it.
- v) Make the health and safety file available for inspection by anyone who may need information to comply with legal requirements. The owner will sell or pass on the file to a future owner or a person acquiring the interest in the property of the structure to which it refers.

The trend is clear that owners are getting more concerned about construction safety, but many owners are confronted with the problem of how to effectively influence project safety. For example, a safety campaign supported by the owner was conducted during the construction of the Resund Link between Denmark and Sweden. Primarily, the safety campaign consisted of a comprehensive information campaign aimed at promoting positive attitudes towards safety among employees, and a specific campaign aimed at the behavioral aspects to increase the level of safety when performing routine work at the construction site (Spangerberg, 2002). In the end , the results of the

campaign did not satisfy the owner's expectations of low injury rate, which led people to question what techniques by the owner can effectively improve construction safety.

Therefore, it would be essential to investigate the current techniques employed by owners to achieve good safety performances on construction sites, and if possible establish the effect the techniques on the resultant safety performance.

2.3 HOW OWNERS TAKE THEIR ROLE IN SAFETY

Owners can actively impact construction safety by selecting safe contractors, addressing safety issues in design, and participating in safety management during construction (Hinze,1997). To the extend possible, the owners, through their project representatives, should participate with the contractors in all project safety activities, including but not limited to new employee orientation, safety meetings, audits and accident investigations, training, incentive programs and other safety related programs (Gambatese, 2000b)

One of the earlier studies on the owner's role in construction safety by Levitt et al. (1981) reached the conclusion that construction owners who selected or prequalified contractors based on safety performance, and/or who got involved in construction safety management, had fewer accidents on their projects. The owner's involvement in construction safety management not only reduces the number and severity of accidents but probably also reduces the owner's total liability exposure.

The American Society of Civil Engineers (ASCE) moved to the forefront in the trend to involve owners in safety following the issuance of ASCE's Policy Statement 350 on construction site safety in 1998. The statement outlines ASCE's belief that "improving construction site safety requires attention and commitment from all parties involved." The policy states that safety should be addressed "for each project on a project specific basis," and that owners should "take an active role in project safety." Various ways owners can actively address safety were given in the policy, including the following:

- i) Assigning overall project safety responsibility and authority to a specific organization or individual (or specifically retaining that responsibility) that is qualified in construction safety principles, rules, and practices appropriate for the particular project.
- ii) Including prior safety performance as a criterion for contractor selection.
- iii) Designating an individual or organization to monitor safety performance during construction.
- iv) Designating in the contract documents those parties responsible for the final approval of shop drawings and details.

Gambatese (2000b) summarized various ways in which owners can actively address safety, including the following:

- i) Establish a clear position on safety.
- ii) Ensure that safety is addressed in project planning and design.
- iii) Consider safety performance when selecting a contractor.
- iv) Address safety on the construction contract.
- v) Assign safety responsibility during construction.
- vi) Participate in project safety during construction.

2.3.1 ESTABLISH AND COMMUNICATE ATTITUDES TOWARDS SAFETY

All owners have legal and moral responsibility to insist on the safe performance of their construction contractors and to use reasonable care to prevent contractors from injuring others on the site. Owners should understand that their involvement in construction safety management not only reduces the numbers and severity of injuries, but is also likely to reduce the owners' total liability. In addition, the owner should realize the safe performance is generally related to lower costs, better quality work, improved productivity, adherence to schedule, reduced exposure to bad publicity, and minimal disruption of the work being performed. As Hinze (1997) stated, owners whose objectives are to avoid injuries are likely to have a proactive and more direct involvement in construction operations. Therefore, the first step of the owner's involvement in safety is commitment, especially management commitment, to create an injury-free project. Each owner in the survey conducted by Levitt and Samelson (1993) stated the believe that active involvement in construction safety . done properly, served to reduce rather than increase the firm's potential liability for construction accidents.

The owner's position on safety should be clearly communicated to the project team at the beginning of the project and to all team members joining the project during the construction phase (Gambatese, 2000b). During project development, owners should convey their commitment to safety to the contractors through various means, including devising incentives for safety and by implementing sanctions for failing to support the owner's safety initiatives.

2.3.2 CONSIDER SAFETY IN CONTRACTOR SELECTION

Traditionally, selecting safe contractors was recognized by many owners as the most effective way to guarantee safety performance on their projects. Criteria for selecting safe contractors have been extensively investigated in the past. Levitt and Samelson (1993) stated that screening contractors in terms of their expected safety performance is an easy and effective way for construction owners to enhance construction safety. Levitt and Samelson (1981) suggested that the criteria must be

- i) Predictive of safe project performance,
- ii) Equally applicable to different construction firms,
- iii) Objective.

Possible selection measures were EMRs, OSHA recordable injury rates, and management safety accountability. Findings from the research that are indicative of safety accountability include the following:

- i) Who in the organization receives and reviews accident reports, and what is the frequency of distribution of these reports? (Frequent reports, detailed by operating units, and reviewed by the president of the firm would be an indication of high company accountability for safety.)
- ii) Frequency of safety meetings for field supervisors.
- iii) Compilation of accident records by foremen and superintendents and the frequency of reporting. (Contractors who categorize their accidents statistics by superintendent and foremen, rather than by larger units, have more detailed accountability system.)

- iv) Frequency of project safety inspection and the degree to which they involve project managers and field superintendents.
- v) Use of an accident cost system allocating or assigning responsibility to individual foremen and superintendents, as well as project managers.

Certain safety criteria during the selection of contractors suggested by Hinze (1997) and Hinze and Godfrey (2003) include the following:

- i) Injury incident rates (including lost workday injury rates, OSHA recordable injury rates, first aid injury rates and etc)
- ii) Job site safety inspection
- iii) Behavior based worker observations
- iv) Experience modification rates (EMR)
- v) Loss ratios of workers' compensation
- vi) Records of OSHA citations and fines
- vii) Litigation related to injuries
- viii) Performance record of key personnel
- ix) Project safety plan
- x) Contractor qualification safety surveys
- xi) Worker's conception surveys

2.3.3 Contractual Safety Arrangements

Owners must also make sure that contractors recognize their contractual responsibility to perform safely (Levitt and Samelson, 1993). Contractually, most owners have the

contractor indemnify them from any losses or liabilities resulting from injuries, but it is also essential to include specific and thorough safety requirements in the construction contract. The requirements might include the following (Gambatese, 2000b):

- i) The requirement that the contractor abide by all applicable safety laws and regulations;
- ii) A delineation of the responsibility for safety on the jobsite;
- iii) The submission of a written contractor safety program before work begins;
- iv) A requirement for implementing a substance abuse program; and
- v) The submission of an emergency plan and accident reporting procedure.

Questionnaires sent to owners and contractors (Business Roundtable, 1982) were used by Stanford University to identify safety requirements owners placed on construction contractors and specific practices of owners to emphasize safety with contractors. The responses are arranged in decreasing order of use by the respondents. Require use of a system of permits for potentially hazardous activities.

- i) Require the contractor to designate a responsible supervisor for safety coordination on the job site.
- ii) Provide the contractor with safety guidelines that must be followed.
- iii) Discuss safety at owner-contractor meetings.
- iv) Periodically discuss safety audits of the contractor operations
- v) Require immediate reporting of contractor accidents.
- vi) Stress safety as part of the contract during pre-bid-walk-around.
- vii) Investigate contractor accidents.
- viii) Maintain statistics of contractor accidents.
- ix) Conduct periodic safety inspections

- x) Set goals for construction safety.
- xi) Consider safety in pre-qualifying contractors for bidding on projects.
- xii) Set up a construction safety department to monitor contractor safety.
- xiii) Set safety guidelines in the contract.
- xiv) Be involved in orientation sessions alerting workers to safety hazards on the job.

An owner, to be actively involved in construction safety, might consider several contractual issues. Many of the issues related to the safety obligations placed on the contractor. Hinze (1997) suggested that contract provisions may include the following requirements:

- i) Submittal of a project-specific safety plan
- ii) Job Hazard Analysis
- iii) Regular safety meetings with supervisory personnel
- iv) A designated project safety coordinator
- v) Mandatory reporting of accidents, safety inspections, and safety meetings
- vi) Inclusion of subcontractors in the safety program
- vii) Compliance with the owner's safety guidelines
- viii) Establishment of an effective worker orientation program

As the major binding document between the owner and contractor, the contractual arrangement (lump-sum) will also impact how safety will be addressed on the project.

One reason that the contract type should be considered when addressing project safety is that the contract essentially determines how the owner will make payment to contractors to compensate them for their services on the project, and therefore, can impact the relationship between owner and contractor (Dagostino, 2002). As safety can be obtained

only through the concerted efforts of different parties. (owner, contractor, and designer), and nature of their relationship can be expected to impact safety. For example, if the contractor has a close, long-term relationship with the owner, they will generally use cost reimbursable contracts (cost plus). Thus, safety investments will be reimbursed by the owner to support the contractor's efforts. This arrangement encourages the contractors to spend the necessary funds on safety.

2.3.4 ADDRESS SAFETY DURING DESIGN AND CONSTRUCTIBILITY REVIEW

Design decisions can dictate the structure, elements, materials and even the construction methods to be used on the project. For example, the selection of forming systems, cycle times, sequences, equipment, and design of temporary structures are significantly impacted by the design of the permanent construction. Therefore, designers are very influential, perhaps unknowingly, in impacting the way safety issues will be addressed during construction. Consideration of construction worker safety by designers can lead to a reduction in injuries and associated costs during the construction phase. Toole (2002) stressed that the designers are in the best position to implement specific safety design recommendations, thereby preventing less safe conditions on the site. Also, designers may be able to identify questionable structural situations such as temporary loadings on the permanent structure or temporary work platforms, provided they are explicitly requested to do so and processes all of the data necessary to perform the analysis. One reason why the Corps of Engineers has had particularly low injury rates on their construction projects is that it coordinates the design with erection procedures and coordinates their efforts on safety (MacCollum, 1995). Although the involvement of