THE UNIVERSITY OF HULL

A STUDY OF BEHAVIOURAL CHANGE IN OCCUPATIONAL SAFETY IN A METAL WORKS AT SHENZHEN CHINA

Being a Dissertation Submitted to the University of Hull for the Degree of Doctor of Philosophy

by

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ABSTRACT

The present study applied a combined behvioural and attitudinal approach in occupational safety in a Hong Kong-based metal house in Shenzhen, China in an attempt to modify the safety behaviours and attitudes of the workers by means of posted feedback plus goal-setting. To the best of the researcher's knowledge, this is the first study of this type to be attempted in a Chinese industrial setting.

A total of 142 respondents from the four departments, namely Heavy Duty, Small Press, Hand Press and Drilling were involved in the survey with a multiple-based line design for an environment where random sampling was impossible. Meanwhile, the study also intended to explore the underlying factors that affected the safety attitudes of the respondents. These factors included influences from traditional culture and religions.

A self-constructed observation checklist and a questionnaire adopted from the Health and Safety Executive Report No. 81 (HSE, 1996) on attitude investigation were the major research instruments. Percentaged analysis, ANOVA, T-Test and Fisher Exact Test set at 0.05 level were applied to determine the significance of differences in the workers' behaviours and attitudes before and after the intervention.

From the results of the research, it was found that

i) there were relationships between the workers' behaviours in occupational safety and posted-feedback plus goal-setting in the Heavy-duty Press, Small Press and Hand Press Departments;

ii) there were relationships between the intervention and the workers' attitudes in terms of

-'Supervisor Satisfaction' in the Heavy Duty and the Small Press Departments;

-'Shop-floor Training' with the Heavy Duty Press and the Small Press Departmets;

-'Safety Meeting' with the Small Press Department;

-'Safety Working Procedures' with the Heavy Duty Press and the Small Press Departments;

iii) the results demonstrated that there were relationships between attitudes of the formally trained workers and those of their peer workers without formal training towards occupational safety in terms of

-'Supervisor Satisfaction' with the Heavy Duty Press Department;

-'Safety Meeting' with the Heavy Duty Press Department;

-'Safety Working Procedures' with the Small Press department;

iv) there were relationships between workers with self-reported accident rates and those without in terms of their safety attitudes towards

-'Supervisor Knowledge' with the Heavy Duty Press Department;

-'Shop-floor Satisfaction' with the Heavy Duty Press Department;

-'Shop-floor Environment: Hardware' with the Small Press Department;

intervention was related to both the workers' attitudes and their behaviours in work safety in the Heavy-duty Press, the Small Press and the Hand Press departments.

Throughout the investigation, no significant change was found with both the respondents' safety behaviours or attitudes in the Drilling Department during the periods when interventions were introduced to other departments.

Concerning the controlling factors for the workers' attitudes towards work safety, cultural and religious factors could explain the workers' under-reporting of accidents and injuries.

These findings implied that researchers needed to be aware of the tremendous local cultural and religious concerns when applying western rationales to constructing a safety culture in developing countries.

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PERSONAL RATIONALE

This section will explain the reasons for the choice of the current research venue and the personal background of the author with regard to occupational safety.

Venue

A sheet metal stamping factory in P.R.C. (People's Republic of China) has been chosen as the venue for the study. The choice is based on the concern for occupational safety in relation to the dangerous nature of the work as well as the hazardous working environment. A metal works is considered a place where the high risks exist during the daily operation of the stamping machines (power presses) that can injure the operators if handled improperly. (Appendix 12)

Personal Background

The choice of metal sheet stamping for the research is also based on the personal career background of the researcher who had been engaged in supporting industry for tele-communicative products for more than nine years. He had been participating in both the operation and top management for the manufacturing of printed circuit boards, plastic injection, sheet metal stamping and printed circuit board assembly respectively. During years of operation in the plants, he had been exposed to a substantial number of reports of industrial accidents that had alerted him of the importance of work safety and health. Since he is familiar with the working environment of the plants, the specific requirements of the working processes in the respective types of factories, he will stand a better chance of enlisting the assistance of the factory employers for conducting a research in their plants.

CHAPTER I

INTRODUCTION I

Changing Economic Patterns in Hong Kong and Shenzhen

1.0 Background of the Study

The purpose of this study is to develop occupational and health in Shenzhen, China. Before the investigation, it is crucial to have a comprehensive understanding of the historical, political, social, economic and cultural background of modern China, since all these factors are inter-related for the emergence of the Special Economic Zone and the timing for introducing a safety culture into China.

Since the early 80s, encouraged by the innovative open-door policy of Deng Xiao Ping, the late number one leader of Communist China, thousands and thousands of employers had moved their factories to Shenzhen from Hong Kong. Their purpose was to take full advantage of the cheap labour in China for their labour intensive industries to make their products more cost effective and competitive in the international market. The rapid development and the high demand for skilled and semi-skilled labour had triggered an influx of millions of youth into the economic zones. These out-of-province low wage earners mostly came from primitive villages or remote hilly areas where education was a secondary priority to helping their families for a livelihood.

Among the young workers, the girls would normally be engaged in manual piece-work while the boys would take up work that required more physical devotion. They had only gone through quick and simple training before they joined the production force. Because of their overall low educational background, they had limited knowledge in operating the machines properly and insufficient awareness in work safety and quality. The operators especially in metal sheet stamping, for example, had incurred higher risk than their counterparts in other types of manufacturing, owing to the dangerous nature of the operation. There had been a high frequency of work accidents. Among the seven major manufacturing industries that involved serious occurrences of industrial accidents metal work stood high on the list (Table 1.1). Workers were often hurt in material handling, owing to the sharp edges of the metal sheets and the unsafe operation of the machines (Industrial Accident Statistics, 1997).

Industrial Accidents in the Seven Major Manufacturing Industries in 1st Quarter of Years 1996 and 1997 Analyzed by Industry Table 1.1

Manufacturing Industries	1st Qtr. of 1996	1st Qtr. of 1997
Textile	228	161
Wearing Apparel	118	96
Electronics	79	59
Metal (Stamping)	169	181
Plastics	52	47
Shipbuilding and Repairing	69	74
Printing	142	156

At the early stage when the joint-ventured or Hong Kong owned enterprises were first set up, many of the management personnel came from Hong Kong for technical and management transfer. As a result, most of the management systems in the Special Economic Zone (SEZ) had been more or less modeled on that of Hong Kong. Unfortunately, in industrial safety management, Hong Kong had long been accused of inadequacy. Thus, to find future direction and solution for the industrial safety in China, it was imperative first to examine the historical background of the occupational safety in Hong Kong upon which the Chinese counterpart had learned subsequently. It is also fair to say that the problems of occupational safety in China were closely related to the rapid development of industries in the last twenty years as a result of the open-door policy. To China, the problems in industrial safety were brought along with the influx of Hong Kong and foreign industries after China had opened its door to outside investment. All these issues were inter-related. It is, therefore, worthwhile to understand the background for the open-door policy that attracted Hong Kong investment, leading to the subsequent drastic change of domestic economic direction. Without the open national economic policy in China, probably the impact of Hong Kong on the Chinese industries and on its occupational safety would not have been so tremendous. This chapter, therefore, besides investigating health and safety at work in China, tries to examine the contributing factors leading to the urge for modernization and also the backgrounds that were responsible for the coming of investment that indirectly led to the issue of occupational safety. To summarize, this chapter will examine the following issues:

a) reasons for investment in Shenzhen from Hong Kong and the industrial environment in Hong Kong

b) background for the economic reform and the emergence of the Special Economic Zone

c) the workers in Shenzhen

d) occupational safety---China and Hong Kong

1.1 Reasons for the Investment in Shenzhen from Hong Kong

Up to the end of the 1970s, the Hong Kong economy had enjoyed a blooming success for the previous twenty years, with political stability and support from China in terms of the supply of raw materials and foodstuff. The focus of the Hong Kong economy had been on financial activities (for example, stock exchange, foreign exchange and local realty), neglecting the hidden economic competition from the neighbouring countries such as Singapore, Taiwan and Korea. For example, the total production value of Hong Kong for the year 1996 was US$1527 millions while Singapore yielded US$941millions but in 1997, the yield of Singapore had already reached US$1049 millions when Hong Kong only accomplished US$1701 millions. The fact indicated that the pace of economic growth of other countries was faster than could be expected (Shenzhen Year Book, 1998, pp-735). As a result of labour shortages and increased costs in manufacturing and being overwhelmed by the upsurge of high technology in industry in the countries mentioned above, Hong Kong was gradually forced to change its basic industrial structure from labour-intensive manufacturing to that of high technology and services for survival. Meanwhile, in response to labour shortages and increased costs of manufacturing, a considerable number of Hong Kong manufacturers had irreversibly moved their business investment to China. Their concern was that their costs had to be very marginal to allow room for growth in production capabilities.

1.1.1 Costing

The greatest attraction for setting up the production in China rather than in Hong Kong was the need to cut down the wages. The monthly processing fees for hiring a Chinese worker ranged from HK$300 to HK$1100 in Shenzhen (Tretiak, 1992, pp-299), depending on the location and the types of industries. The processing fees normally referred to the charges of rent, water and power. In comparison, the average monthly salary paid to a Hong Kong based manufacturing worker amounted to as much as HK$4000 (Tretiak, 1992, pp-299).

1.1.2 Labour Shortage

Hong Kong faced a crisis of labour shortages that became increasingly acute at the end of the 1970s. The Hong Kong government reported in 1978-1979 the job vacancies in manufacturing for both 1976 and 1977 to be 4-6% of the total manufacturing employment (Hong Kong Government, 1979). The shortage was partly due to labour mobility. In fact, the labour market had showed a sign of shortage since 1963-64, when the Commissioner of Labour warned of the under-supply and high mobility of labour that had curbed the expansion plans of many factories to recruit an adequate workforce (Commissioner for Labour, 1963-1964). With regard to the mobility and turnover of the labour force in Hong Kong, Geiger (1973) argued that the workers in Hong Kong were characterized by their frequent changes of job and lack of loyalty to their work organization. The easy turnover was probably because of their sensitivity to any slight wage differences which drew them from their present post to one with higher pay. One catalyst for the frequent job mobility was the easy exchange of job information in an area with geographical compactness and the lack of strict job contracts for binding the employees (Hsia and Chau, 1978). It can also be argued that the turnover of workers reflected the special way of the local employees to express their discontent towards their employer. Chinese employees do not usually resort to trade unions for assistance (England & Rear, 1978). According to the Labour Force Survey of

September, 1978, the high labour turnover was most serious with garment-making and electronics industries (Hong Kong Census and Statistics Department, 1978). In order to alleviate the labour shortage to survive in a competitive environment, the union representatives appealed to the employers to consider automation and machinery (Hong Kong Standard, pp-5-4, 1989).

1.1.3 Change of Industrial Structure

In the face of the declining competitiveness in the market owing to labour shortage and the increasing costs of operation, the introduction of new technology coupled with a more flexible corporate strategy were the only means of maintaining Hong Kong's competitiveness in the international market. In this way, better productivity and good product quality could be pushed (Poon, 1992). Alongside opting for high technology in manufacturing, many organizations attempted to "increase and improve their product design and technology (Poon, 1992, pp-199)". They indicated that their Hong Kong operations would in the future concentrate on business negotiation, marketing, documentation, merchandising, product design, research and development (R & D), etc. (Tretiak, 1992, pp-300). For the labour intensive manufacturing, China was the best possible choice for a solution.

Regarding the industrial activities conducted in China for Hong Kong, according to the Hong Kong Trade Development Council (TDC, 1988):

> "it is estimated that as of mid-1988, there were enterprises employing 1-1.3 million workers on behalf of overseas customers: over 80% of them, (i.e. 11,000-12,000 enterprises and 850,000 to 1.2 million workers) were producing for Hong Kong companies. The investments made by Hong Kong companies in processing assembly activity in Guangdong were estimated to have exceeded US$1.8 billion from 1979 through 3rd quarter, 1988. During 1979-87, Hong Kong contributed US$2 billion (90%) of the processing fees earned by Guangdong. For 1987 alone, the amount of processing fees paid by Hong Kong to the province

was approximately US$500 million. On the other hand, there existed about 2,400-2,700 enterprises employing 0.5 million workers in Guandong which had direct investment from Hong Kong-based companies. Though they were engaged in a variety of business, a large number of them were in various light industrial manufacturing sectors, especially in and around the Pearl River Delta".

In short, at least 25% of Hong Kong re-export products were manufactured in China especially in Guangdong by companies owned by Hong Kong industrialists (Tretiak, 1992).

1.1.4 China---a Target-Market and Sources of Support for Hong Kong

China is important to Hong Kong in that it serves as a Hong Kong export target. Though Japan, U.S.A., Taiwan and South Korea were the top four major destinations for Hong Kong's re-exports, the market in China grew dramatically between 1978-87. It totally surpassed U.S.A., keeping a growth rate of 28.016% and by 1987, re-exports to China had amounted to 1/3 of Hong Kong's re-export (S C M Post, 12, July, 1989). China is also one of the biggest sources of support to Hong Kong in terms of the supply of consumer goods and foodstuffs. Of the total imports in 1987, about 47% consumer goods and 40.4% foodstuffs respectively came from China.

1.2.1.0 The Background for Open-Door Policy

The New China has experienced many political fluctuations in its national history. Before the Sino-Soviet split, China, headed by Mao relied on the Soviet Union as the major source of technical and economic support. The policy in this period was in favour of self-reliance and self-sufficiency. This policy had remained dominant in China until the end of the Cultural Revolution when the leadership was aware of the capital and technologies from the West being able to help push China's economic development. The open-door policy that was introduced in 1978 was Deng

Xiaoping's decision to extend the 'Four Modernizations', a policy in which economic development was given the top priority.

As pointed out by Howe (1992), the 1950s saw the adaptation of China to the Soviet system that was characterized by a low level of income, a reflection of the "absolute fairness" regardless of personal ability. The workforce within the state enterprise was guaranteed lifetime employment accompanied by comprehensive welfare care, resulting in a rigid and egalitarian payment system.

From the 1950s to the late 1970s, the rigidity and confusion in the socialist economic system of China was further accentuated by the Cultural Revolution. Frozen wage systems and the modest inflation jeopardized the real wages and eventually brought a negative impact to the overall work morale. Poor performance in labour productivity was the characteristic of the period in the 70s (Howe, 1992).

China in the 70s was monopolized by the state enterprises being featured by the tight control of the Party on the workers over their comprehensive welfare and personal affairs. In addition, the practice of job inheritance by the children, once the employees had retired, had created the problem of over-manning in Chinese industries (Howe, 1992). When people had got used to the concept of lifetime employment and comprehensive welfare support, the reform in wage and labour in 1985-86, in an attempt to replace the old employment system and abolish the internal job inheritance, had met with resistance among the workers (Howe, 1992).

1.2.1.1 Political, Economical and Historical Background

As a consequence of the problems in the old economic system mentioned above, China experienced severe economic crises by the end of the 1970s. Field (1984, pp-741-761) had a detailed description of the problems:

> "Factory productivity was declining; equipment and machinery had not been replaced. Since the early 1950s, 30% of capacity was kept idle, and the prices of industrial goods unchanged since the early 1960s, had led to stockpiling of produce goods on the one side, while under-priced input was used rather lavishly causing bottlenecks on the other side".

In the state-owned organizations, considerable problems in organizational structure and responsibilities jeopardized the efficiency in operation, quality of manufacturing or profit. In terms of job responsibilities, the division between definition of the staff and line functions was blurred, resulting in the overlapping of efforts and frequent "friction between production workshops and specialized sections". (Lockett, 1990a, pp-154) This problem had been pointed out by Lockett (1990a, pp156):

> "As a result, higher level managers are quickly overloaded with routine decisions and relatively minor disputes between departments. This problem is compounded by the unclear definition of responsibilities within senior management. So relatively minor and routine internal matters need to be taken to the enterprise's top body to be resolved".

Lockett (1990a, pp-158) further commented that

> "extensive differentiation of activities, as in the proliferation of staff sections, combined with inadequate integrative mechanisms lead to efficiency problems; the consequence is an overloading of hierarchical channels which clogged with relatively minor issues".

The other problem of state-owned organization was the overall lack of qualification among the Chinese managers. This problem owed its origin in the past, when political, rural and military cadres who knew nothing about industry were promoted to the top of the management during the Revolution in 1950 and in the Cultural

Revolution in the 1960s. Though many old managers who had been sent to work on the farms during the Anti-Rightist Movement in 1957 and the Cultural Revolution were reinstated in the late 1970s, they had been absent from their posts for over ten years. They found it difficult to catch up with the latest developments in the specific professions, for example, teaching, medical practice, the 'high-tec' electronic manufacturing such as surface mounting and semi-conducting, international trading and the mass transit systems, just to name a few.

The impotence of the management had been reflected in the ineffectiveness in operation, as pointed out by Jiang and Min (1979, pp-161):

> "In many economic management bodies, there are too many bureaux and hierarchical levels. The procedures are alarmingly complex, excessive numbers of people are involved, the work drags on, and productivity stays very low. Meetings are real disasters; with empty political arguments, inability to resolve the smallest concrete problem that makes formalism grow and prosper like a weed. To get anything done, it is necessary to have the written agreement of a dozen people and the stamps of seven or eight units; this can drag on for several months, sometimes even for a year or two, without reaching a solution".

In the socialist economic system, product quality is a significant problem. Fu, Shou and Huang (1981) have described the problem:

> "An indication of the scale of the problem is provided by the TV industry in Shanghai, a city known in China for relatively good management. In 1978, 24% of TVs were found to be faulty on being opened up in the shop and had to be returned to the factory. Eighty-seven percent of sets needed repair in the first year, though this was reduced to 54% two years later".

The poor performance was partly due to the lack of morale and discipline in the workforce. Reliance on the ideology and politics did not seem to be every effective in improving the situation (Lockett, 1990a, pp-163).

Despite the government's attempt to increase incentives to boost the morale, the efforts were offset by the allocation of bonuses on an equal basis and by the problem of material shortages. The government policy of maintaining high employment and low pay, would not help improve efficiency other than accommodating some unskilled labour, making the wastage of human resource more serious (Lockett, 1990a, pp-163).

Furthermore, the low morale of the cadres could be attributed to the job misplacement of the staff to positions that they did not match. As a result, "many of the managing cadres in state-owned enterprises not only had inadequate technical training for their positions, but also showed no interest in such improvement" (Lockett, 1990a, pp-163).

The resistance of the older managers to retirement later had added to the problems of lack of skills of the management, when there was a substantial overlap of the top management and the Party cadres.

1.2.1.2 Performance and Attitudes of Workers

Many of the junior workers were found to be incompetent, owing to their inadequacy in work training, suffering from the breakdown of education during the Cultural Revolution. What was worse was their lack of enthusiasm in their work. Negative attitudes including "high absenteeism, ineffective production, low working morale, and reliance on 'back-door relationships' to get things done was widespread among the workers" (Chan, H. 1990, pp-170-171).

1.2.1.3 The Economical Reforms

There was a deterioration of economy in China at the time of Mao's death in 1976. The state budget deficit rose as high as RMB$2.6 billion, the worst ever since 1949 when New China was founded.

Quite a large number of the top leaders in the Party and government headed by Deng Xiao Ping considered that the only solution to the worsening economy was to introduce a more vigorous reform which meant a further decentralization (Ferdinand & Yongjiang, 1990, pp-19).

To take the lead, the province of Jiangsu participated in the experiment for three years to establish a completely new economic relationship with the central government. The province was left by its own to manage the income and expenditure. The province was given a target for budgetary income, being allowed to retain an agreed percentage of the profit, if the target could be exceeded, compared with figures of the previous year.

Subsequent to the flexible policy allowed for Jiangsu, a set of regulations of financial management were formulated for Sichuan Province which set an example for all other provinces in terms of budgetary relations with the central government (Ferdinand & Yongjiang, 1990, pp-20).

In 1982, the reform was further modified in such a way that the provincial authorities were granted more autonomy to adjust their sources of local revenue to the central government, on the condition that they had met the gross revenue target as agreed.

The two provinces that benefited most from the above mentioned flexibility in revenue system were Guangdong and Fujian which set up the Special Economic Zones to induce foreign investment (Ferdinand & Yongjiang, 1990, pp-21).

According to Premier Deng in the 1980s, the notion of the reform in the coastal provinces was to let some provinces get rich first and the rest of country would benefit later. The government had long been aware of the gap between the more prosperous eastern coastal belt and the poorer western parts of the country. In fact, the central government had to fund the less fortunate provinces from time to time. For example,

> "between 1981,and 1982, however, the central government itself had to borrow over five times as much (RMB$11 billion) from the provincial governments to make good short-term deficits. This demonstrates that the difficulty which the central government faced in attempting to redistribute resources from East to West (Ferdinand & Yongjiang, 1990, p-33)".

1.2.1.4 Contents of the Reforms

There were a series of actions that followed the policy. Besides normalizing the relationship with the U.S.A. in the 1970s, China invited foreign investment and imported modern machinery. It was estimated that between 1977 and 1985, China's loans from the West, U.S.A. and Japan had risen to six-fold and the investment up to US$16 billion with "2645 equity joint ventures, 4075 contractual joint ventures and 130 wholly-owned foreign enterprises operating in China (Leung, 1988, pp-127-128)."

The core of the urban reform in response to the predicament that existed before the 1980s was the change of ownership of the enterprises (Lockett, 1990a):

i) The previous dominant state-formed ownership was decentralized and was replaced by the shared ownership of the workers over the state----termed as 'whole people'. Managers were appointed with greater power to take care of the enterprise assets and resources. The enterprise was then allowed to retain some profit under the tax-based systems created.

ii) The control over the enterprise by the government was gradually shifted to the workforce who shared in the decision making of management and the disposal of profit.

iii) The transfer from State ownership to collective or private ownership, sometimes made in the form of leasing, might create conflict to the basic socialist system which disapproves of exploitation alleged to exist in the capitalist system.

iv) During the shift of form in ownership, there had been a growth of urban private business and the household agricultural enterprises in the countryside, as a result of the encouragement from the local government.

1.2.1.5 Impact of the Reform

Alongside the shift of state ownership towards collective or private enterprise, there occurred the fragmentation of the state organizations. Though the private or collective enterprises could enjoy more and more freedom in control of their management and profit, they also faced the risk of competition in the market. The external competition was good in that it motivated people toward higher efficiency and better services to customers to secure profit. On the other hand, the collective or private-owned enterprises, once being involved in the more automatic and responsible system, as that in the capitalist economies, would run the risk of bankruptcy and be eliminated by the mechanism, if the enterprises failed to utilize their economic resources efficiently to make profit. During the National People's Congress, a Bankruptcy Law was provisionally implemented in 1986 (Jiahe, 1990, pp-14).

The other negative impact of the reform was the conflict of interest in the people involved. The introduction of the western market mechanism to China with a view to bringing new life to the economy had created conflicts between people who benefited from the existing state-owned enterprises and those that rose to power with new economic sects. The former preferred a 'status quo'. To put it more specifically, those who were affected most in terms of the management control, the state-owned organization or the Communist Party organization were the cadres of the "work units" where employment, housing and other state social welfare including pensions were taken care of by the management. In addition, marriage and birth control was also in the control of the "work units". Thus the economic reform would mean that the enterprise would no more function to "the focus of many aspects of life of its workforce" (Lockett, 1990a, pp-7).

The other implication of the transition from the old central planned economy to a "new style commodity economy with less direct control" (Jiahe, 1990) was that people were no more linked to lifelong employment, when the original state-owned enterprise was sold to private sectors. They would be laid off, when the ownership of the enterprise changed. In short, the new form of employment for the workforce who were hired by the newly formed collective or private enterprise had shattered the

"Iron Rice Bowl (of Job security)" and "Eating from One Big Pot (sharing benefits equally)" concept of many people.

The labour contract system was also implemented to empower the enterprise manager with the freedom in recruitment and retention of staff. In the leasing contract, the new management or manager should guarantee a profit and tax growth rate within the contracted period that normally lasted from two to five years.

1.2.2.0 <u>The Emergence of the Special Economic Zones</u>

The Special Economic Zones were products of economical reform. The zones were meant to provide a testing ground for a new economic system. As a whole package offered to foreign investors, the government provided

> "free land and building equipment, a cheap and docile labour force, exemption of duties on imported raw materials and equipment, tax-free operation for two to four years, and a low tax rate thereafter (Leung, 1988, pp-129)".

Investors offered the co-operation package were encouraged to set up their plants in the Special Economic Zones at the southeastern coastal towns of Shenzhen, Zhuhai, Santau and Xiamen. The four initial SEZs had absorbed substantial foreign funds up to US$1.28 billion between 1980 and 1985.

1.2.2.1 <u>Shenzhen--- the Neighbour of Hong Kong</u>

Shenzhen is a frontier city separated by a common border at the New Territories that is at the northern end of the Hong Kong district. The Shenzhen Special Economic Zone was built on a small town with mainly farming inhabitants thirty years ago. The concept of establishing the Zone was inspired by the export processing zones of

Taiwan, Korea, Malaysia, the Philippines and other Asian countries, to attract investment and technology, with the vast cheap labour available in China.

Shenzhen was proud of her success. According to the New China News Agency in January 1988, Shenzhen had successfully secured 5,400 economic agreements with over 20 countries, attracting an investment of US$3.0 billion (Leung, 1988 pp-129). The industries involved in the joint ventures included electronics, textiles, building materials, petrochemicals, machine building and food.

Shenzhen was used as an experimental laboratory to test "new ideas in labour management, market mechanisms, economic and social liberalization, relations with foreign companies and industrial relationships (Leung, 1988, pp-126)", so that the new ideas or experience could be applied to other areas of China if proven to be successful.

1.2.2.2 Workers in Shenzhen

The Special Economic Zones could partly resolve the problem of labour surplus in China that had long been bothered by the over-manning in the State-owned work units. The People's Daily in June 1988 warned that "up to 30 million people out of an urban work-force of 130 million had no real function at their work-places (Leung, 1988, pp-58)". As estimated, China had in 1985 a surplus rural labour force of 150 million people.

The majority of the work force recruited in Shenzhen were rural citizens categorized as peasant workers who worked in the village and township enterprises. The enterprises were huge in number, amounting to 15 million in 1988. They were either privately owned or joint ventures with Hong Kong or investors abroad (Leung, 1988, pp-64-65).

The other category of the workers were those who worked on a temporary contract basis. They were usually young migrants from the rural areas, mostly accommodated by construction, textile and machinery industries and suffering from the poor living conditions associated with the lowest pay.

> "Their housing conditions are poor with many of them virtually living as squatters. Only a few fall within the trade union welfare of network. Migrant workers enjoy little, if any, labour protection in case of sickness, maternity or retirement" as described by Leung (1988, pp-66).

1.2.2.3 <u>The Migrant Labourers</u>

The migrant labourers in the SEZ were recruited from outside the municipality in the infra-structural trades for a period of several months to two years. In Shenzhen, the inhabitants were mostly temporary contracted workers, being excluded from the labour insurance and social welfare net. Unfortunately, immigrant labourers were the favoured employees of the many employers, especially the Hong Kong manufacturers who preferred the relatively low skilled

> "young and obedient workers. Temporary workers, particularly young unmarried peasant women, filled this need. They represented a large pool of young and very low wage labour, which could be made redundant after a few years of work at their most productive age, without incurring any welfare obligations (Leung, 1988, pp-152)".

That is why in 1984 there existed an army of 190,000 temporary labourers in Shenzhen SEZ "nearly four times the zone's permanent employees, and nine and a half times the number of workers on full contracts."

1.2.2.4 Living Condition of the Workers in Shenzhen

A lot of the temporary rural workers who came to the SEZ to seek employment with a higher pay than their home town suffered poor living conditions and lengthy working hours and unbearable working environment. As some Shenzhen temporary women workers raised their grievance in Da Kung Pao in March 1988:

> "We work more than 13 hours a day, overtime everyday, but have never received any overtime pay. The boss doesn't allow us to drink water during work hours, we are body-searched when we go off work. Our living dormitory is crowded beyond imagination----20 to 30 women squeezed into an iron-walled room, without toilet or bathroom. How can we bear this life?"

1.2.2.5 The Wages in Shenzhen

The SEZs, especially Shenzhen, were notorious for their low wages, probably as one of the attractions for foreign investment. In 1986, the average monthly wages the Shenzhen SEZ workers received ranged from US$54 to US$75.6 which was among the lowest compared to that received by their counterparts in Hong Kong and in the neighbouring countries:

Country	Wages in US$
China (Shenzhen)	54 - 76
Philippines	63
South Korea	108
Malaysia	100 - 200
Hong Kong	205 - 380

Table 1.2 A Comparison of Monthly Wages (Leung, 1988, pp-140)

People coming from the barren and remote mountainous areas are in urgent need to 'make money' to feed their hungry family home. In fact, China has been a poor country for thousands of years, owing to her rapidly increasing population, the limited cultivable land and its comparative backwardness in transportation, which has had great impact on the economy. As indicated from the geography of China, though China is the third largest country in the world with a total land area of 9.6 million square kilometers, her population is unevenly and densely distributed along the major rivers and coastal regions where the cultivated land is located. The population density is estimated to 1000 persons per km.

1.2.2.6 Reason for Poverty

China has rich natural resources, the most important of which are coal and iron, amounting to 1500 billion tons and 12 billion tons respectively, but unfortunately, they are located in the northern part of the country. China is also the world's seventh largest oil producer. The obstacle to China's development of industry lies in its transportation networks that are never sufficient to penetrate into the remote regions such as Tibet and Xinjiang, for the need of the quickly modernizing country in terms of quantity and quality (Laaksonen, 1988, pp-15).

The fast growth of population, and the sparseness of cultivable land, together with a far from satisfactory transportation system have restricted the economic development of the country and helped very little to wipe out the poverty of the Chinese.

1.2.2.7 Education----Another Factor for Poverty

The education of a country is closely interwoven with its economy. China is still a developing country. Over 80% of the whole population before the Liberation in 1949 were illiterate. The Mao Government tried hard to reverse the situation by popularizing primary education and developed the tertiary education based on the Soviet model.

> "For the 17 year period prior to the 'Great Proletarian Cultural Revolution', the Chinese made substantial gains in eradicating illiteracy. During this period more than 100 million illiterates were freed from the bondage of ignorance, and literacy levels of numerous others were raised." (Colletta, 1982, pp-27).

However, the efforts made to eradicate illiteracy by the communists in the first two decades since the rise of 'New China" was shattered overnight in the 'cultural war' arising from the internal scramble for power among the leaders:

> "With the ten years of chaos and turmoil that characterized the Cultural Revolution, systematic literacy efforts ground to a halt. The result was that the new literates lapsed back into illiteracy and a generation of youth remained unschooled and illiterate" (Colletta, 1982, pp-27).

1.2.2.8 During the Cultural Revolution

The Cultural Revolution brought stagnation to all education, not to mention the spare-time studies for the workers:

> "At the advent of the Cultural Revolution, spare-time factory school became July 21 Workers Universities as 'serving the people' and replaced the goal of professional advancement. Ideology replaced scientific competence, and adult education became highly politicized. In sum, political goals replaced production targets as politics, indeed, took command."

During the Cultural movement,

> "college entrance examinations were abolished in 1971: 'In the higher education and secondary special education sections, normal instruction and admission of new students were suspended for four consecutive years, 106 higher schools were closed down. Half-works and half-study programmes as well as agricultural and other vocational schools were largely dissolved'." (Lansbury & Ng, 1992, pp-163)

Up to 1981, the national literacy level was estimated to be about 65 percent. It implies that over 100 million adults in China were illiterate or semi-illiterate (Colletta, 1982, pp-28).

1.2.2.9 Other Reasons Behind the Illiteracy

There are a number of other reasons for the illiteracy in a substantial number of the workers in China as summarized by Colletta (1982, pp-51):

"In addition, existing inequities, such as rates of illiteracy in minority areas, unbalanced economic development throughout the country in general, the shortage of teaching materials and the low quality of educational staff are matters for serious thought and action."

In addition to the above reasons, during the reform in the last ten years, the youth in the villages were too eager to make money that they quit school to help in agriculture or try their luck in the cities or Special Economic Zones like Shenzhen:

> "While dropout rate was not normally available, in Chengdu District, the dropout rate of literacy classes was about 30 percent. This dropout rate is mostly attributed to competing opportunity costs of labour for agriculture" (Colletta, 1982, pp-27)

1.2.2.10 Education of the Workers in the 1980s

The Third Plenary Session of the 11th Central Committee of the Chinese Communist Party in 1979 laid down the national policy that education would be given one of the priorities to restore and reconstruct the national educational system and modernization.

Under the diverse forms of vocational training and education activities in China, the most dominant form of technical education open to secondary school graduates was the molding of middle-level technicians in two years' time in the State-run vocational or technical schools. Other forms of vocational training came from labour service companies being specialized in

> "organizing manpower services for various production activities as designed by the industrial bureaus. These labour service companies were often the sources for providing short-term trained youths to the small municipal industries." (Lansbury & Ng, 1992, pp-165)

Nevertheless, the vocational education and manpower training was inadequate and unbalanced. The development of vocational training was "far behind in meeting the needs of society, whether in scales, structure or level" as claimed by the Education Commission (Ying, 1987, pp-166). As Lansbury and Ng (1992) pointed out,

> "by 1985, the comparative share of 'senior technical workers was still a mere fractional proportion (of just two percent) of the total 40 million technical workforce in the State-owned industrial and communication enterprises (Lansbury &Ng, 1992)."

As an alternative to the vocational training offered by the Government, 70 percent of enterprises in China had to run their own in-service training, so did the joint ventured and Hong Kong-run enterprises (Lansbury & Ng, 1992).

1.2.2.11 The Difficulty in Removing Illiteracy----Cost

During the reform, comparatively little resource was allocated to promoting basic education, when most efforts were focussed on economy. As a matter of fact, education was costly and took too long for the return:

> "It is difficult to establish the exact cost of moving a person from a state of illiteracy to that of literacy (by Chinese standards). For example, in Chengdu District, Sichuan Province, it requires 23-28 yuan (US$15-18) to make a person literate. The exact breakdown of expenditures for this process was not provided,

> but one can assume that the major costs were for teachers' salaries and instructional materials. It was stated that the local government usually provides about 3 yuan per person in grants and that the remainder of the cost was paid by the individual" (Colletta, 1982, 27-28)

As mentioned above, the vast number of peasant workers swamped into Shenzhen were educationally disadvantaged, receiving low wages in factories where they were exposed to a poor working environment, being vulnerable to frequent occupational accidents and injuries.

1.3.0 Occupational Safety

Occupational safety can be defined as a safety policy. It contains the line management responsibility, the proper defined safe procedures and management practices at work, the training provided to the workforce to ensure the understanding and meeting of various safety standards, audit for evaluating the implementation of safety standards and involvement of the workforce to establish ownership of safety practices (Schaechtel, 1997).

In the safety policy, education and training, engineering and motivation are of utmost importance, in terms of operation and administration. Education or training in the form of instruction is meant to teach by means of drill and the "presentation of specific message that is needed to fit or qualify one to be proficient in a particular task or skill." (Grimaldi & Simonds, 1975, pp-135) The training, especially for the line supervisors who are the souls of safety management, should include the development of safe working conditions, personalization of employee safety training, promotion of employee participation and enforcement of safety rules (Grimaldi & Simonds, 1975, pp-135).

Engineering, as a component of safety policy, covers a broad range of safety steps in which the major objectives are to correct physical hazards, involving simple housekeeping measures. The engineering steps, according to Grimaldi & Simonds (1975, pp-136) can be outlined as below:

"Step 1. Evaluate process or operation and identify its harmful agents.
Step2. Eliminate the harmful agents by redesign or substitute a less harmful material, arrangement, and so on.
Step 3. Shield, enclose (guard) the hazard.
Step 4. Isolate the hazards (by placing the harmful agent at a safe distance).
Step 5. Dilute the harmful effect (by ventilation, wet processing, and so on).
Step 6. Provide personal protective devices when Steps 2 through 5 do not furnish the level of control needed."

Motivation, an equally important component of the safety policy, can only be accomplished by "enlisting the cooperation of certain executives, the supervisors, and the employees." (Grimaldi & Simonds, 1975, pp-136)

1.3.1 Occupational Safety in Shenzhen SEZ

With regard to industrial safety, especially in education or vocational training, the Chinese Government has done little to meet the need of the industrial population, as mentioned above. Besides, the protection given by the government was virtually inadequate. Workers were exploited and forced to work long hours by some factories. As revealed by the Hong Kong Standard in April 1986 in relation to the exploitation of some Shenzhen employers:

> "Workers in some factories continue to work overtime for six to eight hours. Some have fainted as a result, while some were injured by the machines (Leung, 1988, pp-141) ".

The head of the Labour Relations Department of Shekou Industrial Zone Trade Union confirmed the overtime working phenomenon but defended it unconvincingly, claiming that the overtime was wholly the workers' own demand to earn more:

> "The problem is that workers like to work overtime. They can get 50 percent more if they work overtime on weekdays and on Sundays they are double paid. Moreover, overtime wages are paid in Hong Kong dollars (Leung, 1988, pp-141)".

Superficially, the SEZ labour bureau disapproved of overtime of more than two hours per day and more than four consecutive days in a week and no more than two Sundays in any month. However, forced overtime prevailed in Shenzhen SEZ. It was first practised with the foreign-funded ventures and later extended to other places. The Workers Daily reported in March, 1987, stating that

> "in Jiangsu and Henan province, ... factories had forced the employees to work from 8 am to 10 pm without days off since October 1986. Pregnant women and breast-feeding mothers were included, although it violated current labour protection policy. Workers who refused to co-operate had their regular pay cut (Leung, 1988, pp-143)".

In China, safety is often regarded as a low priority to security. It was reported that many factories locked the stairs and gates to keep the workers in the building for their shift to prevent them from stealing materials or products. And Hong Kong manufacturers were accused of putting profits before safety (Chan, 1996, pp-1). Likewise, the local authorities were criticized by the State Council for 'ignoring industrial safety in pursuit of quick economic prosperity' (Chan, 1996, pp-2).

On the other hand, most of the workers in Shenzhen came from out of provincial villages, being educationally disadvantaged in protecting their rights and safety. Chan (1995, pp-2) had a vivid description of one of the factories called Zhili:

> "Most of the workers in Zhili Factory were young peasant women from Sichuan and Hunan provinces with low education. They were unorganized and had little

awareness of their rights, safety regulations and how to act in an emergency. They were reluctant to complain about the working conditions for fear of losing their jobs."

As many of the factories in the Special Economic Zone in Shenzhen are invested by the Hong Kong manufacturers, the mentality and attitudes of the latter would, to a certain extent have some influence in shaping the safety in those Hong Kong run industries. It is thus worthwhile to examine the status of the occupational safety in Hong Kong.

1.3.2 Occupational Safety in Hong Kong

In spite of the efforts Hong Kong made in occupational safety, the current situation is still disappointing. The number of industrial accidents still remains high as indicated from the Table 1.3 for the year 1991-1995 in Hong Kong.

Industries		1991	1992	1993	1994	1995
All Industries (except Construction)	No. of Accident	25383 (17)*	35628 (17)	30224 (12)	27742 (16)	25733 (14)
	Employment	791872	904763	834309	774661	725227
	Accident/1000 workers	32.05 (0.021)	40.37 (0.019)	36.22 (0.014)	35.81 (0.021)	35.48 (0.019)
Construction	No. of Accident	23115 (54)	18815 (48)	16573 (80)	16422 (51)	15286 (63)
	Employment	63450	62232	56226	59710	64639
	Accident/1000 workers	364.30 (0.851)	302.34 (0.771)	294.76 (1.423)	275.03 (0.854)	236.2 (0.975)

Table 1.3 Accident Rates of Construction and Other Industries in Hong Kong for the Period of 1991-1995 (provided by Labour Department)

* Figures in bracket refer to fatal cases.

Even in 1997, there were more than 9,000 cases of injury reported during manual handling operations over a wide cross-section of trades (Lee, 1997).

The major direction in the promotion of industrial safety by the government had experienced stages of changes, moving gradually from enforcement-oriented approach towards one of more innovative safety management. To improve occupational safety, the Labour Department had done something, which though was far from adequate. For example, until 1986, the Hong Kong Safety Regulations had only focussed on operation and machine guarding (e.g. The Factories and Industrial Undertakings Regulations----Guarding and Operation of Machinery). The Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Ordinance (FIUO) in 1986 implemented the need for safety professionals such as Qualified Safety Officers in the industrial sites, with a view to upholding the safety work system by assisting the employers to promote occupational safety. In 1989, the government furthered the safety system by introducing the "General Duties" Legislation (Appendix 14) to stress the importance of housekeeping in the factories regarding work safety that required the cooperation between both the employer and employees.

In short, the FIUO in 1986 emphasized the importance in safety systems rather than in the job or machines.

The government recognized the drawbacks in the enforcement approach. The prescriptive laws would be likely to be out-dated, in face of the rapid changes in modern production methods. Meanwhile, there was not enough man-power to enforce the laws, in addition to the habitually low fines that had little deterrent effect (Consultation Paper, 1995, pp-6).

The Provision of a "Safe System of Work" implemented in the Section 6A (2) of the Factories and Industrial Undertakings Ordinance stipulated some safe steps to tackle work hazards:

1. Assess the task
2. Identify the hazards
3. Define safe methods
4. Implement the system
5. Monitor the system

(FILD, 1990, P-3)

Hong Kong has seen some advancement in the promotion of occupational safety. In July 1995, the document "Consultation Paper On the Review of Industrial Safety in Hong Kong " was published in an attempt to shift from an enforcement approach to one of safety management.

In order to check the alarming accident figures, the Hong Kong Government implemented the "Occupational Safety Charter" in September 1996 to promote work safety and health and to protect the rights and benefits of employees. Meanwhile, to reinforce the inspection and enforcement measures, the Factory Inspection Division of the Labour Department was integrated with the Occupation Safety and Health Branch (OSHB). The Government also realized the need to enlist the co-operation from the private sectors and organizations to promote safety awareness that could be attained by means of education and vocational training. According to the FIUO, to build up a safety management system, it was mandatory for the employers to offer general safety training to all the workforce, and special training to those "workers engaged in hazardous industries and process (Consultation Paper, 1995, pp-17)." Initiated by the Labour Department, the training courses were carried out by the OSHC (Occupational Safety and Health Council).

Alongside work training, education on industrial safety in the forms of conventional lecturing and promotional campaigns was the responsibility of the professional bodies in Hong Kong. The vocational Training Council (VTC) was mainly responsible for the consolidated arrangement for vocational training at the industrial level. The training board of the VTC was

> " involved in surveys in preparation of skill standards and job descriptions, design of apprenticeship and trainee-ship programmes, as well as the creation and administration of training centres especially for the relevant industries (Lansbury & Ng, 1992, pp-186)".

The characteristic of the industrial training in Hong Kong was solely conducted at the workplace level while the education of technical theory for job performance was entirely the responsibilities of the institutions such as training centres and polytechnics (Lansbury & Ng, 1992, pp-182).

It was also recommended that industrial safety be included in the syllabus of secondary schools to promote safety awareness among the younger generation.

The general duty provisions of work safety were extended to cover occupations other than factories and industries, for example, hospitals and schools in the new Occupational Safety and Health Ordinance. This ordinance came into effect on June 1, 1998 and the provision on manual handling was enacted on 1 July of the same year. Under the general duty provisions for all occupations, both the proprietors and the employees had to observe safety regulations. For example, the employers had to ensure the safety and health of their workforce while the latter had to comply with the safety procedures at work. The failure of either party would result in the penalty of fine and imprisonment (FIUO, 1989):

> "It shall be the duty of every proprietor of an industrial undertaking to ensure, so far as is reasonably practicable, the health and safety at work of all persons employed by him at the industrial undertaking."

In the Occupational Safety and Health Ordinance, the shared responsibility in work safety was emphasized. The employers were required to make stringent inspections of equipment and working procedures, taking special care of the handling of equipment or substances, with adequate safety information, instruction, training and supervision provided to the workforce. Besides, keeping a safety record and accident reports was a requirement (Labour Department, 1998).

For the sake of the health and safety in the workers, the new Occupational Safety and Health ordinance was enacted on 23 May, 1997 and later on 17 June, 1997, the Occupational Safety and Health Regulation was passed. The ordinance empowered the factory inspectors to "inspect all workplaces, investigate work-related accidents, issue improvement and suspension notices and prosecute as may be necessary (Lee, 1997)".

1.4.0 Summary of the Chapter

This chapter has delineated the background of the study, covering the historical factors for the introduction of economical reform in China from which the Special Economical Zone evolved. The mutual reliance between Hong Kong and Shenzhen was examined in detail from political, economical and cultural perspectives. The pressure for the unavoidable move of Hong Kong investments and manufacturing northbound as a result of the local labour shortage and gradual increase of manufacturing cost alongside the change of industrial and economical structure was analyzed. Then followed the scrutiny of the Hong Kong style administration and operation mentality introduced to China with the influx of Hong Kong investment. Industrial safety in both Hong Kong and Shenzhen as the major concern for workers' benefit was addressed.

The following chapter will provide a longitudinal analysis of the cultural context in China in relation to occupational safety from the historical and social perspectives.

CHAPTER II

INTRODUCTION II

This chapter will present an extensive analysis of the Communist and Chinese ethics because these provide key contextual understanding which is vital to the topic. Then the author will examine approaches to safety education.

Communist Ethics and Cultural Context in Relation to Occupational Safety

Occupational safety has not been given due concern in China. Workers do not take it seriously when being involved in minor injuries and tend not to report the accidents (Chan, 1996). Meanwhile, they are reluctant to voice their opinion with regard to the improvements in work safety during the safety meeting. Their avoidance of reporting injuries and passiveness in participating in safety meetings are greatly influenced by the communist ethics and the traditional Chinese culture which shapes the behaviours of the Chinese. The Communist ideology coincident with the Chinese cultural context will be explained from the social and historical perspectives in the following sections.

2.1.0 The Party's Priority for Production

In the communist China, the government emphasized the priority of production as the support of the country's economy especially during the war period (Fung, 1956, pp-44). They claimed that the fruit of revolution can only be safe-guarded with the gradual increase of production. Without production, revolution becomes meaningless. And even at the non-war time, they still merit the revolution in production with regard to quantity, quality and cost. For this reason, people are encouraged to work hard. Minor injuries are deemed insignificant. It is sometimes a shame for the workers to mention minor injuries. As argued by Fung (1956), glorifying self-sacrifice is one of the communist ethics that have greatly affected the safety awareness of the workers as a whole. Many of the workers in China have been brought up with the communist ethics since they were in school (Tao & Wong, 1992).

2.1.1 For the Public----Communist Ethic

Communism demands the individuals to keep in mind the priority of the collective in case there is a conflict between the individuals and the collective. The interest of the individuals will be taken care of by the masses. The death of Tung Qen She is a good example of how the common interest is observed. Tung was a soldier who gave up his own life in order to save those of his peers by igniting the dynamite right at the enemy's fort. The communists require that Tung's spirit of self-sacrifice be carried on even in non-war time, for example, in emergency, helping the civilians to get out of natural disasters and evacuating government properties and effects (Fung, 1956, pp-32, 47, 48, 50)

2.1.2 Communist Morale and Historical Development

The communist ethic has its historical origin. It had been built up ever since the Chinese communist army was engaged in the civil war against the orthodox national force. Being the minority, only with incredible faith in the future did they survive extreme hardship. For this reason, they had to stick together, leading a puritan life, away from the social corruption that prevailed in the country. Even after the war, the puritan virtues of living were deliberately sustained by the Party to boost the morale of the civilians. Civilians were encouraged to work long hours in poor living conditions (Tsai et al, 1984, pp-189). Those who lost their lives in production were nationally honoured. The Communist authorities highly praised Miss Han Yau Lai, a member of the communist Party who died in an attempt to save the government property from the fire. They praised:

> "Under the leadership of the Party, people of all walks of life endeavoured to change the poverty and backwardness of the motherland through constant hard work. Personal suffering, such as injury at work is not worth mentioning. Hard work could discipline the mind to be resistant to the extravagant life style of the bougeois." (Tsai et al, 1984, pp-52)

2.1.3 <u>The Life View of Communism</u>

The positive world-view of communism affirms the sacrifice for the goal and ideal of the Party. The giving up of one's life, no matter when serving in the battlefield, factory, mine, village, wilderness, school, shop, government organization, railway, or on the sea is an absolute honour. This heroic deed is in marked contrast to that of the people with reactionary thought. They would not hesitate to persecute anyone who threatens to abolish the corrupted system for fear of change to their status (Fung, 1956, pp-11-12).

It follows that in communism, the individual can only realize his/her values in the collective. He/she should have his/her interests merged with those of the masses. That means that there is a priority of collective interests over those of the individuals. And if needed, collective interests must be preserved at the expense of the individual ones. (Fung, 1956, pp-32-31)

2.1.4 Communist Collectivism

Modern China values communist collectivism in which collective interest is placed above that of the individual. The adoration of the ideology in favour of collectivism culminated during the Cultural Revolution. Collectivism glorifies self-sacrifice for the good of the team. To accomplish a task, efforts have to be exhausted at whatever cost paid, even at the expense of ones life. A hero such as Lei Feng who was modeled for worship was an example. The spirit of Lei Feng, as they claimed, was honoured for the struggle between materialism and idealism. Collectivism was then elevated as the national policy of China (Tao & Wong, 1992, pp-155). Tao and Wong argued that China is a vast socialist country in which socialism emerges in conflict with individualism. The task for the Chinese people is to continue with the movement of socialism with a view to realizing its virtues. Collectivism reflected in life is the elimination of selfishness for the sheer interest of others.

Tao & Wong (1992, pp-2-3) emphasized that the essence of socialist morale is to learn from a hero like Lei Feng for his unselfish-sacrifice to keep abreast of the reform and the commerce-oriented reality in the socialist country. People have to be inspired to fully utilize their positive-ness for the construction of modernization.

2.1.5 The Spirit of Lei Feng

The core spirit of Lei Feng is to unselfishly devote oneself to serving the people, the country and the races, in a struggle for socialism and communism. Lei Feng once expressed his view about life:

"Life of an individual is limited but serving the people is not. I therefore must devote my limited life to the unlimited serving of the people."

The Chinese communists thus promulgated that the spirit of Lei Feng was imperative for the successful construction of a society with Chinese characteristics. (Tao & Wong, 1992, pp2-3) They also warned that care had to be taken to guard against their polluted values and ethics when introducing into China the learning, the advanced technologies and experience in administration from the capitalist countries. They thought that capitalistic values and ethics strongly reflected in the selfish individualism in the West were money-oriented. (Tao & Wong, 1992, pp-159-160) The freedom of an individual had to succumb to that of the collective which provided room for the former to actualize his /her potential. The teaching of Lei Feng required his followers to totally abandon self-values and find ones values only in the collective.

2.1.6 Cultural Background for the Emerge of Lei Feng

According to Watson (1991) Confucianism was dominant in the traditional Chinese culture which nourished the set of beliefs to unify the morals and ethics of the old China. The core of Confucianism advocated 'familism' which was attributed to the small-scale peasant economy of the society.

2.1.7 Family Orientation

In the traditional Chinese society, the basic structure and functional unit was the family and not the individual. The family, as the centre of living in the economic life of the traditional agrarian society, was important for providing to the family member protection, continuity, harmony and consolidation. This emphasis of the utmost importance on family is termed as familism (Yang ,C.F, 1988; Yu, 1980).

As far as cognition with the family is concerned, the familism of the Chinese merits the five interrelationships: the continuity, harmony, solidarity, wealth and reputation in the family.

In terms of family orientation, the life activities of the individual are secondary to those of the family. The survival of the individual mainly depends on the family, the reputation of which outweighs that of the former. The personal independence is subsidiary to family solidarity while the family goal is supreme. Naturally, those who refuse to be absorbed in the family will be excluded from the circle. In fact, the operational pattern of a family is evidently collectivism-oriented (Triandis et al, 1988, pp-96).

In the traditional Chinese society, whether in the wealthy family of the landlords or in the poor peasant family, the patriarchal characteristics of the social system would leave the decisions in the hands of the fathers. The fathers had the absolute ruling power over the distribution of income and wealth and establish discipline and rules, controlling the will and thought of members of the family. There was an order of seniority in the family that no one could violate.

2.1.8 Collectivism in Chinese Tradition

In terms of 'familism", the Chinese are thus socialized in the traditional culture to fulfil the roles pre-assigned to them in the family. They are encouraged to take into serious consideration the expectation of their parents and the reputation of the whole family rather than their small "selves" whenever action has to be taken (Yang, C.F., 1992, pp-403-404). In other words, a person does not only live for himself/herself but also for the family and in the long run a person learns to suppress the personal desires. They are taught the important human relationship of mutual reliance in the mass to respect the four virtues, namely: ancestral piety, respect for the elderly, fidelity to the government (in the company, department head or employer) and honesty to friends. People are indoctrinated not to act by impulse but to respect the established social order. This altruistic behaviour promoted in the Chinese teaching coincides with the theory of moral judgement from Piaget (1932) and Kohlberg's (1981; 1984) moral developmental approach to socialization. According to Piaget and Kohlberg, the cognitive development of a person is interrelated with his/her altruistic behaviours (Ma, 1992, pp-164).

The Chinese also affirm their own identities by clarifying their social roles in relation to other people. For example, a John claims that he is "the son of a Mr X" or "the brother of a James" to determine the role he should play. The seeking of role identification in the society of the Chinese can be viewed as a form of social orientation.

The social orientation is characterized by the five relationships in which the Chinese can find their own position: for example, the relationship between father and son, between husband and wife, between the elder and younger brothers, between the Emperor and civilians, and between friends. To fulfil these roles, the result of a long established cultural evolution, the individuals have to suppress their personal features.

2.1.9 The Origin of Social Orientation in the Chinese

In ancient times, the agrarian feature of Chinese society placed great emphasis on cultivation that demanded heavy labour. Reliance on the land as the main source for survival resulted in a close family relationship that set the base for authority orientations and social orientation. To protect the aged, the family became the basic social unit for livelihood. In order to guarantee the efficiency of long term cultivation life, stability was needed for the relationship among members of the family. For this purpose, the roles of the members had to be clearly defined and formalized.

In the traditional Chinese family, the properties were owned by all and this practice was beneficial for the unity of the family to which every one resorted for comfort and safety. Under this system, members of the family tended to lose their independence and self-centeredness. They were gradually socialized to be submissive to public opinions (Yang & Yue, 1992, pp-123).

2.1.10 Collectivism Versus Individualism

In the Chen Dynasty (500 A.D.), Confucianism advocated loyalty to the imperial family and upholding of the patriarchal order in society. In the prevailing feudalism, an individual was only subsidiary to the family and society. Personality was suppressed.

2.2 The Communist Interpretation of Individualism

Individualism can be understood as the freedom of and respect for the individual. Every individual has the right and freedom to choose his/her own way of life with that no one has the right to interfere or control. The criticism of Tao and Wong (1992, pp-148-152) was that individualists put themselves on a confronting position with society and people around, thereby denying the reasonable constraint of society and leading to the extremity of individualism in absolute self-centeredness.

According to Tao and Wong (1992, pp-148-152), though individual interest can be the drive of society, individualism will cause the decomposition of social structure, if allowed to go too far. In reality, people will eventually lose their freedom in a society where competition is keen.

Historically, the terms 'individualism' originated in England in the mid-17th Century before it spread to Europe and North America. In a few hundred years, the capitalist societies in the West were the breeding grounds for individualism. People in the West got corrupted in their life style.

Individualism owes its origin to Hedonism in ancient Greece. The Hedonists believed that the meaning of life was found in the pursuit of personal material enjoyment and satisfaction in physical desires. The individualists argued that seeking pleasure and avoiding pain was a human instinct. Individualism started with the love of oneself. In their opinion, politically, the government should be the instrument of the individuals. Thus the power of the government should be reduced to its minimum while individual freedom be expanded to its maximum. Only the basic law and order should be maintained.

2.3 Personality

Individualism can also be understood as the respect for an individual's personality. The Communist Party does not deny the existence of personality that is not in conflict with the existence of the class and Party. However, as claimed by Chan (1943) any personality in a class society carries a class imprint. In a class society, each person belongs to a particular class and is restricted by a predisposed social relationship and historical conditions. The personality of people must be subordinated to the interest of a particular class (Chan, 1943). The 'petti' bourgeois' claim that there is no room for the personality to develop freely is not true. The poverty in the capitalist countries is in fact a reflection of the suffocation of the freedom of personality.

For the Communist Party, obedience is a necessity that requires the hierarchical obedience from bottom up. That is an individual must obey the Unit in which he/she is working; the minority must obey the majority; the inferiors should obey the superiors and Party members should obey the Party Central. Thus for the needs of revolution and communism, when members are called upon to perform a task, in no condition should they consider their personality but the common party interest. (Chan, 1943)).

The common nature of the communists merits the sacrifice of personality. A member must be faithful to the Party. The sacrifice of humanity means the abandonment of cowardice and the fear of death. (Fu, 1957).

According to the Chinese communist argument, individualism, if encouraged in China, would only bring about negative consequences rather than advantages. The characteristic of the agrarian Chinese society in the last five thousand years was basically self-sufficient. The closeness in the agrarian society was a breeding ground for selfishness and egoism that, if merged with individualism would negatively reinforce the latter, thus imposing a negative impact on the Chinese society. (Tao & Wong, 1992, pp-157-223) Thus, egoism in the form of individualism is suppressed in the communist China.

2.4 The Class Ideology

The world-view of communism was evolved from an ideology that attaches to the different classes in society, regardless of the difference in spiritual life and thought of the individuals. According to the communist doctrine, there are differences in the social ideology of the ruling class and that of the ruled at any period of time in history (Fung, 1956, pp-25).

2.5 The Relationship between Class Ideology and Culture

Culture as a social ideology is a concrete historical phenomenon that adapts itself to the development of society. Each social class germinates its corresponding culture.

Culture has a political and economic imprint. It has great influence on the political and economic base of a society (Tao & Wong, 1992, pp-137-223).

"Culture" according to Watson (1991, pp-8), is

> "intimately related to perceptions of appropriate life style- this, in turn, incorporated into ones sense of personal identity. Culture is embedded in family patterns, religious beliefs, political attitudes, and in the rituals of everyday life."

Despite the definition above, culture is constantly changing. The active participation of people combined with the state authority helps create acceptable and 'routinized' culture. In spite of the Maoists' intention to "construct a competing version of a new socialist culture" (Watson, 1991, pp-8) during the traumatic Great Proletarian Cultural Revolution in an attempt to obliterate the old culture, the high degree of traditional cultural integration of the late imperial China still persists in the agrarian China. Watson (1991, pp-8) stated that in face of the

> "serious divisions based on kinship, ethnicity and regional loyalties, the historical theme of ever increasing cooperation among the Chinese in terms of traditional culture is dominant. The Chinese were still organized under the abstract identity named as 'Chinese civilization'. The notion of a shared culture had experienced some division during the early 20th Centuries, when some movement led by the students tried to introduce a total reform to China and eradicate the traditional Chinese culture. It survived even after the collapse of the imperial regime."

People found their root in traditional culture that they were proud to share. Watson (1991, pp-9) interpreted the loyalty of the Chinese to their 'Chinese civilization':

> "People of all stations of life - peasants, workers, land-lords, merchants, officials, already related to China's grand tradition with its ancient history. For ordinary Chinese this abstraction was concretized and represented in everyday discourse as the 'civilized' or appropriate way of life, those who did not follow accepted norms were defined as 'uncivilized'. Notions of civility, conformity, and order are thus at the heart of what all Chinese accepted as the irreducible basis of their cultural identity."

Probably, the great integrated force that formed the Chinese culture was ascribed to "a common script, a centralized state, a complex hierarchy of central places" (Watson, 1991, pp-10) that united the Chinese for thousands of years. Watson stressed that a shared oral tradition and the centrality of ritual were the two more down to earth features that contributed to the Chinese identity, the shared rituals. That means one should comply with the performance of key rituals in the accepted manner, before he/she is considered behaving like a Chinese.

In fact, the proper ritual----behaving like Chinese---- should follow the principle of 'Le', the core of Confucian notions of order. The central theme of Confucianism advocated "harmony in thought and action. Correct ideas should be followed by proper behaviour" (Fingarette, 1972).

Zheng & Abeele (1997, pp-94) summarized:

> "Confucian tradition has a concern for the correct and well-mannered conduct of one's duties, based on a sound respect for the social conventions of a patriarchal system. It stresses order, hierarchy, quality of relationships, and obligation to social collectives, especially the family. Age is respected, particularly in the case of male heads of family, while education is valued as the means to achieving a better social status, which reflects well on the family."

Thus, orthopraxy (rightness of action) instead of the control of orthodoxy, as pointed out by Watson (1991, pp-15) became the guidance for all social classes to achieve a cultural integration which could never be replicated in other peer agrarian countries.

2.5.1 The Foundation of Chinese Culture and Management

Confucianism is widely recognized as the foundation of China's great cultural tradition, shaping the norms of the Chinese interpersonal behaviour, despite the fact that other diverse and competing philosophies such as Buddhism, Taoism also come into play with the culture of traditional China.

The three core beliefs of Confucianism have been generalized by Punnett and Zhao (1992, pp-80) as below:

> "1. Social Order. Confucius taught that everyone had their correct place in society, denoted by their title, and must act according to the rules associated with that position. This was particularly true in the family where relationships were

clearly defined and filial piety was believed to a basic virtue. The result of this belief is adherence to well-defined hierarchies. The family also remains the central force in China, and the law requires children to care for their parents.

2. Correct Behaviour. Confucius believed people should behave correctly, because it was morally right and not for external results. Social obligations must be fulfilled. Correct behaviour is still considered important to the Chinese who prize the quality of 'guai' in their children (Butterfield, 1983) a word that means 'well-behaved' and conveys a sense of submissiveness, quietness and placidity. The Chinese values emotional control because it is seen as encouraging correct behaviour.

3. Personal Relationships. Personal relationships form the basis of social order and correct behaviour, and these relationships are used to get things done (Butterfield, 1983). The family is the foundation of the Chinese social universe and training for the proper application of 'guanxi' (personal relationships) begins with family relationships. Personal relationships and the use of such relationships remains an inherent aspect of Chinese society. "

Though the communist authorities once attempted to demolish the old culture and rebuild in its place the Soviet models (Binn, 1980, pp-180, Lane, 1981, pp-16), the traditional culture had never been eradicated. The old civilization----'Li', was still embedded in the life style of the Chinese in China, Hong Kong and Taiwan. The collectivist spirit emphasized by the Chinese authorities as the communist ethic even coincided with the Confucian doctrine, the compliance with the existing order of society to suppress individual desires. It can be understood that the new collective identity through the renovation of inner beliefs and purity of thought as claimed by the communist is partly built on the traditional orthopraxy. Besides, the reforms of the late 1970s and 1980s were a complete "repudiation of Maoist doctrine, returning the society to a system based on performance rather than ideology" (Lane, 1981).

As interpreted above, the historical background about Chinese culture plays an important role in the daily life of the Chinese. The indoctrination of the 'rightness of action' and 'obeying the authority' is rooted in the Chinese culture and dominates the behaviours of the workers in meetings. For example, in a safety meeting, constructive opinion can seldom be heard.

2.5.2 The Patriarchal Pattern of Management

Meetings in Chinese factories are characterized by their patriarchal way of process. The meeting is a place for the employer or the management to give instruction or to criticize the mistakes made by the workers in daily operation rather than one for both parties to communicate. For example, Chen (1992, pp-255) described his attendance in a production meeting when he was conducting his research for his PhD:

> "Most of the time in the production meeting, it was the top management who was giving a lesson. Supervisors were questioned why quality control was not observed, why the production was down; why there was a suspension of material supply that caused the production to stop; why there were complaints from customers. The whole meeting was analogous to an angry father scolding his mischievous children. There was hardly any protest among the silent audience

except the mumbling of the top management. After the meeting, when asked why he did not defend himselves, one of the supervisors explained that he better keep his month shut less he would be avenged later."

2.5.3 The Contrast of Values

With the influx of Western investment in industries, the Chinese are facing the dilemma of accommodating the opposing values that come along with the Western know-how during the daily interaction. Western views may contradict the established Chinese values (Punnett & Zhao, 1992, pp-87), as the interaction will involve the "culture and ideology related to work goals, power tactics, goal-setting." This contrast of values between China and the West is difficult to compromise, though not impossible. Confucian beliefs continue to influence the behaviours of both the Chinese management and workers, regardless of the assumption of some Westerners that some Confucian beliefs have been subsumed into the Chinese communist system (Laaksonen, 1988, pp-79).

2.5.4 The Comparison of Chinese and American Management

There is a great contrast between the manner of management in terms of organization value. The Americans use a rapid evaluation and promotion approach whereas those used by the Chinese were slow ones. While the Chinese would directly assign a single job to their employees, the Americans, by contrast, would tend to plan or develop a career path for their employees. As far as decision making is concerned, the Chinese use a collective approach while the Americans prefer an individual mode. In terms of responsibility, the Chinese rely on collective responsibility method when a decision is made, while the Americans favour responsibility to be allocated to individuals.

2.5.5 European Culture and Management

The great contrast in the European culture with its Chinese counterpart has its historical origin. Further to the Greek heritage in European culture, Christianity is recognized as the "second pillar of European culture. Humanism can be considered the third pillar" (Zheng & Abeele, 1997, pp-94). Thus the core beliefs of humanity extol the born freedom of the individuals.

European enterprises seek to satisfy "individual needs, caring about individual people, social responsibility, as well as some perverse aspects of individualism in the workplace" (Zheng & Abeele, pp-96). However, in the Chinese organization, the extended family forms the basic social unit that emphasizes group orientation. People's loyalty is directed at the family and work groups rather than the society at large, imposing difficulties for the development of individual responsibility. One of the features about Western management is that the top management is empowered with the leadership, with the assumption of their prior consultation, discussion and negotiation as a result of horizontal coordination between the management and each level of the workforce. However, in China, "there is a great distance between ruler and ruled, and the top management heads a strong internal influence coalition compromising all personnel groups of the firm" (Zheng & Abeele, 1997, pp-97).

2.6.0 Summary of this Chapter

Inspired by the success in research of occupational safety as mentioned in the contemporary researches, the feasibility of applying the successful Western experience to a different social context was discussed. This chapter pointed out the strong impact of local culture, custom and religions on imported concepts on safety management. The former had posted tremendous barriers in safety research in China.

The next chapter will be devoted to the review of the related literature in occupational safety from which the frame of reference and research methodology of the study will be formulated.

CHAPTER III

LITERATURE REVIEW

3.0 Brief Introduction of the Chapter

This chapter inspects the research on occupational safety in terms of the causes of accidents and the possible solutions. The writer attempts to identify an optimum approach for improving work safety appropriate in the Chinese context.

Part One of this chapter addresses the various causes of accidents including human, environmental and organizational factors. Among the factors, the human factor is given special attention. What follows is the interpretation of the causation theory which describes the failure of a person to deal with a real situation. Environmental factors and also the interaction between man and machine are looked into.

Part Two is devoted to the discussion of approaches of combating occupational accidents, the solutions and their problems. Both the strengths and weaknesses of these approaches are contrasted. The other part of the chapter identifies two other important approaches----behavioural approach and attitudinal approach. Of these two approaches, the behavioural approach is especially focused. Analysis is also given to the relationship between attitude and accident, between attitude and behaviour to examine their possible causal relationship. Both alternatives are brought into comparison and contrasted concerning their "researchability". The second to final part of this chapter is given to the possible combination of behavioural and attitudinal approaches which is thought effective to occupational safety. To conclude the chapter, the promotion of safety culture in an organization is examined.

Status of Work Safety

The study of work safety and health has long been a task for social workers, psychologists, academics and other experts (Mintz & Blum, 1949; Harris, 1950; Keenan, Kerr & Sherman, 1951; Van Zelst, 1954; Davids & Mahoney, 1957; Kerr, 1957; Crawford, 1960; Verhaegen, Vanhalst, Derijcke & Van Hoecke, 1976). Every year, despite people's efforts to combat safety and health problems, there are many serious accidents and occupational injuries in the working place and occupational accidents continue to happen worldwide. In the U.K., 150 people die by accidents each year and 2,500 to 3,000 are seriously injured whilst 30,000 to 40,000 suffer lost time injuries on construction sites (Davies and Tomasin, 1990). In the United States, the repetitive stress injuries from industry cost the employers more than $20 billion for the workers' compensation claimed in 1993, while indirect costs may be estimated as high as $100 billions (OSHA/NIOSH January, 1997 Conference). In West Germany, around 100,000 accidents and incidents of occupational diseases are reported annually (HSE, 1993). It seems that progress for the prevention of occupational accidents is still slow and there is much room for improvement.

Before seeking new approaches to add a further contribution to existing research on occupational accident prevention, a detailed analysis of what is known about the causes of injuries and accidents at work from several perspectives is required.

PART ONE

3.1 CAUSES OF ACCIDENTS

Heinrich (1959, pp17) mentioned the theorems of the cycle of an industrial accident which causes an injury:

"1. A personal injury occurs only as the result of an accident.

2. An accident occurs only as the result of a personal or mechanical hazard.

3. Personal and mechanical hazards exist only because of the faults of persons.

4. Faults of persons are inherited or acquired by environment."

Heinrich's theorems relating to the causes of accidents are pertinent and acceptable except the fourth which is rather controversial and will be discussed below. However, the above theorems in accident causation can be treated as a cycle in which one step leads to the next when human faults seem to be the primary factor.

3.1.1 Personality Factors

Attempts have been made to examine the relationship between accidents and factors stemming from personal attributes such as age, sex and experience (Mintz & Blum, 1949; Davids & Mahoney, 1957; Harris, 1950; Kerr, 1957; Crawford, 1960; Verhaegen, Vanhalst, Derijcke, & Van Hoecke, 1976). These early researches were concerned with human errors that might be the main causes for industrial accidents. They believed some workers had inherent characteristics that caused them to have more accidents than others. Though no experimental data have supported the effect of workers' personal attributes on accident rate, it is still worthwhile to review the constitutional factors which are believed to be the causes of accidents, since these studies are part of the researches of occupational health and accidents.

Of the constitutional elements of accident proneness, carelessness as well as physical factors are thought to be responsible for some unsafe behaviours.

3.1.1.1 Accident Proneness

There has been a tendency since the beginning of the century to lay the blame for accidents on man rather than the situation (Greenwood and Woods, 1919; Newbold, 1926). This tendency has been exaggerated and also reinforced by the legal and insurance perspective of accidents as summarized by Hale & Hale (1970).

Accident proneness, according to Kerr (1957, pp-3), was a "constitutional tendency within the organism to engage in unsafe behaviour within some stated field of vocational activity". The establishment of the principle of accident proneness labeled certain types of people as more possible accident repeaters. The principle was first based on the researches of Greenwood and Woods (1919) who pointed out that the existence of differences in accident proneness indicated that the obtained distribution of accidents significantly differed from chance expectancy. That is, some people have fewer accidents than may have been expected by chance. Conversely, some people have more accidents than would have been expected in the perspective of a simple random distribution.

Greenwood and Woods (1919) collected data on the accident frequency of 14 groups of 50 to 750 women working in a British munition plant during World War I, and detected that a few workers had most of the accidents. This finding led them to hypothesize that there existed in some workers the inherent characteristics that caused them to have more accidents than others. Newbold (1926) added to the findings by stating that a minority of the workers were responsible for a large number of accidents. Newbold further reported that there was significant correlation between the accident rates for the same people in two successive periods, after she compared their accident rates in her research. She could not accept the notion that the differences in accident liabilities were wholly attributable to job hazards.

In the 40s, 50s and 60s, the idea that accident proneness was a stable personality trait was questioned in terms of both statistical evidence and the validity of the tests to identify people of accident proneness in a variety of situations.

Mintz and Blum (1949) challenged the validity of the principle of accident proneness. They criticized Greenwood and Wood's misleading method of using the percentage of people. The frequency of occurrence of accidents indicates that the incorrect assumption (based on data obtained in accident distribution) of a small percentage of people having large percentage of accidents as evidence to support the principle of accident proneness fails to contradict the chance distribution. The chance distribution is that which would normally be expected by "by chance". (i e, if all individuals are equally liable to accidents).

According to the assumption of equal liability (or Poisson distribution), people who have one accident cannot be immunized from involvement in future accidents as those who have not had any. Thus the chance is some people are likely to have more accidents than other people in a given population but they should not be labeled as more accident prone than the average. It can be shown that the differences between the obtained and expected distributions are not significant and do not support the notion of accident proneness. It is unfair to classify certain people by means of an arbitrary criterion as excessively accident prone, being responsible for the accidents, though differences in accident liability cannot be ignored as a factor in the different accident records of the people investigated (Mintz & Blum, 1949).

Kerr (1957) further stated that the misleading assumption of accident proneness claimed as the cause of accidents might be due to environmental factors such as temperature differences, fumes, congestion-space-threat differences and others.

Hale & Hale (1970) argued that the hypothesis that personality traits are determinants of accidents is untenable owing to the multi-nature of accident causation, and the hypothesis contains the mistake of relying too heavily on the accident record which could be misleading. They further pointed out that most record systems tend to over-simplify the classification of accidents, putting the description of accidents into predetermined categories which only allow one cause for each accident, thus ignoring the fact that each accident has more than one cause (Hale & Hale, 1970, pp-118). For example, in the accident review forms designed by Grimaldi & Simonds (1975), the terms "physical or mental defect (pp-168)" or "wrong attitude" seem to be over-simplifying the causes of accidents. More concrete description other than some vague terms is needed.

3.1.1.2 Carelessness

Many accidents seem to be caused by carelessness that is related with one of the mental and emotional factors. However, the term 'carelessness' is only an excuse to oversimplify the cause of accidents. Grimaldi & Simonds (1975, pp-397) expressed the view that carelessness "neither describes, defines, or implies a phenomenon of human behaviour which would be useful in determining a correction (solution) for the cause of accidents ". The term, 'carelessness' obscures the truth for the accident details. In fact, 'carelessness' is a misleading concept that distorts the feeling and motivation of the victim behind the accident. For example, it would not be fair to put the label 'carelessness' on an operator of a metal stamping machine, when she had lost two fingers in an accident because she failed to use a clip. It is very likely she cared tremendously for her fingers as part of her beauty and also the ability to seek livelihood to support her family. It might be that she never realized the danger or she did not want to bother using the correct tool for reasons of time saving and convenience.

A more realistic word to describe the cause of accidents is the concept 'thoughtlessness'---"the limited, incomplete, stagnated, blocked, or otherwise restricted use of sound mental judgment can be in its place. If this is the case, correction can be considered through habit improvement, training and the stress of concentration" (Grimaldi & Simonds, 1975, pp-397). In other words, the implementation of a training course in safety operation can help reduce the chance of accidents.

3.1.1.3 Physical Factor

Some of the possible causes of accidents are related with physical deficiencies in the individual or physical mal-adjustments (OSHA, Ergonomics Homepage 08-October,1997, OSHA file:A/ergonomics/.htm).

Grimaldi & Simonds (1975) argued that several physical factors are partly responsible for industrial accidents. These factors are vision, reaction time, relationship between perception and muscular responses and accidents, relationship between intelligence and accident experience, hearing, age, experience as well as emotional instability:

3.1.1.3.1 Visual Performance

Visual performance has been considered as being related with accidents. Past studies revealed that groups of workers who had eye defects experienced more accidents than did others with normal vision (Wirt & Leedke, 1945).

3.1.1.3.2 Reaction Time

It is thought that the reaction time of a fraction of a second between the time, when an individual receives a sensory stimulus and decides his response in action, may have a significant bearing on an individual's ability to avoid accidents. The assumption, though, does not have valid evidence for generalization, as in some instances, the outcome is on the contrary. For example, the National Safety Council reported that a fast reacting motor-coach driver experienced more accidents than the one who reacted more slowly (Farmer & Chambers, 1926).

3.1.1.3.3 Relationship between Perception and Muscular Responses and Accidents

Drake (1942) in his investigation of the relationship between the speed of muscular responses and accidents reported that people with quicker muscular responses than their eye sight seem to have more accidents than those who have slower muscular reaction and better visual discrimination.

3.1.1.3.4 Relationship between Intelligence and Accident Experience

Intelligence as measured by an IQ Test, did not prove to be related to frequency rate of accidents (Barry, 1975). 80%-85% of the accidents, as pointed out by Heinrich (1959), could be attributed to the inadequacy of the workers in work safety. No correlation between accident repetition and level of intelligence has been found, though some minimum intelligence is the prerequisite for helping a person to avoid accidents but above the minimum level, the causal relationship between the two variables is questionable.

3.1.1.3.5 Hearing

In contrast with the many negative or null relationships reported above, hearing defects appear to have a greater negative impact on a person's accident experience than other physical deficiencies. The loss of hearing reduces the hearing perception of a person both to the frequency of sounds and the intensity of sounds in a normal working condition. Thus a person with hearing defects will fail to detect the established warning signals that enable him to distinguish the normal sounds from the abnormal ones in an environment where unseen but audibly detectable hazards from machine operation may exist (Harvey and Luongo, 1945).

3.1.1.3.6 Age

Despite the reports that the occurrence of accidents declined with age, the relationship could probably be the result of accumulated experience with age to perform operations more safely (Zelzt, 1954; Grimaldi & Simonds, 1975). Zelst (1954) assumed that in many jobs the high-accident employees tended to resign or retire because of injury. In fact, according to Zelst's study, the effect of experience upon the occurrence of accidents was only important during the first half year of employment. Through the remainder of the employee's work history, no significant change of the frequency rates of accidents had been noted. In short the reduction in accident rate with increasing age and experience might be partly caused by the process of natural selection which retained those who knew how to protect themselves in the job.

3.1.1.3.7 Experience

Likewise; there have been studies (Fisher, 1922; Ghiselli and Brown, 1948) which implied that accidents were correlated with experience. Fisher (1922) reported that accidents decreased with experience. Ghiselli and Brown (1948) identified a significant negative relationship between accident rate and experience when they studied a group of motor-coach operators and street car motor-men. In the meantime, there also co-existed totally contradictory results, when Shrosbree,(1933) argued that work accidents are positively correlated with experience. Nevertheless, care must be taken to determine the nature of work, when a job with more physical demands will incur increasing hazards to aging workers (Stevens, 1929, pp-138-145).

3.1.1.3.8 Emotional Instability

Emotional factors can be various. There are difficulties from work and from home. In the factory, one of the problems, for example, is the result of tense relationships with the supervisor. At home, marital and financial problems often bother the individual. Furthermore, the lack of sleep, fatigue, emotional upsets resulting in functioning below a person's normal level of competence may often be related with occupational accidents (Hersey, 1936). Hersey (1936) investigated 400 minor accident cases in a clinical study and found that over 50% of the accidents were associated with workers who were in a low emotional state during the occurrence of the accidents. However, most people do have inner coping strategies and not everyone having emotional problems may be involved in a work place error (Kamp, 1994).

As summarized by Santamaria (1978) we can say that in spite of the popular belief today that personality factors have influenced the causes of accidents, the assumption is still inconclusive, owing to the lack of valid experimental data. Though psychological applications may be considered useful in understanding people's unsafe behaviours and attempts at modifying these behaviours, none of the above constitutional factors can be isolated to demonstrate that they are associated with the incidence of accidents. Therefore, these factors cannot be the basis for formulating corrective measures of accident production.

3.1.2 Accident Causation Model

Hale and Hale (1970) who developed a model of accident causation described an accident as " the failure of a person to come into play with a real situation and both the person and situation" (pp19) should be held liable for the cause of failure.

In their accident causation model, Hale and Hale (1970) described the closed loop process of how a person as the central channel responds to information and interacts with the situation both past and present (Figure 3.1).

THE MONITORING LOOP

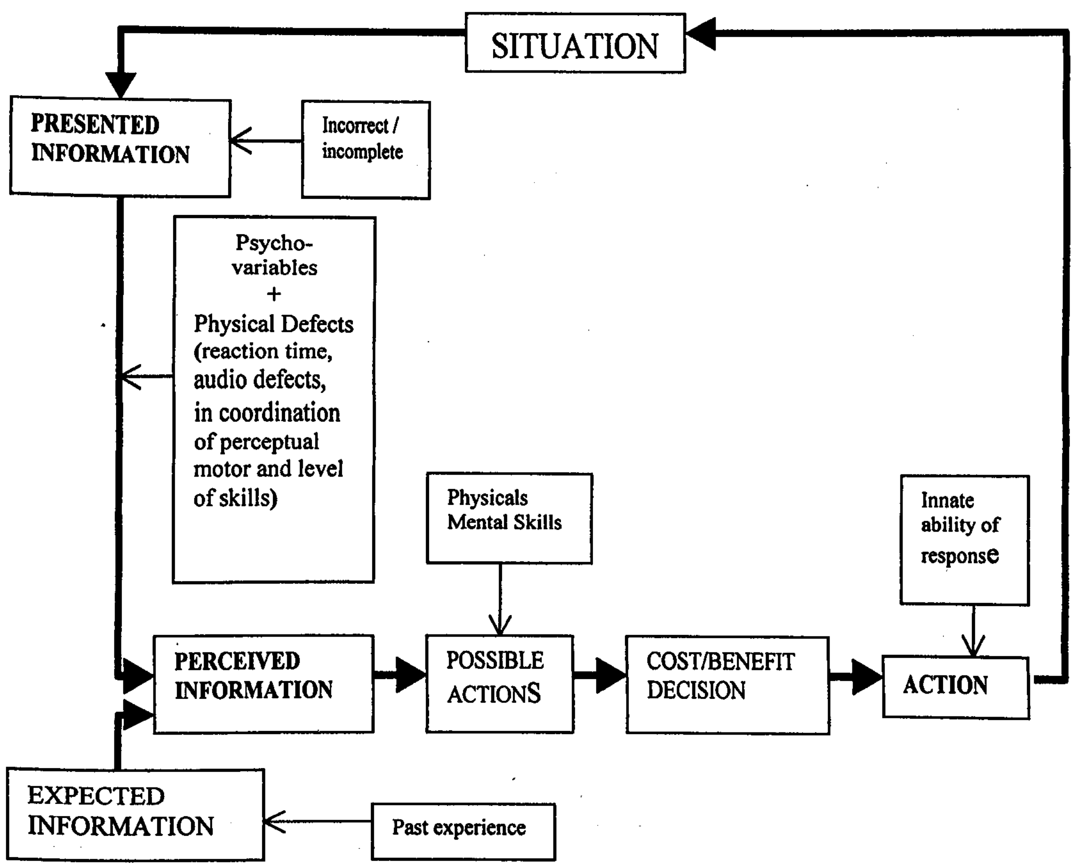


Figure 3.1 Model of Accident Causation (simplified from Hale & Hale, 1970, pp-118)

The breaking down of the chain of the person and situation being affected, for example, by a false instrument reading, will result in an accident, when the person does not have sufficient information to guide him or her to the correct direction if he or she fails to seek further information.

To put it in another way, a person in a given situation has his or her own expectancy about the information presented to him or her. This expectancy will sometimes distort his or her perception. The distorted perception will sometimes prevent him or her from seeing clearly the aspect of the situation. This discrepancy of reading the information happens when he/she is under time pressure or in poor physical state, as a result of reliance on expectancy rather than the information actually presented (Hale & Hale, 1970).

The action to cope with the situation from the person and the decision for action is controlled by a number of factors. First, the expected result is decisive. Whether the person will avoid making an error mainly depends on the correct instruction being given by the authority. The person may consider a number of alternative approaches which, if inadequate, owing to wrong calculation, poor training or failure in the application of past experience, will lead to errors.

The second controlling factor at the decision stage is the person's physical and mental skills, the poor status of which may result in an injury or near-hit. Full use of a person's skills can often equip him or her with the capability to avoid injury in critical situations, such as traffic accidents.

Third, behind the possible action to be taken, a process of estimation of the cost of risk or benefit anticipated will affect what action to choose. For example, for a metal stamping worker, the decision to use one hand to press instead of two to save production time or to obtain convenience may be weighed against the risk of an injury, if the 'one hand' gets trapped between the mould and die.

The last factor behind a decision for an action is associated with the innate variability of response----a response deviating from usual practice when executing the task. The deviation may incur a chance for error.

To ensure that a person will recognize a potential danger, there is a monitoring loop inside him, according to Hale and Hale (1970), guiding the action to determine the level of seriousness and the responding action when detecting that the situation has deviated since it was last monitored. In case of unusual situations, the monitoring system will be triggered to regulate. However, an accident may ensue if any malfunction of the aforesaid steps occurs. For example, an employee working in the spraying department of a metalwork shop can detect potential danger from the escape of thinners, if he has a normal monitoring system (smelling) which alerts him of the hazard and the necessity to stay away from danger. However, in case of the malfunction of his smelling system (e.g the blocking of his nose after influenza), he is unable to detect the danger and to take any protective action. And there also co-exist some secondary factors that will mediate the functioning of the various parts of the above process. They are psycho-physical variables, the reaction time, audio defects, incoordination of perceptual motor and level of skills (Figure 3.1). As emphasized by Hale and Hale (1970), this model highly discredits the misconception of accident proneness which attributes accidents to personality characteristics as the unifactor, while the complicated interaction between the person and situations can explain some of the causes of accidents.

3.1.3 Environmental Factors

Responding to legal demands to render more protection to workers, safety studies in the 1960s and 1970s turned their attention to the causal relationship between accident and environment instead of the individual involved (Greene, 1969; Paterson, 1969; Jones, 1971). However, according to earlier researches, it is hard to determine the proportion of the responsibility of either side, when in some cases, the worker was to be responsible for the causes of accidents. The workers were blamed for their faults and their accidents were thought to be associated with personality factors which led to most industrial accidents (Kerr, 1957; Heinrich, 1959). In other cases, environmental conditions were more dominant (Hoyos, 1995). The environmental conditions that are attributed to the causes of accidents are connected with the failure of the control of working environment such as the absence of risk prevention systems, the negligence of machine maintenance and the lack of effective training programs for safe operation. People must recognize the hazardous situations in which they are working and that they can be endangered at any time. The hazard can sometimes be described as "latent amounts of physical energy, or certain objects or substances, which may hurt the human body if energy potentials are released" (Hoyos, 1995, pp-236). To be protected, it must be ensured that people are separated from the hazard-related physical energy, or objects or substances which carry potential danger. For instance, the workers must be guarded against moving parts, falling objects, heavy goods, electrical current, radiation and so on. Protective means such as helmets, goggles, gloves or protective arms on the machine can be very effective for safety (Hoyos, 1980;1987).

Industrial hazard also arises from people's abuse of machines, owing to their misunderstanding of instructions, lack of knowledge or training which results in unsafe acts. Human beings who have invented, designed or operated the machine, should be responsible for the injury and cannot resort to the excuse of mechanical faults. As stressed by Heinrich (1959, pp-24-25), "man failure directly as well as indirectly causes the great majority of accidents", and an injury is the penalty workers pay for one of the numerous unsafe acts. They must be educated to prevent repetition of accidents caused by violating safe practices.

Hacker (1986) reported that human errors are often the result of the failure of a person to comprehend information associated with hidden danger and to perceive the existence of dangers, especially when they have to execute their comprehensive and perceptive abilities under unfavourable circumstances as listed by Wenninger (1991,pp-237):

"i) The reception and assimilation of information is interfered by outside stimuli, which can be noises or acoustic impulses. The former affects the threshold of vision while the latter tend to lower visual sensitivity to colours.

ii) Additional stimuli interfere with the person's acoustic system to discriminate hazard signals

iii) The distortion from faulty signals such as reflection lowers a person's ability to receive a safety signal."

As summarized by Hoyos (1995), the perception and recognition of a hazard is crucial for the choices of appropriate action that follows judgment, evaluation and decision in the hazardous situation.

3.1.4 The Interactive Man-machine System

In addition to environment-oriented accident investigations, studies in the area of health and safety in the last ten to twenty years have devoted much attention to an integrated examination of the man-machine system. As cited by Santamaria (1978, pp-19), the early research reported a close link between industrial accidents and environmental hazards that reflected three main causes: (a) plant or material failure in the presence of workers. The escaping of gas is a good example: in the spraying department of a metal stamping house, poor ventilation is likely to lead to explosion when the thinner evaporates and gets trapped in the room where the oven for baking the sprayed products is located. (b) contact between machines and worker e.g. accidentally getting a hand trapped in a machine, (c) creating hazardous situation e.g. by blocking the passage with objects or spilled oil. Addressing the above types of accidents, the importance of ergonomics in producing a safer man-machine system was highlighted by the National Safety Council (1977).

The concept that both error and hazards are part of a chain of events in the integrated man-machine system was stressed earlier in the last section in Hale & Hale's (1970) accident causation model which postulated that both hazard and error are necessary conditions for an accident to occur.

3.1.5 Dangerous Behaviour

In the studies of occupational safety, people's efforts are often misdirected to lost-time or major accidents, ignoring valuable statistical data for the more numerous unsafe acts that accumulate before an injury is caused. They are, in fact, studying the results instead of the causes. Heinrich (1959, pp-29) argued that "attention should be directed to accidents as properly defined, rather than the injuries that they cause". The severity of an injury is hard to control, because it is associated with a lot of uncertain factors. The factors can be "physical or mental condition of the injured person, the weight, size, shape, or material of the object causing the injury, the portion of the body injuries, etc" as mentioned by Heinrich. The cause analysis of the major injuries alone and the resulting data from the analysis is too varied to justify for subsequent corrective or preventive actions, because "the major injury does not always result from the first accident in the series of which it is a part. It may occur as a result of the last accident or at any intermediate points, or it may be the result of an exceptional isolated accident type that might never occur again" (Heinrich, 1959, pp-29). The repetition of no-injury accidents that are normally ignored by people may eventually lead to injuries, or catastrophes that result in substantial loss of life. It is valuable that studies be directed at the minor injuries as part of the large injury group. In other words, hazardous practices or conditions that lead to accidents, minor or major, should be given first priority for correction. This widely known safety theory of Heinrich is crucial in understanding the key cause of most occupational accidents. He recommended that attention be paid to "averaging a sufficient spread of data" rather than to "assumptions having a basis in isolated cases selected chiefly because they are spectacular" (pp-29).

3.1.6 Failure of the Organization and Inadequacy of the System

An overwhelming number of accidents have been closely connected with human factors which cover

> "the perceptual, mental and physical capabilities of people and the interactions of individuals with their job and working environments, the influence of equipment and system design on human performance, and above all, the organizational characteristics which influence safety related behaviour at work (Eves, 1994)".

Rather than laying the blame on the individual, the primary responsibilities for accidents should invariably rest with the failure of the organization and the inadequacy of the system, as echoed in the Challenger space shuttle disaster (Carter and Jackson, 1992, pp-49-51). On 28 of January 1986, the US. space shuttle Challenger exploded 73 seconds after launching, owing to failure of O-ring seals in one of the rocket booster joints. Despite recorded suspicion of the integrity of these joints, probably being associated with leakage on previous flights and the advice from the engineering team, the management still ordered the flight to be launched as scheduled. The engineering team warned that the seal temperature, if dropped below 53 degree F, would affect the seal integrity according to investigations. The overnight temperature forecast made before the launch dropped to 18 degree F. The disaster is an example of the lack of safety awareness of the management who refused to discard their old beliefs and accept the new information presented to them. The reasons for making the wrong decision were, according to the writer, rather ridiculous: substantial investment in the project, pressure from outside and the defense of power (fear of losing face)...... and so on.

Human errors have been responsible for at least 92% of the root causes of accidents (Eves, 1994). There is a necessity to review the management structure with regard to health and safety to ensure safe operation and to equip the workers with adequate risk preventive knowledge. In reality there are often conflicting perceptions between supervisors and the workers about the causes of accidents (Bradley, 1978, pp-251). The confronting relationship between the leader and members stops them from interpreting the behaviour of the other side in their responding perspective, and attributes the responsibility to the other side when accidents occur. This lack of real communication results in their inability to analyze the objective causes of accidents and seek preventive measures (Bradley 1978). For example, workers tend to attribute the occurrence of accidents to external causes (e.g. not enough instruction from the supervisors) while the supervisors are likely to think they have done a good job and attribute the maintenance of work safety to external causes (good leadership) and failure (the occurrence of accidents) to internal characteristics (worker's negligence of instruction) (Green and Mitchell,1979).

The examples presented above, bear the implication that workers often do not receive enough instruction on safety beyond those designated by law. To remove the indifference of the work force to safety and give them the concept of accident prevention, they must be educated to learn that accidents are not chance products. In the daily meetings between the supervisors and the workers, instruction on safety, safe work habits and preventive measures of accidents should be included and closer interaction between both parties is needed (Niskanen, 1994).

Human errors and omissions of behaviour of the people at work are inseparable from safety and health. That people are often not well-motivated for self-protective behaviour is an attitudinal issue.

3.1.7 Negative Attitudes

Almost 90% of all occupational accidents including those which are claimed to be due to the errors and omissions of people at work are in fact due to the negative attitude of the workers and management towards health and safety (Eves, 1994). Negative safety attitudes are responsible for the inadequacy of organizational and administrative systems to ensure safe operations (Eves, 1994). For the part of the workers, they often do not have the sensitivity to accidents as a result of the lack of positive safety attitude and may occasionally break safety rules during operation (Mason and Simpson, 1995; Spigener, 1995).

PART TWO

3.2 OCCUPATIONAL SAFETY

Confronting the rapid rise in the number of work injuries and the adverse impact of these on society, occupational safety, as one of the important parts in the promotion of worker wellbeing, has become a global task for health professionals and academics. Tireless efforts have been made by researchers from various fields to study safety issues and to explore possible solutions. Attention has been paid to the value of collaboration in interdisciplinary fields such as occupational medicine, industrial hygiene, nursing, epidemiology, safety engineering, ergonomics and behavioural science (Sulzer-Azaroff et al, 1994) to "help build a worldwide multidisciplinary coalition of injury prevention" (Sulzer-Azaroff et al, 1994). The international multidisciplinary coalition in safety and health was the theme of the Second World Conference on Injury Control held in Atlanta in May, 1993. Among the interdisciplinary research, behavioural science in relation to human performance in hazard prevention has been given particular attention (Sulzer-Azaroff et al, 1994, pp-321). Before looking into applied behavioural analysis, it is useful to review some of the major occupational safety-related studies. It is not possible to appreciate fully the efforts in research behind the approach, without examining the theoretical base from which the behavioural-oriented approaches have evolved.

3.2.1 Major Trends of Occupational Safety Research and Problems

3.2.1.1 Safety Management

Some researchers have tried to investigate the effectiveness of professional involvement in safety management (Planek, Driessen & Vilardo, 1967). Conventional safety management, which has been developed for half a century, mainly focuses on case analyses, communication, inspection and supervision and safety training (Grimaldi & Simonds, 1975,).

Case analyses as part of the conventional safety management tried to classify the accidents and injuries, identifying the causes followed by related evaluation. Communication of the result from the analyzed events was done by incorporating the safety standards formulated according to the analysis into the instructional program to be delivered to workers in the format of meetings, text, posters, visual reminders and films to delineate the causes of accidents and corresponding corrective actions. Concurrently, the labour laws, operating directives and incentive plans were revised according to the formulated instructional knowledge on safety performance. Along with labour laws, inspection, as part of the safety system, is deemed a powerful means for injury prevention to safeguard the plants from hazardous conditions and operations (Grimaldi & Simonds, 1975, pp-12-13).

In safety management, some attention has been diverted to the comparison of safety performance of factories by industry, size and geographical location (Simonds, 1973). The larger companies, though not necessarily or inherently better than the smaller ones, do have the edge over the small companies in terms of safety performance, because they can afford to hire staff specialists who possess professional knowledge in overall management including health and safety control. They can assure the higher level of management that OSHA (Occupational Safety and Health Association) is not only a concern for the staff but also a tremendous help on the cost and profit structure. Compared with the big companies, the small companies are unlikely to have the resources needed for a full-time safety specialist, and this failure to afford a full-time post of safety responsibility is said to account for the poorer accident records often found with small industries (Simonds, 1973).

In Business Week, an anonymous author of a study also agreed that factory size is crucial in enforcing occupational safety. A specially assigned expert in a large factory can better ensure the compliance of the workers to the adoption of personal protective gears to guard workers against hazards, compared with a small factory (Business Week, April 13,1981, pp-9). In addition, the type of industry can affect safety performance. For example, in a plating shop, where workers are regularly exposed to corrosive chemical solutions, the complicated work environment tends to make the enforcement of personal protection more crucial when goggles, respirators, gloves and rubber boots or aprons are needed. As a result of enforcement, accidents in factories, where the necessity of personal protection is emphasized, are less likely to occur, compared with factories where it is not.

In addition to the size of factories, the location of the factory to a particular type of industry is especially important in safety management. (Stillman, 1990). For example, the location of some small factories in the old industrial area of Shenzhen has a significant impact on safety. Because the location of the factories within the city does not allow a spreading out design, the multi-storeyed design of the plant tends to create hazard during transportation and handling for some types of industries. The reason is, in the metal-works and tooling shops, raw material, semi-finished products or finished products of metal have to be transported between levels for work processing (Shenzhen Safety Manual, 1990). Besides, the multi-storeyed design creates difficulty for the management in effective supervision, in terms of work safety.

Part of the conventional approach to safety management is the provision of safety training for the supervisor to familiarize themselves with the responsibilities needed for work safety. This training stresses the importance of complying with the rules and regulations set by the management.

However, the traditional safety approach which relied heavily on regulation and supervision did not seem to be very effective in yielding much improvement in work safety (Grimaldi & Simonds,1975). It is necessary therefore to consider other approaches.

3.2.1.2 Information Campaign

An information campaign can be one of the interventions for safety performance at work to improve workers' safety awareness in the form of publicity campaigns. These aim at communicating to the workers information about legislation, education programmes, enforcement and incentives.... and so forth (OECD Report, 1993).

The aim of an information campaign, sometimes delivered in the form of persuasion, is to instill the required safety knowledge to influence attitudes and eventually bring about behavioural change with a view to inducing the likelihood of reduced accidents (OECD Report, 1986, pp-75) The effectiveness of an information programme depends on whether consideration has been given to the motivation of the receivers and arousing their interest in the information to be presented.

It must be noted that in order to make the campaign successful and to convey the desired message to the audience, care must be taken to account for the prevailing attitude in the audience. The message should be reasonably entertaining and avoid lecturing or an authoritarian approach which is likely to be rejected. An effective safety message should contain high-charged behavioural instructions with clear and unambiguous steps for achieving the expected behaviour. And owing to the limited time, delivering the message through the immediate media (eg. T.V. poster....) with ample explanation for the advocated behaviours is impossible. Other low-immediacy media that carry the necessary background information have to be considered as a combined channel for publicity. The message should be designed in such a way that personal relevance to audience can be accounted for, to achieve the highest appealing effect (OECD Report, 1986, pp-76-77).

One problem involved in tackling safety issues by means of an information campaign is the difficulty of finding definite (ie objective) criteria for evaluating the programme (Shinar and Mc Knight, 1985). An example of a safety campaign is described below:

In December, 1990 in Belgium, a six-week campaign against drinking and driving was launched by means of TV-and-Radio-Spots accompanied by special media such as telecards and the drawing of a lottery (Prigogine, 1991). The result was positive, showing a decrease of the number of drivers drinking above the legal limit (80mg/ml) from 13% during the same month of the previous year to 5% after the campaign. It is also interesting to note that the drivers' intentions to drive after drinking also decreased significantly. Nevertheless, it seemed not possible to determine the cause of the observed relationship between the campaign and the downward trend of the drivers' behaviour in view of the different measures used simultaneously (ie posters, TV-and radio-spots and special media). It was difficult to prove the effect of any single measure. Besides, it was not possible to relate the change of attitudes towards drinking and driving with the measurements adopted, for certainty, since the downward trend began before the campaign was introduced (Prigogine, 1991).

According to the OECD report (1993, pp-57), by the use of an information campaign alone, whether it be delivered through mass media campaigns or posters, little or no effect can be achieved. Wilson (1989) confirmed that informational safety campaigns had not been consistently successful, unless it was combined with other campaign tools. The information campaign launched to combat drinking and driving in Belgium in December of 1990, by using special drawing of the lottery through the media and other campaign tools such as posters as mentioned in last paragraph is a good example. On other occasions----during Christmas Eve and New Year Eve, alcohol free beverages were promoted. The results were confounding. The number of drivers found speeding decreased by 5% compared to those of the previous year and the number of traffic victims decreased by 9%. However, compared with an increase in the sale of alcohol free beer there was a drastic increase in the number of female drivers at night.

As has been shown in the examples above, there are limitations of the information campaign approach to improving safety:

a) the lack of well-controlled studies with systematic assessments before and afterwards (Campbell & Stanley, 1963)----The change claimed to have occurred in the research cannot exclude the possibility of the coexistence of other variables. For example, variables such as history, maturation and statistical regression may be responsible for the change, as noted by Komaki et al (1978);

b) the difficulty in arranging a control group---- in the workplace, it is sometimes not realistic to assign randomly the subjects to different groups because of the interruption that may be caused to the production activities and as a result of the intact group used for comparison, the groups may not be equal in their personal attributes (Komaki et al, 1978);

c) for ethical reasons, it may not be feasible to observe the occurrence of accidents and injuries at the worksite;

d) the difficulty of recording the real lost-time accidents, owing to their unpredictability of occurrence. By definition, lost-time accidents refer to "death, permanent total disabilities, permanent partial disabilities (Komaki et al, 1978, pp-435)" and temporary total disabilities which are 'rare' as commonly described by statisticians. In reality, the infrequent and unpredictable occurrence of the lost-time accidents mentioned earlier makes it difficult to use lost-time accidents as the primary index to measure the effect of a safety program. The record can be delusive and unreliable when the figures reported are actually a mixture of the disabling and minor injuries, the latter of which cannot be eligible for lost time but still need medical aid.

One of the possible reasons for the limited success of safe information safety campaigns may be due to the downward comparison of the target people who may perceive that the skills they possess enable them to avoid the accidents that occur to other people (Svenson, 1981). The downward comparison theory has been first established by Robertson (1977) who argued that people show the lack of interest in safety devices because they underestimate the probability of the occurrence of an accident to themselves. Their denial of their own vulnerability to accident and injury is embedded in their overconfidence about their abilities. Robertson's finding was backed up by the statistical data he collected in his investigation with 1017 new car buyers among whom 94 % perceived their chance of being killed in a car accident smaller than that of other drivers. The theory was supported by Svenson (1981) and enriched by many other researchers (Wills, 1981; Williams, 1985; Perloff and Fetzer, 1986; Mc Cormick, Walkey and Green, 1986; Finn and Bragg, 1986).

Despite the significance of these studies as a starting point, it is yet too soon to draw any firm conclusions (Komaki et al, 1978). An information programme is effective only when used to support other measures in safety promotion, for example, a programme of behavioural modification, as mentioned earlier. Research suggests that, compared with information campaigns, educational programmes are likely to be more positive in the modification of attitude in occupational safety (OECD, Report, 1993, pp-47).

3.2.1.3 Educational or Training Programmes

Educational programmes in occupational safety have in their objectives the instruction of workers about occupational hazards. An educational program on safety should not be delivered to workers unless a prior thorough assessment and analysis of the educational needs of the workers has been conducted to establish key objectives (Pierson & Murphy, 1996; Gagne, Briggs & Wager, 1988). The program is usually given through lectures and group discussion. In one of the examples, a project intended to promote seat belt use among police officers in the States of Maryland, United States was administered to 300 officers by means of information contained in a brochure requiring officers to wear restraints (Mc Knight, McPherson and Hilburn, 1988). The reason for the policy was explained in the brochure. The subjects were divided into two groups. An instruction of a 3-5 hour course by means of lectures, small group and role-play discussion was accompanied by videotaped testimonials of accident victims. The instruction was also reinforced through possible penalty for officers who did not use a seat belt. Observational data on the use of seat belts were collected by means of pictures for the vehicles. A control group with civilian vehicles was utilized. The results seemed to be positive towards safety belt use and the value of the programme.

Intervention can create long-term behaviour change to minimize extrinsic controls which can be a barrier to individuals benefiting from internal justification for performing the target behaviour after the external controls are withdrawn (Bandura, 1989).

3.2.1.4 <u>Engineering Approaches</u>

Apart from the above-mentioned approaches of safety management, many other explorations have been dedicated to improving safety. One of the topics is that of the engineering aspects of safety (Grimaldi & Simonds, 1975). "Engineering" refers to the design of the machinery and equipment, taking into consideration the protection of the workers by guarding the moving parts to keep the operators from direct contact with hazards. For example, safety wipers should be installed on a stamping machine in order that no worker's hand will get into the space, where the hand can be cut or pinched. And for open wheels or belts, they should be covered to ensure no flying parts will be released in case of a break. If the possible escape of toxic vapour is involved, a ventilation and explosion prevention system should be installed. Workers in relevant trades should be educated about the necessity of wearing masks, gloves, safety glasses and so forth as protective means (Simonds, 1973).

Engineers should be entrusted with the special responsibility of evaluating the protective equipment installed in the work place. Concern should also be given to the workers for the comfort and convenience in using the equipment. The equipment must be repeatedly tested under various conditions to ensure its performance level and to confirm that the wearing of protective equipment such as the goggles or ear-plug does not meet with resistance from workers. As has been pointed out by Colton-Craig (1997), before the protective equipment is put into use, it must go through strict laboratory and especially on-site testing for engineering control to evaluate its stress performance. For example, the failure of a respirator is caused by

> " many variables, including possible face-piece slippage caused by heat and humidity, work areas that are cramped and limited, actual workplace movement (lifting, pouring, welding, casting) and respiratory performance characteristics that are difficult to replicate in the laboratory (Colton-Craig, 1997,pp-2)".

Very often when mishaps occur, the causes may not necessarily be attributable to an error on the part of the person immediately involved in the accident, but the causes may have been the error of the designer, because a poorly designed machine may result in disasters. The workers are sometimes helpless in face of failure due to causes beyond their control. This failure might have been corrected during the research and development stages which should take account of the person's capabilities, limitations and other factors that may come into play. Industrial mishaps are frequently the results of the failure of mechanical design which has concentrated on the statistical aspect of various tests on an average person rather than the person in the actual situation in which the person's capabilities may be less. As stressed by Willie (1976, pp-96-97),

> "industrial machines maybe beautifully designed for very high speed operation which could involve their operators in accidents: For safe operation the machine must be fitted to the operator, or he will make errors."

Willie (1976,pp-96-97) further outlined the general errors, causing industrial accidents that an engineering designer should predict:

"• Failure to perform a required function (omission), a step is left out of a procedure, intentionally or inadvertently, or there is failure to complete the sequence of operations. In some instances, intentional omissions may be due to procedures that are over lengthy, badly written, or in defiance of normal tendencies and actions.
- Performing a function not required, including repeating a procedure or procedural step unnecessarily, adding un-called-for steps to a sequence, or substituting an erroneous step (omission).
- Failure to recognize a hazardous condition requiring corrective action.
- Lack of response towards contingency.
- Wrong decision as a solution to a problem that arises.
- Poor timing, resulting in a response that is too late or too soon for a specific situation."

Nevertheless, as commented by Komaki et al (1978), evidence for the casual relationship between unsafe, mechanical or physical conditions with accidents is, as yet, weak, as accidents due to these causes are relatively few.

3.2.1.5 Legislation and Enforcement and Incentive

As pointed out by the OECD Scientific Expert Group (OECD Report, 1993), legislation and enforcement set the criteria for safety to which behaviour should conform, thus making the behaviour predictable and compatible. In the case of accidents, legislation is the yardstick by which the responsibilities can be measured and the settlement of accident damage can be judged with the support of the law.

Enforcement, when accompanied by extensive publicity, resulted in a substantial increase in the percentage of drivers wearing belts with a drop in the accident rate by 50% as claimed by Ross, (1981, pp-405). Likewise, Voas, Hause and Klein (1983) found a significant reduction in alcohol-related crashes in Stockton, California following a prolonged period of 3-1/2 year of the introduction of increased enforcement and program in traffic safety.

However, the functioning of the legislation and regulation depends on the social norm that is generally accepted and observed by the majority in society. People only adapt their behaviour to legislation and regulations that are deemed to be reasonable. Regulations, thus, have to be made flexible to try to obtain their acceptance.

Legislation is more effective in our age when it addresses behaviour rather than attitudes. Legislation can be accepted within the public sphere but not in the private sphere where it may be regarded as an intrusion to privacy or human rights. The success of the administration of legislation also depends on whether it is "applied quickly and consistently without doubt, delay and confusion "(Katz, 1985, pp-621).

Furthermore, increased enforcement combined with extensive publicity, sometimes can achieve an immediate effect (OECD, Report, 1994, pp-66) but cannot usually persist for a long period. Ross (1981, pp-405) reported that the offending drivers would gradually return to their former habits such as drinking and driving, after they had survived the adverse consequences of apprehension and penalty.

As far as the use of enforcement agents is concerned, the reliance on the police in distributing public information, however, did not seem to be very successful. For example, in a study by McKnight et al (1982, pp-403), police officers gave verbal warnings to 40,000 speeders while a random half of those speeders were given booklets, providing them with both the possible consequence of future violation and what is required in safe driving. Subsequent accidents and violations later did not indicate any effect of the issue of the booklet.

Campaigns that stress the potential costs and benefits when committing the violations are especially effective with drivers of the younger groups who are likely to be affected by significant others. The perceived expectation of others and the disapproval of their behaviours from peers and other referents to abstain from violations, for example, drinking and speeding, will have important implications for them. Meanwhile, they tend to be more receptive to persuasive communication in which they are educated to know that the commission of the drinking or driving violation is under their volitional control (Parker, Manstead, Stradling, Reason and Baxter, 1992, pp-100).

Legislation and enforcement are external sanctions for disadvantageous behaviours. This negative impact can be complemented by incentive which acts as an motivator for desired behaviours. Thus "Legislation and enforcement may impose social norms to discourage risky behaviour. Incentive may focus attention on and provoke desired behaviour (OECD Report, 1993, pp-52)". Although incentive schemes may offer a stimulus for accepted behaviour as a substitute for the stark force of legislation and enforcement, they should not be abused. The more effective approach is the coordinated use of both instruments to change the behaviour to the desired direction. Nevertheless, legislation, enforcement and incentive are only part of the solution.

The biggest problem of the early approaches adopted by many behaviour researchers has been their failure to find the focus of the problem. They concentrated only on the safety system, the physical and mechanical conditions which were, in fact, the peripheral issues to occupational hazards. Instead of looking only at the safety system, attention should, have been paid to human beings for its major concern.

3.2.1.6 Summary

The studies exploring legislation, engineering failure, safety awareness campaigns, safety training and unsafe acts all have strengths and weakness in the promotion of occupational safety.

Safety management can ensure better work safety which can be integrated into the operation system. However, the great strain on company resources in terms of the demand for specialists and professionals to monitor the systems is sometimes beyond the ability of the small companies to afford.

Information campaigns are useful in influencing behaviour and attitudes by means of building on legislative actions and regulations only to a certain extent. Though this instrument may highlight occupational safety through the communication among the workers and implementation of safety intervention, it can only be used occasionally and independently from other measures. Besides, the lack of definite objective criteria for evaluation and well-controlled experimental researches, limit the scope for the development and understanding for this route to increased safety.

Educational and training programmes may equip the trainees with the skills of safe operation but the skills are merely restricted to the regular operating procedures. These skills are inadequate in dealing with emergencies unless training in handling anticipated risk is included. The positive side of training and education is the possibility of changing values and building up constructive attitudes towards work safety. However, training would sometimes lead to over-confidence that must be guarded against. Engineering or educational approaches account for the worker's physical capabilities and limitation in mechanical design. Attention is also paid to the installation of protective devices. But engineering issues are not in the control of the workers (Colton-Craig, 1997). And more important is that the casual relationships between mechanical or physical failure and accidents cannot be judged.

Legislation and regulations are inseparable from information programmes to act as a norm for the desired behaviour or attitudes reinforcement. Despite the good intention to enforce safety practice, legislation and regulations may sometimes meet with resistance and criticism, if being executed rigidly. Enforcement and incentive schemes can act as external motivators. These two instruments for behaviour or attitude are complementary in terms of achieving the final result. The drawback of these instruments is that they both originate from the same source----external reinforcement which cannot be as effective as the internal one for lasting effect.

To conclude, all the instruments above aiming at the solutions of work accidents have their positive and negative sides. The introduction of the behavioural and attitudinal approaches in the following sections by no means intends to reject the above instruments which can be helpful in safety work promotion but in comparison, behavioural and attitudinal approaches seem to be more widely accepted as significant instruments in promoting occupational safety. The next section will focus on behavioural and attitudinal approaches to improving safety at work.

3.3.0 The Development of Behavioural Approaches

Applied behavioral analysis in occupational hazard prevention owes its theoretical origin to previous researches. The concept of behavioural study derives from Skinner (1974) who reported that behaviour is the function of its consequences. Besides, as described by Sulzer-Azaroff et al (1994), the behavioural approach (performance management) deals with "behaviour occurring as a function of its relation to various prior and current events (pp.322)". Behaviour is influenced by the context of the events and antecedents (happenings that precede the behaviour) and consequences (happenings that follow the relevant performances). The requirements of a job, for example, can be regarded as the context that conditions the performance. It is assumed that the consequence will be reinforcing the performance if the frequency of an act increases in occurrence. Following the same logic, the consequence is assumed to be aversive, if the frequency of occurrence decreases. Thus the association of antecedent with the predictable consequence can become a powerful tool in influencing behaviour. In reality, antecedents can be embodied in the form of rules, instructions, or guidelines that can powerfully mediate the behaviour in the presence of means that enforces the behaviour. In safety performance, for example, the safety program will contain the antecedents----the instructions or standards of acceptability for elements of the desired behaviour paired with the consequences----the reward for accepted behaviours or discouragement for unwanted behaviour.

Sulzer-Azaroff et al (1994) exemplified the performance management theory in a programme conducted in a plant in the U.S. engaged in printed circuit board assembly (PCBA) for telecommunications. In addressing the repeated serious injuries or near-misses stemming from the overloading of the worker in transporting the PCBs between departments, feedback methods in the form of graphed percentages was delivered to one of three groups after a baseline performance assessments which lasted for several weeks. Performance goal levels were set in the meeting with the first group. Goals were reset after they had been achieved and members of the group were rewarded with incentives in food or small gifts. In a few weeks, the first group achieved 100% of the level set for safe working. The first group had received graphed feedback and reinforcement and set goals. The second unit and later the third received similar treatment. Each group showed a significant increase in the percentage of safety practices. This example reflects the powerful pairing of antecedent and consequence in behavioural management. Before anything, however, can be done to improve the safety behaviours in a worksite, an assessment is needed to look into the real safety situation of the factory to determine subsequent actions.

In addition, the external action of human beings is worth studying, since direct observation is free from the distortion that may arise from the self-reported questionnaires currently being used. And there have been a considerable number of researchers who recommend the utilization of applied behavioral analysis in the area of occupational accidents and precaution (Altman, 1970; Ellis, 1975; Smith, Anger, & Uslan, 1978). The rationale for behavioural study originates in the premise that work accidents and injuries arise from hazardous acts performed by the workers. [e.g. failure to use protective devices and taking safety measures in operation (Grimaldi & Simonds, 1975)]. However, despite the aggressiveness in behaviour explorations by the researchers, there have been setbacks during the course of investigation, since the research in occupational accident and injury prevention is an exploring process which demands persistent efforts. Below are the major concerns of behavioural investigation.

3.3.1 Major Concerns of Behavioural Investigation

3.3.1.1 Safety training

For behaviour modification, safety training as an integral prerequisite, is considered only part of the solution while the implementation of rules and regulations alone do not appear to be very effective to uphold safety performance in the absence of any reinforcement contingencies for the employees (Pierce & Risley, 1974; Quilitch, 1975). In comparison, the application of a behaviour modification approach aiming at eliminating unsafe behavior at the workplace was preferred in significantly reducing the accident and injury rates. The applied behaviour approach is meant to motivate the workers positively to perpetuate desired practices (Bird & Schlesinger, 1970).

3.3.1.2 Continuous measurement to monitor the safety system and the stages of behavioural change

The effectiveness of the behavioural approach depends considerably on the provision of sensitive and reliable monitoring of the safety system in the workplace by means of preliminary and continuous measurable behavioural observation accompanied by a regular recording system (Smith, 1976; Komaki, Barwick & Scott, 1978; Reber and Wallin, 1983). A safety system helps link human beings and their environment in harmony. And safety can only be safeguarded by accident prevention and safe behaviours. To achieve this end, there is a need for recognition of and knowledge about danger. Therefore, the integration of the safety recognition and knowledge in the system can only be made possible with the use of a continuous monitoring and measuring system (Hoyos, 1995, pp-248). Nevertheless, behavioural change does not come overnight. It involves a series of stages in which different types of information and assistance are needed to help the person move from one stage to another. The process of behavioural change as pointed out by Dejoy (1996) [(relaying Prochaska & DiClemente's (1992) study)] covers five principal stages: precontemplation, contemplation, preparation, action, and maintenance.

Precontemplation refers to the initial stage in which obvious change of the subjects cannot be detected, when the subjects are not consciously thinking about the change of their behaviour.

And soon as the subjects start to reflect seriously upon their changing in a short period of time, they have entered the contemplation stage.

Preparation ensues when the person has an intention for change in the very near future with an action plan and has moved forward a small step towards change in terms of both internal and behavioral dimensions. What follows is the action that will normally last for six months before maintenance is required, extending from action till termination. It would really help, if the researcher can identify the various stages of the change process, so as to implement effective strategies such as information, consciousness-raising activity, stimulus control and social support. These strategies that are crucial respectively for facilitating the person's move from one stage to the next (Di Climente et al, 1991).

3.3.1.3 Behaviour modification

Persistent efforts have been made in behavioral studies to apply modification strategies to match the different stages of psychological change of a person (Zohar et al, 1980; Feller, D and Sulzer-Azaroff, B, 1984b; Carter and Menckel, 1985; Alavosius and Sulzer-Azaroff, 1985). The usage of reinforcement contingencies to increase earplug usage is an example (Zohar et al, 1980).

In an attempt to evaluate the change of workers' behaviour in relation to the usage of personal ear protectors, a feedback process was used in Israel by Zohar et al (1980) in a large metal fabrication complex that employed approximately 2000 workers. Two departments with equal numbers of workers, around 82, were chosen. Both departments were predominately engaged in lathe-type operations. The workers in one department served as the treatment group while those in another as a control. After a baseline observation which recorded the frequency of earplug use in both the experimental and control departments for a period of one month with a behaviour sampling scheme, intervention in the form of lecturing was given to workers from both groups for hearing conservation in a noisy environment. The general use of ear protectors was demonstrated while the experimental group was given additional knowledge about the purpose and process of the test. The audiometric testing and feedback process lasted for one month before a five-month follow-up in observations ensued in order to detect the possible long-term behavioural change. The subsequent result indicated that the feedback process had evoked a significant increase in the use of ear protectors in the experimental group with the absence of similar change in the control group. The follow-up period even witnessed a continuous rise of the use of earplugs at final 85-90% level which showed the significant lasting positive effect.

Other reinforcement contingency studies have resulted in the reduction of coal-mine ventilation violations (Rhoton, 1980), the increased application of eye protective equipment (Smith et al, 1978) and the reduction of safety hazards (Sulzer-Azaroff, 1978; Sulzer-Azaroff & Santamaria, 1980).

Meanwhile, the adoption of behavioural approaches to safety has been supported by evidence of an apparent decrease in accident rates. A successful example was in the appropriate operation of patrol cars (Larson, Schnelle, Kirchner, Carr, Domach & Risley, 1980). A positive support for a behavioural approach, though indirect, was found in the study of Komaki and her associates, utilizing a combined training and feedback to reinforce desired behaviours in two organizations (Komaki, Heinzmann, & Lawson, 1980; Komaki, Collins, & Penn, 1982). In another study, similar positive results confirmed the improvement in accident rates achieved by feedback and antecedents such as goal setting (Kim & Hamner, 1976).

3.3.2 The Basic Stages in a Behavioural Approach to Work Safety

In order to understand the features of a behavioural approach, there is a need to examine each of the underlying key contributing elements. The sequential stages of the approach normally adopted by researchers are shown in Figure 3.2 to indicate their connection (Dejoy, 1996).

risk assessment → baseline setting → goal-setting → intervention → feedback →

Figure 3.2. Stages of Behavioral Approach (Goal Setting and Feedback)

According to Dejoy (1996), a behavioural approach normally starts with risk-assessment to find out the real safety status of the work-place, followed by a baseline setting to collect data on existing performance. Goal-setting and intervention with feedback follow as a treatment to be implemented. As indicated in the above figure, the behavioral approach involves a combination of intervention and reinforcement, along with other key components incorporated into the approach (Sulzer-Azaroff et al, 1994). For a more in-depth understanding, the following procedures will be brought into discussion:

i) risk-behaviour assessment

ii) baseline setting

iii) goal-setting

iv) intervention feedback

3.3.2.1 Risk-Behaviour Assessment

Despite people's awareness of preventive measures that are closely linked with the assessment of the safety conditions in an organization, paradoxically, many behavioural techniques taught for industry have never been measured by the management, nor have they been quantitatively defined (Feeney, 1972). Likewise, it is seldom the case that the with-in-job performance of the employees is audited (Feeney, 1972). And as a result, the management is blind to the real safety status in the workplace: whether a particular hazardous behaviour has occurred or not is unknown (Feeney, 1972). That means without the audit of the employees with regard to their safety performance, the management of an organization is often not in a position to articulate the real on-the-job truth of the performance deficiency in terms of work safety.

Therefore, as part of the integrated safety system in the workplace to sustain safety behaviour, risk assessment by the management is a must before any form of intervention tailored for the condition of the targeted site is introduced (Eves, 1994;

Weinstein, 1996). Gagne, Briggs & Wager (1988) and Pierson et al (1996) held a similar view that, prior to the appropriate instructional system being designed and developed, a thorough evaluation and analysis of the safety intervention needs of the workers is imperative in determining their needs.

In risk-behaviour assessment, a review of the past records of work accidents and interviews with the work force will give a clue to the location of trouble spots. For example, from the record, the researcher will be able to analyze precisely the nature of the job during the occurrence of the accident. A detailed documentation of the respective accident, preferably from the original record of accidents can reveal the frequency and severity of the cause of the accident together with the corrective actions under scrutiny. For instance, details such as the type of accidents within each department with the description of the position of the body injured should be specified. The description may help categorize the accident, based on the severity, so as to identify the hazardous behaviours and causes contributing to the accidents (Cooper, 1994). Cooper's study has demonstrated a good example of how risk assessment can help diagnose safety conditions in a factory and to decide the appropriate intervention to be made later.

Cooper (1994) conducted a study in a multi-departmental factory, manufacturing cellophane film with approximately 540 employees. In an attempt to help improve safety in the plant, he reviewed the factory safety record in the previous two years to identify possible contributory factors to accident causation and classified them by observable behaviours or situations that were reflective of safe and unsafe events. The accident data sorted by department were further sub-divided by the place of injury on the body, so that when the major types of accident had been located, the types of job connected with the causes of accidents were identified. The records were further examined to determine if the accidents were caused by individual behaviour or by the situation. That is whether the accidents related with human errors or with environmental issues such as the poor physical setting or mechanical malfunction had to be analyzed.

Efforts were also made to confirm if accidents were more frequent with particular individuals. Subsequent attention was paid to the specific behavioural causes. It was found that accidents were frequently associated with forklift drivers who often hurt their thumbs because they put their hands on a knob on the steering wheel. The operators who thread the cellophane film through slitting machines often cut the back of their hands on circular knives, when they placed the spare knives in the way. The operators in the metal casting department often hurt themselves on the blades because they did not place the blades in the proper places. Likewise, the maintenance engineers often allowed fluids to be squirted into their eyes because they failed to wear eye protection during unloading valves. Both the safe and unsafe behaviours classified were useful for developing a departmental checklist of critical behaviours. Items on the checklist were later verified with the supervisors and workers to ensure the validity in a pilot study on the causes of work hazard.

Likewise, by examining the turnover of personnel at supervisory level, the modification of production arrangements in meeting deliveries and the change in environmental settings, it may help understand the direct or indirect impact on workplace safety (Sulzer-Azaroff, 1987; Eves, 1994; Cooper, 1994; Minter, 1996).

The turnover of supervisors affects safety management. The rush for deliveries creates more opportunities for accidents while a change in environmental setting may have physical irritation on the workers. In addition to consulting the records, interviews with the employees at each stratum of the company, such as the piece-worker, foremen or fore-ladies, supervisor of quality assurance, factory manager and man-power personnel will help reflect the perceived strengths and weaknesses of their safety system.

Some unreported potential hazards arising from dangerous practices, however, would not have been revealed by individual description if not for the anonymity guaranteed in the structured interview (Sulzer-Azaroff, 1987). Sulzer-Azaroff (1987), for example, uncovered some dangerous episodes reported by the workers in his study. Some forklift operators sped around the corners to scare their peers on purpose while on other occasions, some workers were seen taking short cuts by dangerously climbing over conveyor belts or doing the cleaning on revolving machines. These hazardous episodes would not have been revealed, if not for the anonymity guaranteed by the research in the interview.

The experienced operators interviewed may give the researchers inspiration for the sort of intervention suitable for the particular situation in the worksite (Sulzer-Azaroff, 1987). Sometimes the researcher, however, is not fortunate enough to obtain the desired accident reports which may be either incomplete or totally absent to provide information concerning the antecedent conditions of the accidents. If this is the case, an interview with each stratum of the employees can be very helpful and may be the only source of information.

In the case of Weber's (1992) research with a farm machinery manufacturing company, attempting to investigate the direct relationship between a behavioural measure of safety and occupational injury rates, they were unable to locate complete company records on accidents. They had to interview supervisors and employees of each department to provide additional behavioural items other than those identified in the company accident report, according to the safety practices advocated by OSHA and the American National Standard Institute (ANSI), the organizations in occupational safety in the States.

The supervisors working on the 'first line' have the direct day-to-day contact with the workers and machines. Being familiar with the working condition in the workplace, supervisors are the persons who most understand the safety conditions and what kind of safety and health program should be implemented. As emphasized by Weber,

> "the supervisors as the lowest level line manager, can best affect safety performance by formulating safe work routines, providing proper training and coaching, ensuring maximum placement of personnel, motivating employees and adhering to high standards of housekeeping and machine maintenance (pp-351)".

Despite the outstanding contribution of the supervisors in leading the workers, Weber's statement, tends to exaggerate the role of the supervisor in safety promotion, because other variables such as the attitudes of the workers towards work safety is beyond the control of the supervisors. In the meantime, other effective progammes appropriate for the workers, for example, intervention in safety awareness with feedback (Hoyos, 1995) developed by safety researchers are still needed.

In short, as emphasized by Sulzer-Azaroff et al (1994), the selection of the most effective corrective techniques cannot be successful without first finding out the relevant antecedents and consequences directly related to the conditions and acts implicated in accidents and near-hits (dangerous behaviours or situations leading to accidents) (Carter and Menckel, 1985; Sulzer-Azaroff et al, 1987).

After understanding the safety status of the worksite, the researcher has to determine what necessary measures are likely to be most effective. The researchers should concentrate more on the before-the-fact measure rather than an after-the-fact result such as frequency and severity rate to analyze safety performance; this goal can be attained by contacting the employers who may provide them with some effective strategies for accident precaution (Weber, 1992).

In the above examples, the importance of risk assessment in a behavioural approach has been demonstrated. Another critical component of a behavioural approach is the setting up of a baseline. This will be discussed in the section to follow.

3.3.2.2 Baseline Setting

In the behavioural approach to accident prevention, ethics and reasons of economics make it difficult for the researcher to collect data over an extended period of time and to identify the pattern of the accidents that will be tested against the concurrent behavioural performance. The difficulty also arises from the unpredictability of lost-time accident and injury (Grimaldi, 1970; Jacob, 1970; Tarrants, 1970). The more feasible alternative to a long observation period is to observe the frequency of behaviour occurring in a baseline period (Reber, 1983).

The baseline data reflect the level of performance before or in the absence of any treatment or intervention (Hersen & Barlow, 1976; Komaki, 1977) and thus provide an assessment of the current performance levels as interpreted by Reber (1983, pp-70): "Baseline performance should be an extrapolation of previous behavioural performance provided. No intervention had been introduced ". The baseline data refer to the average figures from the observations on the frequency of occurrence with regard to the targeted behaviours of the observed before any treatment or interventions can be applied within a specified period of time. The safety performance data for each department is obtained after each observation by dividing the number of employees working completely safely by the total number of departmental employees observed and multiplied by 100 (Komaki et al, 1978; 1980). In the 'all or none' theory for measuring the safety performance (Komaki et al, 1978), a worker may have been performing in accordance with the operating rules. However, if he/she violates just one of the safety items, he/she is still considered not working safely, as there still exists a possibility for an accident to occur.

There are two types of baselines: the single and the multiple. To set up a single baseline, observations are conducted by the observer on the behaviour of the workers in the relevant department at a session of 10-20 minutes everyday or every shift. It is recommended that a minimum of four weeks data should be collected from the respective department of the organization to formulate the baseline figure (Cooper, 1994). This length of time for baseline observation has been proved to be feasible in the workplace.

As far as the multiple baseline is concerned, Komaki et al (1978, pp-439) successfully used the design in their study with a view to improving worker safety in two departments in a food manufacturing plant. In the study, baseline data were collected in both departments. After the duration of 5 and 1/2 weeks observation (19 observations), an intervention was administered to the first department (Wrapping Department) and after the 13 and 1/2 weeks (49 observations), a similar intervention was introduced to the other department (Make-up Department). The intervention in the Wrapping Department lasted for 11 weeks and that for the Make-up Department stayed for 3 weeks before a reversal phase was instituted in each department respectively (Figure 3.3):

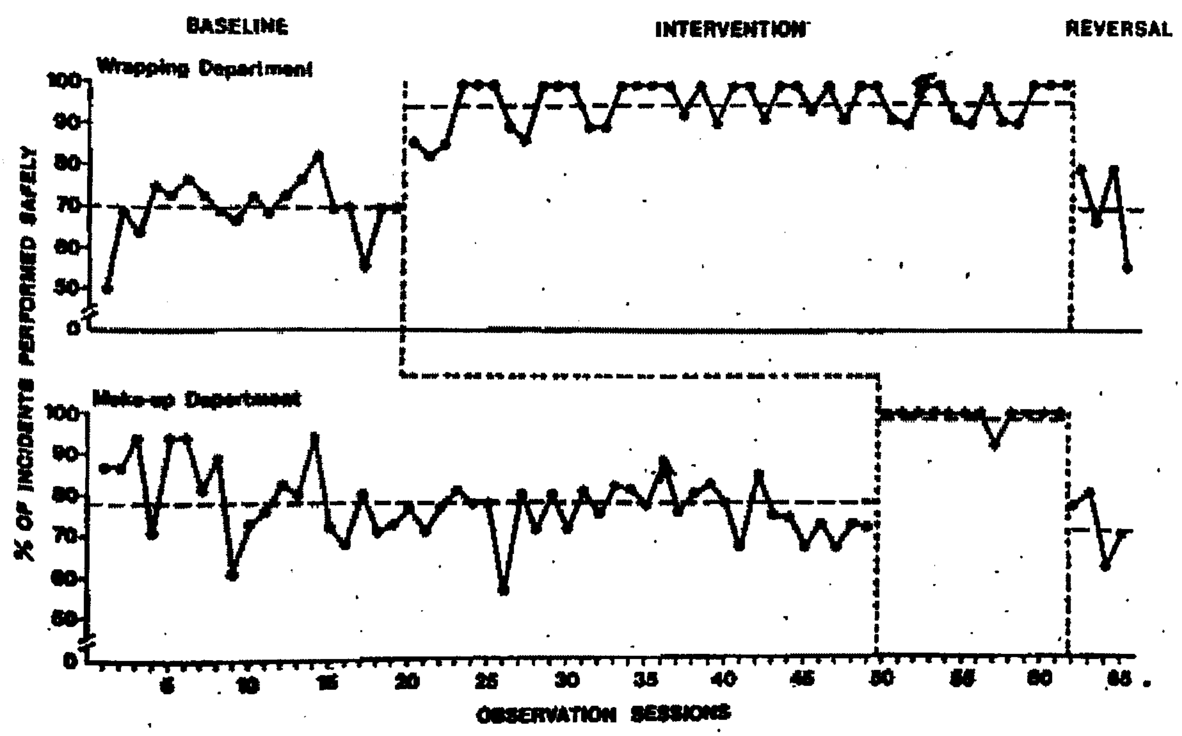


Figure 3.3 Multiple Baseline By Komaki (1978, pp-439)

The result obtained from the multiple base-line in Komaki et al's (1978) study made it possible "to draw causal conclusion about the efficacy of the intervention without traditional control groups (pp-443)".

Another multiple baseline design was used Lingard et al (1995, pp-28) in their research to improve safety performance on construction sites in Hong Kong. At the start of the research, data were collected for four different performance categories (housekeeping, access to height, bamboo scaffolding, personal equipment) at the same time. After an eighteen-week baseline had been completed, an intervention was introduced to three of the categories at three different intervals while the fourth was retained as control with no intervention involved (Figure 3.4).

baseline (Department A)	intervention		reversal	
baseline (Department B)		intervention		reversal
baseline (Department C)			intervention	
baseline (Department D)				

Figure 3.4 Multiple Baseline By Lingard et al (1995, pp-28)

Thus, as demonstrated in the examples above, no fixed length for the baseline has been mentioned in either the single or multiple-baseline periods. The length of baseline should be subject to the real situation allowed, before an intervention is introduced in the single baseline design or to the first department in the multiple-baseline design. Nevertheless, it is certain that the multiple-baseline itself is a powerful component of the behavioural approach, regardless of the duration of time used, and especially in the multiple-baseline design, the effect of control can be achieved. As argued by Lingard et al (1995, pp-28),

> "a multiple baseline design allows causal inferences to be made without relying on the traditional control versus experimental group comparisons. It is particularly useful in applied settings in which random assignment to control and experimental groups is difficult to achieve."

For example, the limitation of the workplace such as the metal work that would not accommodate a control group for randomized allocation of the samples to different groups. In this case, the multiple baseline design can be used to eliminate the sources of internal invalidity such as history, maturation and statistical regression

(Komaki, 1977). The design is based on the assumption that it is not likely that another extraneous event would influence two different departments equally at two different points in the production. When observations start with two departments at the same time but the time for the treatment given to each department differs and if maturation is involved, improved performance would be expected as a function of the passage of time. That is when change or improvements come only after the introduction of the interventions, other possibilities related with internal invalidity can be ruled out (Komaki et al, 1978).

As an integrated behavioural approach, a powerful component that follows the baseline period is goal-setting which is usually combined with feedback as an effective behavioural manipulating technique.

3.3.2.3 Goal Setting

Because the use of goal-setting and feedback techniques is highly recommended by Marsh (1995) for motivational reasons, it is worth attempting to understand in detail these two key behaviour-based concepts.

In applied behavioural analyses, goal-setting has been regarded as a necessary companion to feedback. A goal implies what an individual is attempting to accomplish. It can be the object or aim of an action (Locke et al, 1981). The concept of goal setting is included in the domain of cognitive psychology and pursued by behavioural psychologists in the studies of cognitive behaviour modification (Meichenbaum, 1977).

Goal setting may be the immediate means for modifying human action but the casual relationship between goal and action has not been established, owing to the possible error people may make in performing their work and inability to achieve the objectives.

Lingard and Rowlinson (1995) explained that goal setting is considered a motivation. It derives from the premise that there is a close relationship between performance and individuals who set the goal for themselves or accept the goal from others. Lingard and Rowlinson (1995, pp-27) mentioned that "an individual will be satisfied or dissatisfied with performance to the extent that performance matches the goals accepted by those individuals". When an individual fails to accomplish a goal, dissatisfaction will result and in order to alleviate or eliminate his/her dissatisfaction, he/she will set a further goal to improve performance. And interestingly, the study of Lingard and Rowlinson (1995, pp-27) has revealed that anticipated satisfaction merged with a performance goal is inseparable from future performance. Meanwhile, an over-whelming number of studies have confirmed the valid premise that the harder the goal is, the better the performance will be, as long as it has been accepted. In addition, presumably, specific "hard goals" will result in better performance outcomes than general " do your best" goals (Locke et al, 1969-80; Lingard and Rowlinson, 1995). The level of difficulty and impact of the goals have been discussed by Locke et al (1981). They thought that harder goals would incite greater efforts than easier ones.

Nevertheless, the goals to be set must be attainable and accepted by the workers. Erez and Zidon (1984) hypothesized in their study that goal acceptance can moderate the relationship of goal difficulty with task performance. The relationship between the goal and task performance is positive and linear for acceptable goals and on the opposite side, there is a negative and linear relationship with a rejected goal. In an experiment, subjects were asked to complete a perception speed test which required them to determine how many digits or letters in a row were the same as the circled one on the left of each row. Their performance was determined by calculating the number of numerals and characters correctly circled within the allocated time. One point was given to each correct circle, plus one additional point for correctly recording the numbers in each row in the blank space to the right of each rows. The sum of the correct circles and correct recordings thus made up the total performance score. In the experiment, 140 subjects were randomly assigned to a two-phase experimental condition, the specific goal difficulty was gradually increased from Trial 1 to Trial 7 (from Trial 1-very easy to Trial 7- very difficult) and a control group (n=36) given the general 'do your best' goal. Each goal was assigned at the beginning of the Trial. Subjects were asked to underline the row defined as their goal (eg. The 10th in Trial 1, the 14th in Trial 2), and to answer two questions (one on subjective goal difficulty and one on goal acceptance) before the start of the trials. The task was to determine (within a two-minute trial), the number of digits or letters in a row being the same as the circled one to the left of each row. The above hypothesis on the relationship between goal acceptance and goal difficulty with task performance was supported in the result. It is thus highly recommended that a meeting be held for the fore-men prior to the goal setting to discuss the procedures for the selection of goals by the participating workers. An outline depicting the proper way to guide workers to select challenging but realistic goals should be provided to all supervisors (Fellner & Sulzer-Azaroff, 1986). Preferably in order to secure maximum responses from the workers, a list of possible goals fabricated from past experience can be provided for selection by the researcher (Fellner & Sulzer-Azaroff, 1986). The researchers or supervisors should be reminded that during the meeting, the workers be encouraged to actively opt for the goals. Participative goal-setting is imperative for bringing about most effective results in improved safety performance, for example, in the U.K. construction sites (Cooper, 1992).

Participation from the workers can surely encourage the voluntary commitment from them to secure an improvement in task performance. However, it is a little discouraging to find in Hong Kong the conservativeness of the Chinese characterized by their reluctance to voice personal opinion about goal setting, leaving the final decision with the site project manager, factory manager or senior management (Lingard, 1995). In Lingard's (1995) study on the construction sites with combined goal setting and feedback to test the effectiveness of using these techniques to improve safety performance, he conducted a goal setting meeting at the sites where he invited workers and the staff to participate to suggest realistic goals. After a discussion between workers and the management, a goal was finally set. However, Lingard felt that the meeting was only a formality, because in goal setting meetings in Hong Kong, the final decision was in the hands of the site project manager or senior management attending the meeting, although the workers did discuss the goal with the management. The workers did not try hard to defend their rights. During the research, goal setting was set with only one site but no project managers participated in the other two site meetings (the "access to heights" and the "bamboo scaffolding" goal setting sessions) reflecting the lack of interest of the site managers in the research following the initial intervention. The project managers or senior management in Hong Kong are not open to input from workers in the meeting, because of their intolerance for challenge from the workers to their power and this concern for authority is part of the characteristic of the Chinese culture. The example demonstrates that although a supportive atmosphere is important in safety management, the existence of this atmosphere is not in the control of the researchers. This points to the fact that some limitation of cooperation from certain management in the field is possibly unavoidable.

3.3.2.4 Feedback

In a behaviour modification process, feedback is effective in the motivational process and many learning theories, such as goal-setting (Locke & Latham, 1990). Feedback can be defined as "information provided to individuals concerning some aspect of their performance on a task (Young & Kline, 1996)." As far as the format of feedback is concerned, the devices can be various. Either posted charts (Fellner & Sulzer-Azaroff, 1984a) or posted charts accompanied by comments and praise (Rhoton, 1980) are commonly applied. Other aids include copies of observational recording (Sulzer-Azaroff & De Santamaria, 1980); written summary notes (Fox & Sulzer-Azaroff, 1984), notice of accident or injury rates (Kim & Hamner, 1976) and audiograms delineating the degree of temporary hearing loss (Zohar, Cohen & Azar, 1980).

Feedback greatly helps arouse people who have difficulty to perceive the existence of mistakes. By being shown or told about the observed problems, it is hoped that they are able to correct their errors. It so happens in workplaces that because of people's inability to spot mistakes, they do not know that problems exist right under their eyes. Thus, instead of problem solving, feedback diagnoses the possible existence of problems and mirrors their magnitude (Feeney, 1972).

Feedback, as a reinforcement strategy, is even more powerful than goal-setting which, in fact, always comes with the former as a combined stimulus (Sulzer-Azaroff et al, 1987; Dejoy, 1996). Feedback, when used as a non-monetary consequence, has been proved to be one of the most effective motivational strategies being welcomed by both employees and employers (Hegarty, 1974; Leamon, 1974; Adam, 1975; Catano, 1976; Kim & Hamner, 1976; Nadler, Mirvis & Cammann, 1976; Sulzer-Azaroff, 1978; Cooper, 1994). In a three-shift production plant in the U.K., Cooper (1994) applied goal-setting and feedback techniques to the site which employed over 540 people in 14 departments. After a participative goal was set for the critical behaviours within each department, performance feedback [the response given to the workers concerning some aspects of their performance on a task (Young & Kline, 1996)] was given graphically to each department weekly. The combined goal-setting and feedback demonstrated its effectiveness in achieving obvious improvements in safety performance, having significantly reduced corresponding accident rates in the plant. Referring to Cooper's (1994) study above, for example, the progress in safe behaviour level made in the casting department had risen from the level of 22 percent in 'week one' to 68 percent. Similarly, the safe performance in the engineering department, starting from 40 percent, had almost gone over the goal level of 85 percent near the end of the intervention. As can be seen, goal-setting and feedback can be mutually supportive to achieve significant results. It is therefore preferable to include both strategies in any intervention. In other studies, reinforcers such as social recognition, praise, and more conventional rewards and incentives, as well as reinforcement protocols have been used for promoting safety performance (Smith, Anger & Uslan, 1978; Zohar, Cohen, & Azar, 1980; Dejoy, 1986).

The primary purpose of introducing feedback in a workplace is to convey the message to the employees that their performance is so appreciated by the company that it is constantly measured. Feedback tells the employees what they are doing well (Feeney, 1972), thus enabling them to assess how much more effort is needed to attain a goal (Lingard, 1995). Feedback, as a behavioural change agent, is seen to be especially powerful when used for publicly posting of group feedback from which all the employees in the relevant department can determine if their collective efforts have fruitfully attained the goals (Cooper, 1994).

Feedback is essential in motivating behaviour in that it mirrors the result of the performance. Locke and Latham (1990) asserted that it is feedback that attaches persistent significance to goals on performance. Feedback can foster self-protective actions and motivation (Dejoy, 1996), when its content is comprehensible and achievable to the employees who are consciously reacting to the continuous stimulus---feedback (Colarelli, Dean, & Konstans, 1987). As has been mentioned before, the increased use of ear protectors in Zohar et al's (1980) study illustrated how feedback had strongly motivated individual workers to overcome their resistance to the using of ear protective devices and triggered the wanted behavioural change. Before the presentation of feedback, the management had tried to encourage the workers to use earplugs through group lectures, poster campaigns and talks with individual workers but without success. It was not until the feedback on the advantages of wearing ear protection was introduced that the use of earplugs drastically increased. The feedback demonstrated to the workers that without earplugs, there were large differences between the hearing levels detected before and at the end of the work-shift and in a direction showing more noise-induced TTS (Temporary Threshold Shift) temporary hearing loss. The feeding back of the TTS information to individual workers who were expected to wear personal ear protectors in a known noisy work-site, convinced them of the benefits of the protection and prompted more users.

Komaki et al (1978) also confirmed that frequent feedback was essential to ensure effective improved safety performance. In their investigation of the effect of a behavioural approach to pinpointing and reinforcing safe performance in a food manufacturing plant, they utilized frequent feedback as the low-cost reinforcement for maintaining the desired behaviour subsequent to an intervention. After the presentation, whenever observers collected data, they would record the data on the graph the percentage of events performed by the group as a whole, thus reflecting to the individuals feedback on their safety performance. There was a marked improvement in the workers' safety performance that rose from 70% and 78% to 96% and then to 99% in observing safe protection. Feedback, as a reinforcer for desired behaviour, is able to motivate an individual for a further attempt, when an individual finds the feed-backed improvement on performance satisfying. The consciousness from the individual reported improvement being appreciated by their superiors will reinforce the satisfaction. Lingard (1995) remarked that " the performance feedback may act as a reward which elicits further improvement".

In the workplace, to establish an effective feedback system the following objective functional criteria should be observed as recommended by Feeney (1972):

a) One of the objectives is to investigate people's view about their performance and to diagnose their actual performance by collecting raw data that will be brought into comparison with those of their perceptions. People always perceive their performance at a high level but it actually turns out to be lower than their expectation (Young et al, 1996). Further, from the statistical perspective, feedback must be measurable to provide the subjects with reference in relation to performance in a previous similar time frame. It should also be borne in mind that feedback must be objective, delivered according to an observational code formulated by outside observers (Komaki et al, 1978).

b) After objectively finding the performance and the things to be improved in the individuals by consulting the records in the company, it is imperative that the individuals concerned must be informed. That means the feedback should be targeted at the right person. Conveyance of the feedback to the relevant department of the company is thus important, as the response of performance is only meaningful to the people who need it. The workers, foremen and intermediate management levels are also the addressees of the feedback.

Group feedback can be delivered to the relevant department on a weekly basis, as in Cooper's (1994) study. In addition, other feedback on the individual's work performance during the routine observation done by the researchers or the management must be provided at the right time; this should be preferably done right after the executed behaviour has been detected. Instant feedback is more likely to be accepted and to be received positively by the workers (Minter, 1996). For example, an operator of the stamping machine must be warned against any hazardous actions to bypass the protective arms on the machine. A feedback provided in a timely fashion by the management can alert the operator of the seriousness of the latter's actions.

The positive message in the feedback to provide encouragement on the safe behaviour in the workers is vital in implying favourable attention and recognition of the accomplishments of the employees from the company. This positive approach is in sharp contrast to the traditional practice adopted by the employers. Prior to Young et al's (1996) investigations, the result in the study of Brockner, Derr, and Laing (1987) reported that negative feedback is likely to curb the enthusiasm of the employees who tend to doubt the certainty of acquiring ensuing positive results with increasing effort. Negative results would often lead to reduced efforts, as a defense mechanism to justify their failure, probably due to the lack of efforts rather than incompetence (Jagancinski and Nicholls, 1990). A similar view was held by Sulzer-Azaroff (1987) who implied that negative consequences such as non-positive feedback (reprimands, fines, penalties and adverse personnel actions), though may be helpful in reducing undesired behaviour, can also deter people from resorting to the preferred alternative actions that are available.

3.3.2.5 Intervention

With regard to the improved frequency of pinpointed safe behaviours demonstrated in the research of Komaki and her associates, the significance of the intervention (training) cannot be overlooked (Komaki, Heinzmann, & Lawson, 1980; Komaki et al, 1982).

Intervention is central for increasing safe practices (Fellner et al, 1984b; Sulzer-Azaroff et al, 1994). Prior to an intervention, the target workers will be asked to attend an orientation session in which the researcher will have to explain to them the purposes and contents of the forthcoming intervention. The orientation sessions are also meant to create a state of readiness in the learners, to establish the urge to learn (Minter, 1996).

During the intervention, workers of the departments involved in the study will be exposed to knowledge intended to help them build up safety practices. For example, in a metal work context, an intervention in the form of training will teach the workers to learn how to discriminate between safe and unsafe practices, in a thirty to forty-five minute meeting, in which, the employees were exposed to slides (35 mm transparencies) corresponding to items on the observation code, depicting the safe and unsafe acts related to the category of performance (Komaki et al, 1978). After viewing the unsafe practices, the employees will be asked to describe verbally or in written form in each scene the unsafe acts that will later be replaced by safe ones in the same context. The employees will then be asked to keep in mind the safety points illustrated in order that they might have criteria to follow for safe performance in the future (Komaki et al, 1978).

To conclude, Komaki et al's (1978) presentation with slides and self-discovery strategies in the training can help the workers form a clear picture of the distinction between safe and unsafe behaviours on which they can model in their subsequent performance with the standard for the safe behaviour internalized.

Alongside the above studies to combat occupational hazards, an attitudinal approach to improving safety is often considered as an alternative. It is closely associated with behavioural modification based on the argument by Ajzen & Fishbein (1977, in OECD Report, 1993, pp-23). They argued that an attitude towards "a specific act in a given time in a specific context will be predictive of the actual performance of that act at that time and in that situation." The sections below will investigate the strengths and weaknesses of the attitudinal approach and its controversial relationship with the behavioural approach.

3.3.3 The Development of Attitudinal Approach

The attitudinal approach is important in safety research because of its impact on behaviour modification. As concluded by the team of researchers in the OECD Report of 1993 (pp-76), attitude modification in safety research has been recognized as being increasingly influential. Though attitudes do not necessarily induce behaviour formation in all situations, "a stimulation of existing attitudes may give support for safe behaviour." It is thus worthwhile to investigate the "attitude approach" in relation to safety behaviour.

3.3.3.1 Definitions of Attitudes

Though there is no universally accepted definition of attitude, Olson & Zanna (1993) outlined three classes of general definitions (OECD Report, 1993, pp-26):

a) In terms of evaluation, attitudes guide the individual along in the evaluative response----"to evaluate a particular object with some degree of favour or disfavour" (Eagly & Chaiken, 1992).
b) In terms of cognition, attitudes are characterized as "knowledge structure" (Anderson & Armstrong, 1989).
c) In terms of affect, it is "associated with a person or an object" (Pratkanis & Greenwald, 1985).

However, the common-known definition of attitude is related with its distinctive feature of double polarity in direction. That is attitude is characterized by its provocation in behaviour as remarked by Katz, (1985):

> "Attitude is the predisposition of the individual to evaluate some symbol or object or aspect of his world in a favourable or unfavourable manner."

In fact, this classical view was first held by Bogardus (1931, pp-52) who stated that:

> "An attitude is a tendency to act toward or against some environmental factor which becomes thereby a positive or negative value".

3.3.3.2 Research in Attitudinal Approach

Research in attitudes has a long history since the early part of the twentieth century (Thurstone & Chave, 1929). Thomas and Znaniecki (1918) instituted the concept of attitude as a permanent and core feature in a study of Polish peasants. According to Thomas and Znaniecki, attitudes are individual mental processes used to understand each person in the social world in terms of the person's actual and potential responses. Attitude was also considered by Thomas and Znaniecki a "state of mind of the individual toward a value". Thus the love for money, the worship for film stars and hatred for the enemies can all be regarded as attitudes (pp-21).

Thomas and Znaniecki (1918) stated that attitudes can be divided into natural attitudes (directed towards the physical environment) and social attitudes (directed towards social objects). In 1925, Faris further refined the terms used in attitude research by proposing distinctions between conscious and unconscious attitudes, between mental and motor attitudes, between individual and group attitudes and between latent and kinetic attitudes.

The concept of attitude has formally come into being after the first half of the century when the tripartite model distinguished among the constructs -----affective, cognitive, and cognative (policy orientation)----of attitude (Smith, 1947; Krech and Crutchfield, 1948; Kramer, 1949; Chein, 1951). However, the tripartite model had not been substantially applied to research as a major treatment of attitude theory until the 60s (Katz & Stotland, 1959; Rosenberg, Hovland, McGuire, Abelson, & Brehm, 1960; Insko & Schopler, 1967). Despite the tripartite model being accepted in the textbooks, the multi-component view of attitude did not have great impact on all attitude researchers (Breckler, 1984, pp-631). Breckler did not agree that all attitude components are formed through cognitive process. He argued that

> "Attitude affect may not have verbal or cognitive antecedents. Many behaviours and actions tendencies may also be established through nonverbal or non-cognitive

> mechanisms. Thus the three components of attitude are distinguishable in terms of their developmental roots".

Breckler in his evaluation of a model to provide support for the tripartite model of attitude structure concluded that affect, behaviour and cognition are distinguishable components of attitude. It is thus important for the attitude researchers to specify which of the three components is to be measured, because the statement "measuring attitude" alone tends to be too general and ambiguous.

The concept of attitudes was also summarized by Katz (1985, pp-593):

> "Attitude is the predisposition of the individual to evaluate some symbol or object or aspect of his world in a favourable or unfavourable manner. Opinion is the verbal expression of an attitude, but attitudes can also be expressed in nonverbal behaviour. Attitudes include both the affective, or feeling core of liking or disliking, and the cognitive, or belief, elements which describe the object of the attitude, its characteristics, and its relations to other objects. All attitudes thus include beliefs, but not all beliefs are attitudes. When specific attitudes are organized into hierarchical structure, they comprise value systems. Thus a person may not only hold specific attitudes against deficit spending and unbalanced budgets but may also have a systematic organization of such beliefs and attitudes in the form of a value system of economic conservatism".

3.3.3.3 Attitude as a Motivator

The behaviour of an individual is mainly directed by intention that is defined as one's own subjective probability that he or she will perform a given behaviour (Bentler and Speckart, 1979, pp-453). The behavioural intention is in turn controlled by a) behaviour-oriented attitudes, which consist of beliefs about the consequences of performing the behaviour and the evaluation of those consequences, and b) subjective norms, which are determined by the normative beliefs about what others think and the individual's motivation to comply with those perceived wishes (Fishbein & Ajzen, 1975). The behavioural intention as stressed by Bentler and

Speckart (1979, pp-453) is characterized as the "best possible predictor of a person's action".

The relation of attitude with safety and health had not been given due attention until the 1980s. Possible links had been found between attitudes and personality traits and the links would appear to make the modification of attitudes possible (OECD Report, 1993).

In 1980, Weinstein described the generally held view towards the occurrence of accidents as “unrealistic optimism”. The distorted judgement and perception of some people convinces themselves of the personal invulnerability and the myth that accidents do not happen to them. Their attitude of unrealistic optimism has its consonant term described by Perloff & Fetzer (1986) as “illusion of unique invulnerability” which is referred to as people's affective belief that accidents always happen to others (Eagly & Chaiken, 1992).

Other research revealed people’s selective acceptance of information that supports their current attitudes rather than others deviating from their pre-existing attitudes. Whether a message will be accepted in publicity campaigns often depends on its compatibility with the receivers’ characteristics that include selective attention and perception (Eagly & Chaiken, 1992). Eagly and Chaiken pointed out that, in order to bring about an attitudinal change, attention should be paid to the affective component of attitudes such as the optimism of the view that accidents seldom occur.

Furthermore, the attitudinal reference of Fishbein and Ajzen (1975) termed as theory of reasoned action echoed by Donald's (1994) perspective is important in occupational safety for understanding the attitude behind the safe or unsafe acts. This theory states that people's behaviour towards work safety is partly affected by their perception of the people around them. Therefore, it is not possible to examine thoroughly people's attitudes towards work safety without first investigating the psychological backgrounds of the workers as well as the social and organizational context in which their behaviours and attitudes are shaped.

3.3.3.4 Contributing Factors for the Formation of Attitudes towards Occupational Safety and Health

3.3.3.4.1 Predisposition of beliefs, attitudes and values.

The individuals' attitudes, beliefs and expectations inevitably have a direct influence on their reaction to various health threats (Sheeny & Chapman, 1987; Dejoy & Southern, 1993; Dejoy, Wilson & Huddy, 1995). In other words, predisposing factors that refer to the beliefs, attitudes and values----the characteristics of an individual, may mediate their self-protective behaviours. For example, the popular belief of people tends to mislead them to think they are invulnerable, expecting people other than themselves to be the victim of mishaps (Weinstein, 1980, pp-806).

Coupled with the predisposing factors are enabling factors which refer to "the objective aspects of the environment or system that block or promote self-protective action" (Dejoy, 1996, pp-68)".

Besides the pre-disposing factors that may influence his /her self-protective actions, another theory that contributes to the understanding of safety behaviour is value expectancy theory.

3.3.3.4.2 Value expectancy theory.

Value expectancy is a theory developed by Weinstein (1993, in Dejoy, 1996, pp-62) to explain why people do or do not engage in health enhancing or self-protective activities against job-related hazards. The theory emphasizes the individual's threat-related beliefs or perceptions as the elements closely linked with protective motivation. According to Weinstein's (1993) view, the value-expectancy theory on which the protective behaviour is based is characterized by four aspects, namely: "i) that motivation for self-protective behaviour arises from the anticipation of negative consequences and the desire to minimize these outcomes; ii) that the impact of an anticipated negative outcome on motivation depends on beliefs about the likelihood that this outcome will occur; iii) that motivation to act arises from the expectation that the action will reduce the likelihood or severity of harm and iv) that the expected benefits of a particular action must be weighed against the expected costs of taking the action."

This theory provides a basis for reasoned action. That is if a person thinks that a behaviour will lead to positive consequences for him/her and that other people want him/her to do it, he/she will then take action (Eagly, 1992, pp-694). In other words people form attitudes towards behavioural acts by weighing the outcomes that will be expected and this particular attitude will have direct or indirect influence on their behaviour (Eagly, 1992).

Bentler and Speckart (1979) further added to Fishbein and Ajzen's well-known model of perceived behaviour control by proposing that previous behaviour " may have a direct impact on intention and subsequent behaviour ". As has been noted by Cohen (1960), because behaviour induces attitudes which are consistent with the behaviour, it can be assumed that the effects of previous experience on future behaviour are conditioned by attitudes (Bentler &Speckart, 1979, pp-454).

Thus at this stage, the thinking process of an individual determines the possible existence of dangers at work, the need to take specific protective action and the relative cost of the risk. For example, a worker would consider the likelihood of an accident in cleaning a moving machine without stopping it. He would weigh the benefit of the convenience and speed against the possible injury. If he considers the cost of being caught in an accident is greater than the benefit of deviating from the safety procedures, he would take protective precautions by first stopping the machine.

Furthermore, for more complex behaviour or that which requires the support of resources and coordination of other people, the determinants of actions are often needed in addition to attitudes towards behaviour and subjective norms (Liska, 1984). This element has been incorporated into Ajzen's (1987, 1991) revised model termed as theory of "perceived behaviour control" for the planned behaviour.

3.3.3.4.3 Discrepancy between individual experience and group experience.

Paradoxically, people are often deluded by the discrepancy between individual experience and that of the group in terms of work risk (Spigener, 1995). They usually do not perceive the immediate connection between personal safety and the company's injury rate. Daily experience at work supports their belief that they do not get hurt easily, because they have performed an at-risk behaviour thousands of times with no ill-effect. And because of the unpredictability of the outcome, they are not convinced of the need to take precautions towards work safety. Even safety advice, or coaching from the management would often have been perceived by them as a personal confrontation or interference (Geller, 1995). As a result of people's belief in the scarcity in the occurrence of injury and their failure to take specific protective measures, accidents continue to happen even in the least threatening environments. Workers often behave unsafely, even when they are well aware of the potential risk and capable of taking precaution (Sulzer-Azaroff, 1987).

3.3.3.4.4 The unpredictability of accidents.

A further scrutiny of the indifference of the workers towards safety at work reveals an interesting phenomenon of the paradoxical individual experience. Preoccupied with the exclusiveness of the individual experience, people tend to regard injuries as rare events, because most of them do not get first hand experience of many injuries. Nevertheless, the instances disclosed in the Accident Facts of 1984 (Sulzer-Azaroff, 1987) indicate that there is no such thing as unpredictability about the outcome of hazardous behaviours when hundreds of workers each perform an at-risk behaviour thousands of times. The task-related behaviour of a group of people, for example, 500 people is a very predictable thing. That is, injuries are likely to occur in statistically predictable numbers, when a large number of people are each exposed to a large number of potential risks. In the real world, when injuries occur, the victim is caught by surprise and is psychologically unprepared for the 'rare' event (Spigener, 1995).

3.3.3.4.5 Lack of alertness for hidden hazard.

Spigener's (1995) view about the paradoxical individual experience has a parallel comment from Weinstein (1993 in Dejoy, 1996, pp-67). He emphasized that people only care for instant consequences and are inclined to "have little interest in taking precaution unless they felt personally vulnerable" and "for many different hazards", people considered their own risk to be considerably less than that of other people. That means people always are not well alert to the hidden hazard to take self-protective actions. They believe that they can get away with it in case of danger. In addition to the deluded personal experience in an accident, there is another factor, for example, the sense of priority that motivates the workers to by-pass the safety procedures at work.

3.3.3.4.6 Sense of priority.

People's safety behavior is sometimes programmed by their sense of priority. They tend to have a more positive feeling for advice on work production quantity and quality than on personal safety which is often considered by them a bother (Geller, 1995). One thing that cannot be neglected in relation with the occurrence of hazardous performance is the implied pressure from other people on the workers that production yield is of higher priority than safety concerns. In some factories, the existence of reward systems that emphasize monetary incentives for output may unconsciously encourage the violation of safety practices (Cooper, 1994). In some garment factories in China, for example, the wages of workers are calculated on a piece basis. Workers' income is in proportion to the quantity of parts they complete. A bonus is offered to workers when their production yield has exceeded the target set by the factory, especially during the peak season to meet the deadlines. Under these circumstances, the maintenance workers are urged to work around the normal safety procedures to save time so that a long duration of mechanical idle time does not affect their bonus (Mason and Simpson, 1995).

3.3.3.4.7 Negative perception towards employment.

Some psychologists and psychiatrists believe that one of the causes of accidents is associated with workers' negative attitudes towards their job, though this widespread accepted notion still cannot be solidly verified in well-controlled experiments (Davids and Mahoney, 1957). Davids and Mahoney tried to use projective tests to study the influence of personality traits and attitudes on industrial accidents. Two groups from an industrial plant were chosen and carefully matched on age, education, intelligence, socioeconomic background and exposure to high accident hazards. There were no significant differences in the participants as far as the above-mentioned variables are concerned except in the experience of an accident. In the previous two years, the high accident group reported a total of 47 accidents while there was no accident recorded with the non-accident group during the same period. A test including 100 item sentences was conducted with the subjects, trying to understand their personality dispositions and negative employment attitudes.

The results confirmed the prediction of Davids and Mahoney that subjects with high industrial accidents were highly associated with the variables of negative employment attitude, showing a significant coefficient (+.70). The high accident subjects had a negative attitude towards their job, work in general and their supervisors or employers. This study carries the implication that workers with negative attitudes toward their employment are more likely to be involved in accidents. However, the impact of personality traits and negative attitudes on industrial accidents has to be referred to well-controlled experiments for confirmation.

The various psychological factors contributing to the formation of attitudes towards occupational accidents and injuries have been generally reviewed above in relation to attitude. The results of the studies that have been described should awaken the people concerned to the importance of paying attention to an attitudinal approach to exploring solutions for work safety.

3.3.3.5 Relationship between Attitudes and Accidents

There is evidence supporting the existence of a relationship between attitudes at all levels of management and work force and accidents in studies of major disasters (HSE Report No. 81,1996, pp-16-17).

Levin (1958) considered that attitudes towards safety are connected with all levels of an organization and can be expressed in the dynamics of group processes. This view was supported by Misumi (1989) who found, in a series of Japanese studies over the last thirty years, the importance of group decision making (positive attitudes) in relation to safety accident reduction in numerous organizations.

Marcus (1988) in his study of 24 US nuclear power plants revealed that the overall attitudes (pro-active safety interventions) of the operatives of the plants were related with improved safety performance. In plants where employees held positive attitudes towards safety, control and commitment to accident prevention could be better retained.

According to an HSE Research Report, a study carried out at British Steel by the Surrey Team tried to measure all accidents and lost time accidents at sixteen plants of one British Steel site. The accidents were correlated with workers' attitudes towards safety by means of questionnaires and interviews (HSE 1996, Report No. 81, pp-20). The study established strong links between attitudes towards work safety and total number of accidents, as well as to lost time accidents. The research also suggested that successful application of positive encouragement of safe working performance instead of penalty for unsafe acts, together with management support and leadership involvement would be likely to reduce accidents in British Steel. The study seems to bear the implication that the change of people's attitudes will result in the reduction of accidents. The reason is that the increased awareness of the importance of work safety can strongly motivate the people in the organization to commit themselves to positive safety and stick to safe working practice, thus substantially leading to the reduction of accidents (Fishbein & Ajzen, 1975).

3.3.3.6 The Ambiguity over the Relationship between Attitudes and Behaviours

There have been controversies about the relationships between attitudes and behaviours (La Piere, 1934). In fact, the relationship between the two categories is rather paradoxical. On the one hand, attitudes are traditionally measured with pencil and paper or verbal report. But an attitudinal response is a kind of behaviour. In this sense, attitudes are attached to behaviour. But on the other hand, attitudes are claimed to manipulate behaviour. Thus it would be legitimate to state that all behaviours are measures of attitudes (Kiesler et al., 1969).

3.3.3.7 The Controversy over the Consistency between Attitude and Behaviour

Though there are studies suggesting the existence of an inconsistent relationship between attitudes and behaviour, especially the most frequently discussed one by La Piere (1934), Kiesler et al (1969) denied that there is any inconsistency between attitudes and behaviour. He argued that consistency exists between behaviours in two different situations. Besides, the correlation between attitudes and behaviour depends on the stability of individual differences. That is a person's behaviour sometimes contradicts with his/her attitudes. The classical example in La Piere's (1934, in Kiesler et al, 1969, pp-33) study revealed the inconsistency occurred when motel or restaurant owners actually received a Chinese couple even though they rejected the request for a reservation when being asked by letter.

The example in Lohman and Reitzes' (1954) study has also demonstrated that the same people will show completely different attitudes and behaviours in two different situations. In the study, 151 subjects within a neighbourhood were selected. All, as members of a labour union, were pro-Negroes in terms of recognizing the complete equality of the job for the Negroes. However, the neighbours among whom they were residing were strongly anti-Negroes in terms of resisting more Negroes moving into their neighbourhood. The results indicated that all as members of the Civil Club----the organized property owners association, rejected the

Negroes as neighbours, when the Club provided the members with "formulated statements, reasons and justification for specific actions in specific situations involving the individual's interest in the neighbourhood situation (Lohman & Reitzes, 1954, pp-342-343)". Ironically, in a different context when the same person, as a member of the Labour Union, "with a corresponding organizational structuring of the situation, acts in terms of this definition of the situation by another deliberately organized collectivity-----being pro-Negroes". It thus seems to suggest that differences in the norms for behaviour "create difference in behaviour unrelated to the attitude (Kiesler et al., 1969, pp-29)." Kiesler et al generalized that "attitude factors should, in general, be correlated with some behavioural factors. It does not commit us to the position that a particular attitude factor should be correlated with a particular behavioural factor (pp-37)."

The above study of Lohman and Reites (1954) cited by Kiesler et al (1969) implied that normative differences from one environment to another can influence the people whose behaviours are not always correlated with behaviours, nor are attitudes correlated with attitudes. That means people's behaviours and attitudes may vary with different situations.

Attitudes do not necessarily predict a particular behaviour in all situations. The behaviours may be reinforced or inhibited by the subjective norm (group norm) or affected by significant others. It is therefore not surprising when an individual does not behave in a way compatible to his attitude but conforms to the social pressure (Andrews & Kandel, 1979, pp-298).

It seems logical to speculate that the attitude of a person will be correlated with that in another situation, provided that the situations remain constant. That means the change of attitude in one situation will be likely to invoke attitudinal change in a similar situation. The same rule will apply to behaviour as well. But the question is when attitudes will change. Which attitude is more important than the other? For research in attitude modification, Miller & Tessar (1986) reminded readers that researchers must be sure which particular attitude component is addressed before persuasive strategies are likely to achieve consistent effects.

3.3.3.8 Functional Approach in Attitude Research

The ultimate aim in a behavioural approach is to stimulate in the respondent attitudinal change. The functional approach serves this aim in attitude research. The theory behind it is to arouse some need in an individual or some cue in the environment. The cue from the external environment will trigger the need in the individual for attitude change (Katz, 1985, pp-601). Katz (1985) argued, "when a man grows hungry, he talks of food. Even when not hungry he may express favourable attitude toward a preferred food if an external stimulus cues him ".

In other situations, when an old attitude in an individual no longer satisfies his/her needs, the frustration inside will motivate the individual to modify the old attitude for a new one. Attitude revision is a learning process that takes place when the individual is entangled in problem or bothered with a new situation. The usual persuasive strategy the propagators use is to play with the states of need of people. They try to associate the old cues carrying favourable affect or feeling with the attitude they want to mobilize.

People will develop favourable attitudes towards objects that are connected with the satisfaction of their need and on the contrary will have negative attitudes toward objects that they perceive as an obstruction to achieving their objectives. Thus in terms of the adjustment function, people tend to acquire attitudes towards the means for obtaining satisfaction (Katz, 1985, pp-595).

However, attitude arousal should be accompanied by other factors----the relevant need states and the perception of the appropriate cues associated with the content of the attitude (Katz, 1985, pp-177). That is the "(1) the attitude and the activities related to it no longer provide the satisfactions they once did, or (2) the individual's level of aspiration has been raised". An example to delineate these conditions is a house owner who used to have favourable attitude toward his house may want to buy a bigger one because he has more children now. Another example is the role played by the mass media which can exert a significant impact on attitude change directly related with economic issues by pointing out alternatives for problem solving in time of economical distress.

Attitude change comes more quickly if people believe that revision of the existing attitude can help them achieve their objectives. The observation that people change their attitude and vote for a new political party that they used to oppose is a good example of this kind of change. Their feeling is that the new party can help them solve the existing problems when the old one cannot. In industrial safety, the change of attitude is often the result of unpleasant experiences (injuries) or anticipation of harmful consequences.

Nevertheless, to induce attitude change, it is not recommended to use negative sanctions and punishment, which should be used only when there is a clear measure that can remove the unwanted consequences from the individual (Katz, 1985, pp-179).

When there is no clear perceived association between the punishment and the desired behaviour, negative sanctions tend to have little effect. For the extreme case, if the punishment is unreasonably severe, the individual will build up defensive avoidance that will be reflected in his escaping behaviour to stay away from the whole situation. Taking problem children, for example, mere punishment will only create ego-defensive and aggressive behaviour. In this respect, incentives may be preferable to negative sanctions. The solution lies in the creation of a supportive atmosphere with the removal of threat.

In our daily life, there is sometimes a lack of systematic supporting forces in the social environment to nourish attitude change. Despite some people's willingness to engage in modification, they are sometimes too impotent to stand against external pressure. The discharged convicts finding it difficult to stay away from their former criminal associates to lead a new life can be an example.

Nevertheless, to utilize the functional approach for attitude change, there is a necessity to assess the needs of the target individuals by means of interviews or behavioural observation before any strategy can be chosen and applied.

It must be noted that bringing about an attitudinal change is a constant process and that the existing values of a person are continually influenced by new attitudes throughout his/her life (Katz, 1985, pp-615). The success of attitude modification also depends on the efforts to encourage the person to accept new information, for example, by means of training programs to inspire positive attitudes (OECD Report, 1976). It is important to give feedback to the target people to recognize that there may be a discrepancy between how they perceive their behaviour and how they perceive that of others. They must be convinced to avoid over-confidence in their behaviour. For instance, over-confidence in daily driving skill can lead to accidents (Mc Kenna et al., 1991).

According to current research (OECD Report, 1993, pp-45), legislation and regulations combined with information programs can help create favourable attitudes. However, as people tend to have resistance against regulations, the execution of regulation with flexibility can be a solution (OECD Report, 1993). Meanwhile, as a complement to legislation and enforcement, which does not necessarily always result in attitudinal changes, incentive schemes, for instance, in the form of reward or providing an advantageous alternative can help promote positive attitudes. In the USA, campaigns with rewards to stimulate the use of seat belts in States where seat belt use was not enforced had been carried out (Geller et al., 1990). The last but not the least measure to generate positive attitudes is training. Through exchanging values and experiences and learning the proper operation during education, positive attitudes toward work safety can be developed (OECD Report, 1993, pp-46-47).

Alongside the possibility of the reduction of work accidents by promoting positive attitudes in the workers as mentioned above, a focus on specific aspects of attitudes rather than the ones in a broader framework is more effective in occupational safety (OECD Report, 1993, pp-36). The identification of attitudes relevant to the particular behavioural problem of interest can be achieved by using open discussion or structured interview with the target groups. Often accident statistics or behaviour observation studies can be good sources for identifying important factors for attitude development (OECD Report, 1993).

3.3.3.9 The Measurement of Attitude

The conventional method of measuring social attitude is to use the comparatively more economical means----asking questions (usually in questionnaires) which becomes the most common research method in sociological and socio-psychological investigation. This method requires a "verbal adjustment to an entirely symbolic situation (LaPiere, 1934, pp-576)".

However, direct questioning sometimes may meet with resistance, owing to the sampling method, when inaccuracy of human judgment in classifying attitudes is unavoidable (LaPiere, 1934, pp-577). The respondents would give an answer contradicting their actual action, as exemplified in La Piere's (1934) classical example. The verbalized reaction to the direct questioning was directed at a symbolic situation while the actual behaviour is the response to the ' living' situation. Thus it would suggest that direct questioning in the form of questionnaires should be used with caution in terms of its reliability. Deception would occur especially when using questionnaires to investigate moral life or social status of the respondents.

For example, the possibility of obtaining reliable information about attitudes towards sex is questionable. Thus Allport (1929, pp-574) warned, “So great is the tendency to protect oneself that even anonymity is not a guarantee. Lack of insight, ignorance, suspicion, fear, a neurotic sense of guilt, undue enthusiasm, or even a knowledge of the investigator’s purpose may invalidate an inquiry”.

3.3.3.10 The Argument in Favour of Attitudinal Approach Compared to Behavioural Approach

Topf & Petrino (1995) argued that safe attitudes are the key to reinforcing safe behaviour. They believed that the thought process mirrors the evaluation of safety and controls safe behaviour. In case of any incongruity between the company values which appreciate the compliance with safety regulations to uphold the interest of the company and those of personal value-based behaviour, the employees modify their behaviour accordingly to eliminate the incompatibility. There must be commonly established values to which the employees can adhere. Thus according to Topf and Petrino (1995), there exists a consistency in values of the accepted safe behaviour for which the employees should assume personal responsibility in order to work comfortably (i.e. working in the company's healthy and safe region without stress).

Topf and Petrino (1995) further stressed that employees should be instilled with the awareness that their well-being is closely associated with their commitment to safety----a common goal of the individual and the corporation and this common value should dictate their behaviour. Personal values from the employees are subordinate to those of the company.

Topf and Petrino (1995) thought that the introduction of attitude-based intervention into a company helps employees gain awareness into the underlying values that shape the attitudes and that the awareness will indirectly lead to desired behaviours. People will commit themselves to safety only when attitudinal changes and a strong sense of personal accountability occur in them (Topf and Petrino, 1995). They argued that in order to bring about long-term behavioural change, it is imperative to let the employees be aware of any incompatibility between the company-accepted behaviours and their self-perceptions that represent individuals' collective values and attitudes. They must learn how to remove the incongruity and of course their change in behaviour is the only solution. For example, if the workers believe that their behaviour at work is contradictory to safety regulations set by the company, they should modify their behaviour to act safely to remove the contradiction, if they have been given the awareness. Topf and Petrino (1995) believed that safe behaviour would follow thought processes that reflect the valuation of safety.

In the case of work safety, the promotion of safety attitudes encourages the work force to suggest guidelines they are able to follow. Such self-motivated involvement is conditioned by the individuals' own values. It is argued that the change in values induces a change in attitude, which brings about subsequent behavioural change (Rokeach, 1968). Topf & Petrino (1995) proposed that employees should be assisted in training to clarify personal safety-related values, before they can adjust their behaviour to attain long-term attitude change to achieve congruency between their values and their actions.

Topf and Petrino (1995) may be logically correct to suggest that attitude can guide behaviour but what they fail to recognize is the difficulty of changing people's attitudes. The change of attitudes through training is a long-term process (Creek, 1995). Besides, attitude is unobservable and rather difficult to measure while behaviour can be explicitly observed and is thus more measurable at least for individuals. It is nevertheless not so easy for large groups. When the more observable and measurable safety behaviours have been confirmed to be supportive of occupational safety, behavioural studies in safety promotion have been given substantial attention. The researchers were led by the conviction that safety behaviour and prevention is the key to safety (Eves, 1994; Creek, 1995; Mallett, 1995, Hoyos, 1995).

3.3.3.11 The Argument in Favour of Behavioural Approach Compared to Attitudinal Approach

A behaviour-based approach in safety research, has been shown to be effective in occupational safety (Sulzer-Azaroff, 1978; Komaki et al, 1978; Komaki et al, 1982) through studies parallel to attitudinal research. Behavioural approaches focus on the attempt to influence the behaviour to induce changes, rather than addressing people's attitudes or the situation they are in by means of psychologically based techniques. This approach has opened a new era towards success in safety education (Cooper, 1994).

The endeavours of people to target behaviour instead of manipulating attitudes is connected with the discrepancy between people's expression of how they prefer to behave and their actual performance afterwards. Events have shown that workers who possess the most favourable attitudes towards safety precautions often do not abide by safety regulations (Cooper, 1994, pp-19). The same conflicting example can be found with some employers. They first hold high sounding opinions in support of the work safety of their workers but later surprisingly implement a work flow system or incentive system within which safety is only a secondary concern to the production target of the plant (Cooper, 1994). They are aware of the right measures, yet do not implement them.

3.3.3.12 Behavioural Preconditons

It is crucial to note that the relation between attitudes and behaviour is influenced, to a certain extent, by other determinants. Skills that are one of the important conditioners of behaviours can encourage more positive attitudes, as skills can be considered part of the behavioural controls (OECD, Report, 1993, pp-44). For example, a stamping press operator in the metal work shop is more likely to formulate positive attitudes towards his/her work, if he/she is adequately trained to be equipped with necessary skills in operation. Other determinants such as social influences are deemed to be of equal importance. A social learning process can be initiated, for example, when people may consciously or unconsciously attempt to model or imitate the lifestyle of other socially influential figures for health and safety (OECD Report, 1993).

3.3.3.13 Behaviour-Attitude Interaction

There is mutual influence between behaviour and attitude. Kotler and Roberto (1989) delineated that behaviour is sometimes preconditioned by attitudes that are developed after people learn something about behaviour with reasoning. However, the change of behaviour may be tentative and does not involve any attitudinal change. The adoption of the behaviour is sometimes motivated by random choice, rather than by deliberate or conscious evaluation of the advantages and disadvantages of the behaviour. Petty et al (1988) described this as a "central route" of persuasion that is under the extrinsic influence such as the attractiveness of presentation or status of a presenter.

It is thus evident that the formation of attitudes may precondition behaviour, whereas behaviour may be adopted before any attitudes come into play. People only change their behaviour, when they are highly involved in the matter, after having examined the consequences of behavioural alternatives. However, most people like the road users are not ready to be involved actively in safety because they are influenced by competitive determinants. For instance, the speeding of the road users may be regarded as a way of relaxation, or justified by costs savings or social tolerance for moderate drinking (OECD, Report, 1993).

To get people highly involved in the desired safety behaviour, interactive programmes such as on-job training, seminars and group discussion are likely to be effective. In this way, social norms can be developed through discussion and analysis of the complex safety problem to achieve the change of attitude and may eventually affect behaviour. The ultimate goal of behavioural change is to stimulate lasting inner motivation.

3.3.3.14 The Superiority of One Approach over the Other

There have been arguments above concerning the superiority of either the attitudinal approach or the behavioural approach over the other in work safety. A study mentioned by Cooper (1994) to test the relative effectiveness of the approaches for increasing employee usage of ear protectors in a metal fabrication plant, can give a clue to which approach is more preferable.

Before the study, it was found that the usage of ear protection was very low in the metal fabrication plant. The attitudes of the majority of the workers towards the usage of ear protectors were negative, owing to some discomfort of wearing them.

One group of behavioural scientists attempted to change the behaviour of the workers who did not wear ear protection when working, by means of daily feedback on the extent of hearing loss. The other approach was done by the management in the same plant in an attempt to change the attitudes of the workers toward ear-protection. The instruments used to promote attitude change included group lectures, poster campaigns and talks with individual workers. The promotion was enforced by sanctions in which employees were temporarily suspended from their jobs in addition to other losses of pay and penalties for failure of wearing the protection.

The results showed a great contrast between the two approaches. The behavioural approach by feedback resulted in a substantial increase in the usage of ear protection , rising from an average of 30 to 50 per cent at the baseline period to 80 per cent in five months. However, the attitudinal approach recorded an average only 10 per cent usage of ear protection during the same period of time. This example indicated that the attempt to change attitude alone achieves little effect. Changing the behaviour associated with the attitude may bring about more positive results as claimed by Cooper (1994). The fact is that attitude is hard to change. We only rearrange our attitude to be compatible with our new behaviour, to justify our reason for our behaviour, if we consciously change our behaviour (Cooper, 1994).

3.3.4 The Combined Behavioural and Attitudinal Approaches

Notwithstanding the claim that attitudes do not always lead to the formation or modification of behaviour, the development of attitudes will foster safe behaviour. If the development of the desired attitudes can be stimulated, people will be motivated to weigh their behavioural intentions against the advantages and disadvantages pertaining to the needs and values (OECD, Report, 1993, pp-44). Attitudes are affected by other behavioural preconditoners but attitudes can be influential before or after the formation of behaviour. Based on the above conclusion arrived at by the OECD, Report (1993), it is still difficult to identify the most effective method for modifying attitudes or behaviours. However, proper methods of measurement of attitudes and behaviours such as questionnaires, interview and observation, coupled with a good strategy of evaluations can be helpful in research on modifying attitudes and behaviour. It is necessary to pinpoint one or two methods for behaviour and attitude modification to obtain the desired attitudes or behaviours, because a different method may have a different role for safe behaviour, which is rather complex.

Thus, Cooper (1994) claimed that the combined modification of both the behaviour and attitude to safety at work would be more likely to stand a chance of success.

Cooper further stated that people tend to regulate their attitude to justify the change in their behaviour when consciously changing their behavior to achieve a particular aim they favour. Furthermore, social norms to which the individual conforms, are another example of how behaviour can regulate one's attitude when one is confronting peer pressure (Cooper, 1994).

To invoke attitudinal and behavioural change, there is a need to examine the relation between the two attitude components (affective and cognitive) and behaviour, as behaviour can be affected by the cognitive or affective component of attitude. Millar and Tesser (1986), pointed out that "some types of behaviour may be more cognitively driven and other types may be more affectively driven (pp-271)".

Wilson et al (1984) found that some behaviours for instrumental purposes are more cognitively motivated, in that the individuals are interested only in the attributes of the object and not the feeling aroused by the object. On the other hand, if the behaviours are directed towards non-instrumental purposes (consumatory), it would be more effectively driven. The individual having consumatory behaviour would care for the feeling aroused by the object.

Millar and Tesser (1986, pp-271) pointed out that when the same attitude component (cognitive or affective) influences the general evaluation and drives the behaviour, there will be a strong attitude-behaviour correlation. In other words, if the strong correlation can be made, either the attitude or behaviour will trigger the change in the other. It follows that there will be a combined change in attitude and behaviour. Before these changes occur, it is imperative, as emphasized by Wilson et al, (1984, pp-271) that either the affective or cognitive component of an attitude must be made salient. To achieve this aim, the individuals should be required to list the reasons for favouring or disfavouring an attitude object and then a list of attributes of the object can be generated. Then the cognitive component of the attitude can be identified after an immediate general evaluation made. In a similar way, the affective component of the attitude can be made salient, after the individuals have listed the feeling they possess for the attitude object.

Fazio et al (1978) followed the same direction to make the attitude components salient, when the general evaluation was made. The eventual match between the attitude components that influence the general evaluation and the attitude components will drive the behaviour, thus inducing stronger attitude-behaviour correlation. In occupational safety, it appears that the combined attitudinal and behavioural approach is feasible, when the manipulation of the attitude components induces corresponding changes in behaviour, after the correlation between attitude and behaviour has been made high as mentioned above.

Whether this exploratory attempt at a combined attitudinal and behavioural approach to work safety is effective will emerge as result of the current survey.

3.4.0 The Promotion of Safety Culture

Despite the endeavour of behaviour analysts to set up and improve safety and health systems, without the conscious support from the management of the organization the temporary success of a system is not likely to be sustained. It is necessary that the management commit themselves to the ongoing improvement in promoting organizational safety culture which reinforces both group identity and behaviour (Booth, 1994). Corporate culture has now been accepted worldwide as the top priority with all industries (Booth, 1994). It cannot be denied that there exists in every site a culture whose impact on safety has substantially exceeded the physical factors. The powerful influence from culture can be exemplified by drivers violating the speed limit of 65 miles per hour (in the U.S.A.) on the highway, when the prescribed speed fails to match with the drivers' culture in terms of value (The Executive Safety Committee, 1996).

The safety culture of an organization, according to Eves (1994, pp-38), is "the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management." A safety culture is a significant subordinate part of the general culture of an organization (Eves, 1994).

Although safety culture is recognized as vitally important to factories, caution must be guarded against the delusion that culture can be changed overnight by means of disciplinary measures from the top-down. The attempt to create a rapid cultural change is bound to fail, owing to its high resistance to change at any level in a society. Another problem of the attempt is that a single direct organizational intervention can hardly induce change to a safety culture which is too wide to define and measure (Booth, 1994). The only possible way to develop and maintain safety culture depends on the cultivation in the employees of a sense of belonging which demands trust and confidence between the management and the work force.

The establishment of a beneficial and constructive safety culture can be a struggling learning process for an organization. The process means a steady reshaping of the way of thinking and acting based on shared experience in a situation where common affairs are a major concern (Booth, 1994; Sarkus, 1996). Besides, to change the organizational culture is likely to meet with resistance, when all parties perceive their identity and interests are being threatened. Active commitment from the management to nourish management responsibility for health and safety is the only solution (Booth,1994).

Nevertheless, cultural changes, once accepted, can produce lasting effects. Besides, for workers who work at the risk of injury or illness, appreciation from the management is a non-manipulative way to influence the employees. Individual attitude and behaviour will change when the employees are convinced that the source of influence is believable, positive and respected (Zohar, 1980b; Brown & Holmes, 1986; Dedobbleer & Beland, 1991). On the contrary, traditional power-oriented enforcement of change by means of authority, rewards and discipline would appear to encounter superficial compliance and dissatisfaction (Weber, 1992; Sarkus, 1996).

3.5.0 Research Problems

The main purpose of this study was to conduct a multi-dimensional research project in a metal-work factory in Shenzhen, the Special Economical Zone in China. The research was to be done in more than one department/section. Multi-contacts would be made with the workers through interviews, observations and questionnaires at more than one level (managers, foremen/supervisors/floor-workers) with both objective and affective data collected.

The study was intended to test the effectiveness of behavioural and attitudinal safety techniques in motivating the workers to improve their performance and attitudes in relation to different aspects of work safety.

The study would involve indirect measurement of accidents by observing dangerous acts that might lead to accidents. It would focus on changes in worker behaviours and attitudes, resulting from different kinds of training and feedback in a multiple baseline investigation. For indirect measurements of work safety, the studying of unsafe practices in a factory was a feasible means. The techniques were successfully tested in the area of safety in the U.K and it was interesting to know whether similar experience could be applied to an oriental setting with different cultural values, attitudes and social background. In addition, there might be language barriers and literacy that played a role in the employees' understanding and attitudes toward safety (Safety & Health Manual, 1996, pp-54).

As far as cultural value is concerned, oriental workers are less likely to report injuries compared to their American or European counterparts who value 'independence, freedom, health and money' (Safety & Health Manual, 1996, pp-54). The Japanese are more concerned about the loss of an hour than that of money or safety. "People take pride in their work. If there is an accident or near miss, they are afraid they will lose their job." (Safety & Health Manual, 1996, pp-51). The communication problems stemming from language barriers or literacy often lead to higher-than-average incident rates in developing countries. Similar language problems occur in Shenzhen factories where the majority of the workers are recruited from other provinces. A substantial number of the management in those factories rely on the Hong Kong dialect which is Cantonese while the out-of-province workers speak Mandarin.

The research thus tries to find answers to the following problems:

I. Are there any significant relationships between the worker' behaviours in occupational safety and posted-feedbacks (posting the weekly result of the departmental safety performance on a conspicuous place) plus goal-setting (setting a goal for achieving safety performance)?

This problem is based on the view taken from the literature, (Cooper, 1994, Lingard, 1995) which suggested that an intervention in the form of posted feedback plus goal-setting would have a positive impact on the workers' behaviour and their safety performance is expected to improve in due course.

II. Are there any significant relationships between the workers' attitudes towards occupational safety and posted-feedback plus goal setting?

Similar to the assumption in the above research problem, it is expected that there would be some change of the workers' attitudes (in terms of the 8 dimensions: 1. Supervisor Supervision, 2. Supervisor Knowledge, 3. Supervisor Encouragement & Support, 4. Shop-floor Satisfaction, 5. Shop-floor Environment: Hardware, 6. Shop-floor Training, 7. Safety Meeting, 8. Safety Working Procedures) towards occupational safety after the introduction of intervention in work safety.

III. Are there any significant relationships between attitudes of workers who have had safety training and workers who have not in terms of occupational safety?

It is thought that workers' attitudes towards work safety would be affected by the safety training provided by the factory and there are differences between workers with formal training experience and those without regarding their attitudes (in terms of the 8 dimensions) towards safety. The differences in attitudes due to training would be a ground for introducing the intervention that is thought to be able to bring about a positive change in the workers' attitudes toward work safety and would thus indirectly reduce the accident rates.

IV. <u>Are there any significant relationships between attitudes of the workers with self-reported accident rates and those of their peers without occupational accidents?</u>

If differences in attitudes between the two groups of workers can be confirmed, as a result of occupational accidents experienced, there is a reason to assume that a positive change in workers' accident rates can be expected, in case an intervention in the form of safety training is conducted with the workers.

V. <u>Are both the workers' behaviours in occupational safety and safety attitudes significantly related to intervention?</u>

It is expected that the improvement in both the workers' attitudes (in terms of the 8 dimensions) towards workers safety and their safety behaviours is a result of intervention.

3.6.0 Significance of the Study

It is hoped that through the application of the practices of occupational safety to the Chinese context, safety awareness of the Chinese workforce can be awakened. More attention can be paid to the importance of safety training. The management should be alerted to be socially responsible rather than being committed solely to business growth.

3.7.0 Summary of the Chapter

Part One of this chapter has examined various causes for accidents. Among the causes, the human factor has been analyzed from psychological and behavioural perspectives. Researches in personality factors in relation to industrial accidents from the early twentieth century through the 70s have been examined. The controversial "accident proneness" theory which has been both favourably and unfavourably received by researchers has been discussed. Likewise, "carelessness" which, it has been claimed, may be linked to mental and emotional factors, has been scrutinized. In addition, physical factors in terms of audio-visual performance, reaction time, muscular responses, intelligence, experience and emotional stability and age have been examined. Following the review of physical factors has been the interpretation of the causation theory that describes the failure of a person to deal with a real situation. Environmental factors, thought related with potential industrial dangers, have been investigated. Then the interaction between man and machine has been looked into. All these factors have been considered responsible for industrial accidents and injuries. But what is more important has been the identification of the near-miss leading to accidents when operating a machine.

Part Two has been devoted to the examination of traditional attempts of combating occupational accidents, their potentials and problems. Safety management, information campaigns, educational or training programs, engineering approaches, legislation, as well as enforcement and incentives have been discussed. Both the advantages and limitations of these approaches have been contrasted. It has been found that all the methods of promoting safety attitudes and behaviours have strengths and weaknesses. None of these, however, seem to be a very good solution except the behavioural approach. A behavioural approach has been described in detail in terms of its frame of reference, the basic research design and each stage of the experiment. Regarding the effectiveness and justification for using behavioural modification as a tool to reduce occupational hazards, Santamaria (1978, pp-35) had positive comments:

i) The application of a behavioural approach to improve industrial safety has achieved significantly positive results;

ii) The use of a behavioural approach in industrial settings for the reduction of dangerous behaviours is a developing area of research but such studies are still limited in number;

iii) Training of the workers accompanied by posted feedback of safe performance considerably reinforces and increases the desired behaviours (Komaki et al, 1977);

iv) A feedback system alone within the behavioural approach can diminish hazardous conditions in an industrial setting (Sulzer-Azaroff, 1978).

In this part, analysis is also given to the relationship between attitude and accident, between attitude and behaviour. Despite the controversial views over their possible causal relationship, behavioural modifying techniques are thought to be very powerful when combined with attitudinal approaches. People modify their attitude to be compatible with their behaviour change to meet an aim they favour. An attitudinal approach is thus complementary to a behavioural approach. For the above reasons, this combined approach has been chosen. This study thus attempts to build on the existing behavioural research and apply the behavioural modification techniques supplemented by attitudinal investigation for safety purposes to the industrial context in Shenzhen where the industrial accident rate is extraordinarily high. At the second last part of this chapter, the importance of nourishing a safety culture within the company for on-going work safety has been stressed. The final part of the chapter was given to the statement of hypotheses and the significance of the study. The next chapter will be devoted to the planning of an experimental research for the combined behavioural and attitudinal study for safety behaviour.

CHAPTER IV

METHODOLOGY

4.1.0 Justifications for the Choice of Methodology (Behaviour and Attitude Techniques)

In the field of occupational safety, there have been a number of approaches attempting to improve safety performance and there are strengths and weaknesses on the concurrent approaches to occupational safety according to the literature review discussed in Chapter III. Based on the various combinations and alternatives to be included in this research design in occupational safety in terms of behaviour and attitude modification, the conclusions below are the justifications for the choice of the approach tailored for the present study:

The application of behaviour and attitude techniques in industrial settings has promised effective results, while other instruments in safety research have been shown to be inadequate in one report or another as summarized below:

4.1.1 <u>Safety Management</u>

Safety management, though a good starting point in the development of safety at work, because of its emphasis on the enforcement of regulation and supervision, does not seem to be worker-centered (Grimaldi & Simonds, 1975).

4.1.2 Information Programs

Information programs as an alternative, nevertheless, claimed to be able to achieve positive results in safety promotion, are thought to be unable to establish a strong relationship between a safety campaign and the performance in safety behaviour. Information programs, may be inadequate in their control arrangements and the difficulty in recording real lost time accidents (Campbell & Stanley, 1963; Komaki et al, 1978).

4.1.3 Education or Training Programs

Education or training programs, on the other hand, notwithstanding of some of their positive results shown, have to follow a tedious prior assessment on the educational abilities and needs of the workers, during the introduction of the program (Pierson, Murphy, 1996; Gagne, Briggs & Wager, 1988).

4.1.4 Engineering Approaches

The success of an engineering approach depends on the repeated laboratory tests on the protective equipment. However, the causes of failure may often be confounded by more than one variable in the real work setting. As reported by Colton-Craig (1997), in the testing of the half-mask filtering face-piece and elastomeric respirators for example, the causes of possible engineering failure were various. The failure could be due to face-piece slippage caused by heat, humidity, cramped work areas, actual workplace movement and other respiratory performance characteristics that were not easy to be replicated in the laboratory. Also, in the engineering approach, human causes should be considered. Sometimes, the organizational and administrative systems are inadequate to ensure safe operations (Eves, 1994).

4.1.5 Legislation, Enforcement and Incentives

Legislation, enforcement and incentives are complementary means to change behaviour in the expected direction. Nevertheless, these means are only external motivators for behaviour (OECD Report, 1993, pp-45).

4.1.6 Attitudinal Approaches

Although attitudinal approaches are claimed to be able to bring about subsequent behavioural change, the change involves a long-term process and is rather difficult to measure and observe (Rokeach, 1968). The results are thus uncertain. The change comes only if an awareness of safety can be created within the individual (Rokeach, 1968).

4.1.7 Behaviour Modifications

While other approaches do not seem to be very fruitful, behaviour modification of workers' safety practices has been successfully applied to various settings in the government area (Miller & Miller, 1970; Everett, Hayward and Meyers, 1974; Pomerleau, Bass and Crown, 1975), in the management of hospital setting (Quilitch, 1975) and in the service setting (Winett & Nietzel, 1975; Kohlenberg, Phillips & Proctor, 1976). In comparison, positive reinforcement in behaviour is most widely used in industrial settings. As pointed out in Chapter III, behaviour modification by means of reinforcement contingencies (Smith et al, 1978; Sulzer-Azaroff, 1978; Zohar et al, 1980; Rhoton, 1980; Sulzer-Azaroff & Santamaria, 1980; Larson, Schnelle, Kirchner, Carr, Domach & Risley, 1980) has achieved promising results in reducing industrial incidents. Thus, compared with the limitations and drawbacks of other approaches mentioned earlier, the behavioural approach seems to be a preferred alternative that is more measurable and observable in terms of the methodology in collecting the data. The approach is especially effective when combined with attitudinal reinforcement in developing the desired behaviour (OECD Report, 1993, pp-44)

4.1.8 The Interaction Between Attitude and Behaviour

Contradicting Rokeach's (1968) claim that using anattitudinal approach to bring about behavioural change was difficult, Topf and Petrino (1995) reported that safety attitudes could reinforce safe behaviours. According to their study, the introduction of attitude-based intervention into a company can modify the attitudes that can in turn influence the behaviours towards the desirable safety direction. The interaction between behaviours and attitudes discussed by Kotler and Roberto (1989) makes it clear that behaviours may be preconditioned by attitudes and sometimes behaviours may precede attitudes. As concluded by the OECD Report of 1993 (pp-45), attitudes and behaviours may be modified through different forms of feedback given to the workers. This combined attitudinal and behavioural approach to promote work safety has not yet been reported in China. This approach, however, is likely to be a useful addition to safety research to be administered in a Chinese industrial setting where the historical, social and cultural backgrounds are different from those of the West.

As far as modification in behaviour and attitude is concerned, intervention greatly reinforces the safety performance (Cooper, 1994), because the respondents can learn how to differentiate safe and unsafe behaviours through the training provided during the intervention and will be reminded repeatedly of the safe performance expected. Three different kinds of interventions, namely goal-setting, feedback and training will be developed modelling on a design by Duff, Robertson, Phillips and Cooper, (1994). Goal-setting is the level of safe acts agreed with the respondents. Feedback to the workforce can be done by means of a publicly posted chart that records the results of work safety achieved by the workers.

For these reasons the present study intends to draw upon the researches that have demonstrated the effectiveness of applying feedback in the promotion of industrial safety. Furthermore, based on studies that have been attempted by many behavioural researchers and evaluated in the literature review in the last chapter, the following sequential stages normally used in the behavioural or attitudinal approach will be adopted as the backbone of the present research (Figure 4.1):

risk assessment→pre-measurement of behaviours and attitudes (multiple baseline) →intervention with goal-setting and posted feedback→post (treatment) measurement

Figure 4.1 Backbone of the Present Research Design

In Figure 4.1 above, the pre-and post measurement design has proved to be an effective means for behavioural and attitudinal modification when treatment is used, while risk assessment is necessary before any modification can be done to the target group. Meanwhile, the establishment of a multiple baseline in the above system effectively solves "the control problem". The introduction of intervention and withdrawal to different departments at different points, as argued by Lingard et al

(1995, pp-28) is especially effective in applied settings in which random assignment to control and experimental groups is difficult to achieve.

4.2 The Procedures of the Present Study

In this research, improvement in the safety behaviours in the workers is expected after the implementation of intervention to the target departments in which the existing safety condition in the factory can be diagnosed through the review of the past records of work accidents and interviews with the work force. The results of safety audits will provide valuable information as to what kind of intervention is appropriate for the workers.

The empirical study will be conducted in the four departments of the target metalwork plant in Shenzhen China. These four departments are Heavy-duty Press, Small Press, Hand Press and Drilling. The research will start with a risk assessment. Then comes the multiple baseline period. To provide baseline data, the target behaviours will be measured before the intervention starts. The measurement is achieved by monitoring the behaviours of the workers by means of observation. Each session of observation will be recorded and calculated to show the level of performance reached (Komaki et al, 1978). The stage that follows will be the application of intervention with goal-setting and feedback. Withdrawal is the last stage, when the conditions revert to its pre-intervention level to detect the occurrence of any behavioural change (improved safety performance). The multiple baseline (within subject design) in the study involves three different points of introducing the intervention, accompanied by three different intervention withdrawal points to the

Heavy-duty Press Department, Small Press Department and Hand Press Department (Fig. 4.2).

In Figure 4.2, in the Heavy Duty Press Department for example, there will be a baseline study (A8) of 8 weeks for obtaining the average safety performance followed by an intervention (B8) of another 8 weeks in the form of training and posted feedback. Then comes the reversal period (A4) in which the baseline observation will revive. The same procedure will be replicated for the Small Press Department and Hand Press Department except that there will be a lapse of 4 weeks after the introduction of intervention to the Heavy Duty Press Department and that later for the Small Press Department. There will also be the same lapse of time between the Small Press Department and the Hand Press Department in terms of the introduction of intervention. All through the 25 weeks of research, the drilling department will be kept intact from any intervention except the baseline observation. It will indicate whether or not the improvement in performance occurs only after the introduction of each intervention. Thus if any improvement is noted, it is not likely that it is due to "sources of internal invalidity such as history, maturation and statistical regression" as argued by Komaki (1977).

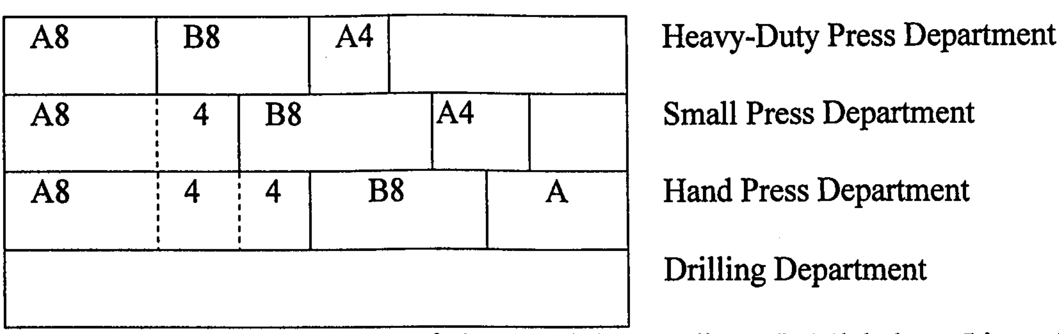


Figure 4.2 Research Design of the Multiple Baseline [Modeled on Lingard & Rowlinson's (1995) design]

In the meantime, attitudes of the respondents will be measured before and after the intervention by means of a questionnaire for all departments. Each basic stage of the behavioural approach will be examined below:

4.2.1 Risk Assessment

To start with the investigation, some risk assessment will be done to develop an objective and quantitative method of safety measurement by identifying contributory factors in the chain of events leading to accidents. The comprehensive list of risk items related with situations or behaviours formulated is based on the investigation into safety journals, HSE publications and past accident records in the factory as discussed in the literature review (Chapter III).

Risk assessment is intended for the purpose of error analysis to identify the activities that carry with them a chance of accident or injury by organizing and describing the tasks and activities performed by operators. The risk analysis form chosen for the study (Table 4.1) has been widely used (Geller, 1995):

Table 4.1. Risk Analysis [Adopted from Geller, 1995]

Operating Procedures	Safe	Unsafe
Body Position/Protecting		
Visual Focusing		
Pacing Of Work		
Moving Objects		

In Table 4.1, work risk in a metal work can be summarized in the following categories (Geller, 1995):

a) Operation Procedures

Any violation of the safe operation procedures will endanger the workers.

b) Body Position/Protecting

Workers engaged in dangerous operations such as drilling in which there will be flying particles, the protection of the eyes and critical positions of the body is important.

c) Visual Focusing

Concentration during operation is essential to work safety. Any negligence of the operator will result in an accident.

d) Pacing of Work

Proper working speed is expected for safe operation. Eagerness to meet production speed at the expense of safety is a cause of accidents.

e) Moving Objects

There must be adequate precaution for the workers to guard against moving objects that are likely to cause hazards.

The safe and unsafe activities at work will be exhaustively collected and recorded under the categories in the above form, which serves as a draft before the contents are analyzed, revised and finalized in the Critical Behaviour Check-list (Observation Form) (Appendix 3) as illustrated by a sample below (Table 4.2):

Table 4.2 (Appendix 3)

OBSERVATION FORM

Date: ____________ Name of Observer: ____________

Time: ____________ Department Observed: ____________

Section I

General Operation and Equipment

		Safe	Unsafe	Not Seen
1.	Workers should not put things under their feet for the sake of comfort. 1.			
2.	During operation, the operator should not chat with the worker sitting next to him/her. 2.			
3.	Both hands must be away from the working area when pressing the foot brake. 3.			

4.2.2 Measurement

Measurement is the core of the research design in behavioural and attitudinal modification. In the evaluation, the numbers obtained in the measurements have to represent a valid measure of the safety performance of the workers. The arrangement and timing of the measurements may be combined with a number of instruments of investigation such as interview, group discussion, questionnaires and observation.

Combinations of Measuring Methods

There have been a number of combinations of instruments for the procedures of attempting to measure changes. Without elaborating each of the combinations, below is the list of choices for the researchers:

a) Pre-test, post-test design with control group [Sanchez, Martin, F. (1993)];

b) The measurement before, during and after the program, long term follow-up to a year after [(Geller, E.S., G.R. Lehman, J. R. Rudd, M. J. Kalsher and F. M. Streff (1987)];

c) Pre- and post treatment measurement, personal interview (Froyland, P. 1983);

d) Pre- and post measurement with non-equivalent comparison group [(Williams, J. I., J. Radford, M. Braney and J.B. Mclellan, (1992)];

e) Pre- and post treatment measurements, interview, questionnaire, discussions [Moe, D., K. Saukshag and T.M. Stene (1986)].

Of the choices of combinations from a to e above, a with a control group does not seem to be very appropriate to a work setting like a metal works. The skill-demanding nature of the work does not allow the workers to be randomly allotted to different groups, thus making the consideration of a true control group impossible.

For choice b, the frequent shift of personnel in the factory together with the concern for possible cooperation from the authority will make long term follow-up difficult. The last three choices especially the last e can be considered a suitable integrated design to cope with the demands of the present study which intends to implement an intervention to groups of workers at the metalworks with a view to modifying their attitudes and behaviours in safety. The interview can be used to identify the existence of risk at work for risk assessment and the workers' attitudes towards occupational safety. The pre- and post measurement of attitudes is intended to detect the impact of treatment that may trigger change in behaviour, if there is any. Meanwhile, the same questionnaires are effective instruments for measuring their attitudes before and after the treatment.

4.2.3 Baseline Setting

The chosen combination e is only partially good for measuring the change in attitude and behaviour, because there is no 'control' in this simple design. For an environment where the application of a true control group is not possible, a multiple baseline added to the design can fill the gap. As has been investigated in Chapter III, a multiple baseline refers to the measurement of the performance of different target groups at the same starting point while introducing intervention to the groups at different points of time. If no change is detected in any of the groups until the introductions of the interventions, the change(s) is /are thought to be due to the intervention. Sulzer-Azaroff (1978) has reported a successful use of a system of feedback with a multiple baseline design over a six-week period across settings in 31 laboratories with medium or low hazards frequencies being assigned to an early, middle or late treatment group. The use of baseline in the experimental design across settings to measure the environmental change is important in safety research. Emmert (1978) pointed out the difficulty of experimental research in work environments where the constant turnover and change in shifts make the use of control groups difficult. Thus in an industrial setting which is beyond the control of the researcher, a multiple baseline design seems to be one solution as discussed in the last chapter.

For the reasons explained in the present study, a multiple baseline with feedback design will be used. The baseline approach has been adopted from the Lingard and Rowlinson's (1995) research which tested the behavioural safety management techniques of goal setting and feedback for their effectiveness in improving safety performance on Hong Kong building construction sites (Chapter III). In their study, a multiple baseline was found to be an effective instrument for detecting the significant improvement in safety behavioural performance in most of the sites. However, a data collection period of 34 weeks in their design is too long to be feasible in the current study. Besides, after discussion with the factory authority, it was found that a month before and after the Chinese New, many workers would ask leave to go home to spend the holidays with their family. Workers' absence from work during festivals is not uncommon. Having taken the situation of the Chinese custom into consideration, only a 25-week duration will be considered. In fact, Komaki et al's (1978) research using a behaviour analysis approach to improve worker safety in a food manufacturing plant lasted only a 25-week period of time and this period was deemed by the researchers to be sufficiently long.

Thus in the current research, an intervention by means of an explanation and visual presentation of the desired behaviours will be introduced together with cost-effective reinforcement in the form of frequent feedback. A multiple baseline research design across departments will be used and the structure has been depicted in Figure 4.2 (See above pp-163). Data are to be collected from the four departments simultaneously with goal setting and feedback at different intervals after an eight - week baseline period. The fourth department will be kept intact of any intervention as a control. A profile (figure 4.3) will be drawn for each department, showing the safety performance at the baseline period before treatment, the period during the application of treatment and the reversal period----back to baseline---- when the treatment is removed:

BASELINE (example)

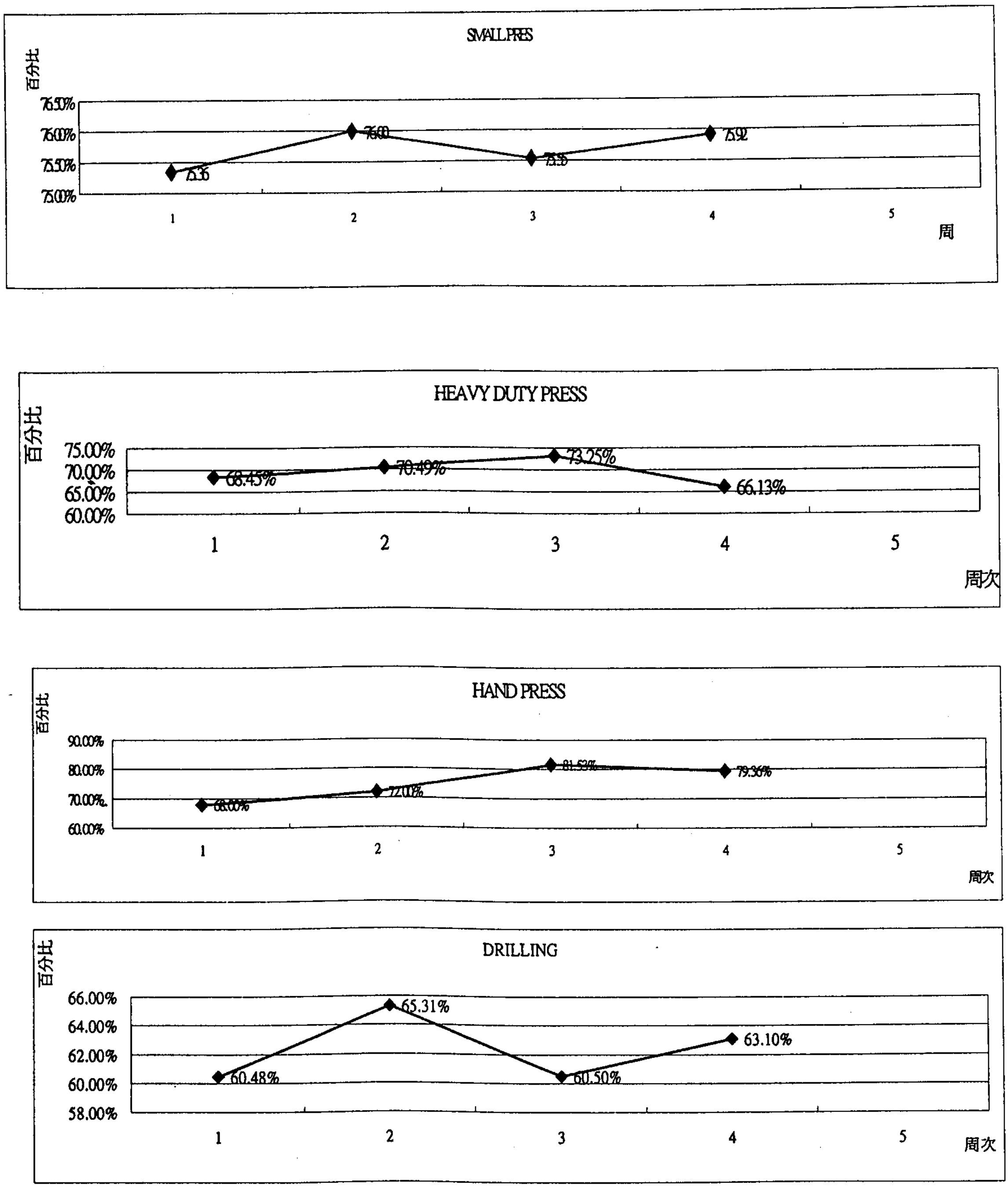


Figure 4.3 A Graphic Example of Multiple Baseline Design Modeled on Lingard & Rowlinson's (1995)

In the profile above, the percentages on the y axis denote the safety performance of the workers in the respective departments observed weekly while the numbers of the x axis refer to the number of observations in a week. The % data are not real and only meant for demonstration.

4.2.4 The Establishment of a Departmental Goal

As has been discussed in the literature review, the implementation of an intervention program can be more effective, if preceded by the setting of a goal (Lingard, 1995) in behaviour modification. A hard but attainable goal can be a strong motivator if workers are involved in the goal-setting at the initial stage of the program. For this reason, the procedure of goal-setting will be included in the design of the present research.

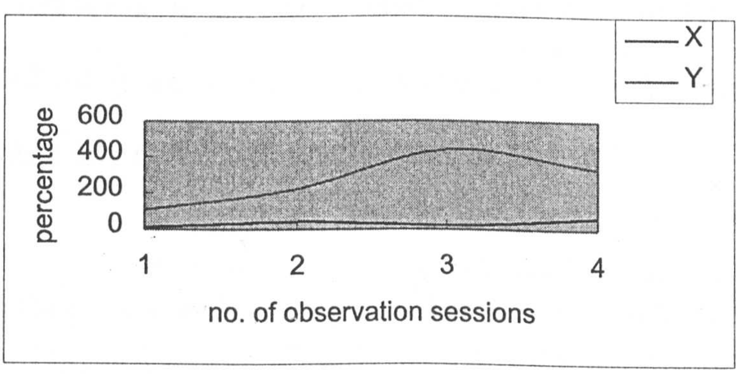
According to researches (Erez & Zidon, 1984; Fellner & Sulzer-Azaroff, 1986; Cooper, 1992), the setting up of a departmental goal helps improve safety performance. A goal accepted by an individual will have positive influence on his/her later performance. And a goal, once committed to, will be actively sought by an individual, regardless of obstacles. To establish a departmental goal properly, the following important aspects and procedures should be followed through:

a) Led by the researcher, all the workers in the concerned departments together with the management will be invited to small group meetings.

b) At the start of the meeting, the attendants will be briefed about the purpose of the behavioural approach. They will be particularly assured that not a single individual will be identified by name during and after the observation, not to mention the disciplinary actions against an individual, should his/her behaviours deviate from the procedures on the checklist. Meanwhile, they will be shown and told about a chart of the checklist to exemplify the behaviours to be monitored.

c) The participants will be presented the results of the baseline observation in the graphical form of 4 x 3 ft charts with vertical axis to represent the percentage of safe behaviour and the horizontal axis to show the number of weeks in each department (Fig. 4.4).

Figure 4.4 Observation Chart by Session



(The **x** line represents the actual safety performance recorded while **y** line refers to the goal level agreed by the workers.)

d) Each group of workers will be asked to commit to a 'difficult but realistic' goal in safety performance, relative to the baseline average. All the groups within the department will create and agree upon a department goal.

e) The workers will be informed that the results of the observations will be recorded on the charts to be posted each week.

4.2.5 Intervention and Feedback

Further to the design of an evaluation procedure, intervention is an imperative part after the baseline period in invoking change in safety performance. During the intervention meeting, desirable skills and knowledge pinpointed at correcting unsafe practices will be conveyed to the target groups with the help of a seminar, in which audio-visual aids and demonstrations can be useful auxiliary tools for postulation purposes (Fellner & Sulzer-Azaroff, 1984a; Lingard, 1995).

In a safety-related research, positive reinforcement was also found to be effective in reducing accidents as exemplified in Uslan's (1977) study in a shipbuilding facility involving 20000 workers. In his study, positive reinforcement training was directed at increasing the number of times the workers wore their safety devices. Posting a feedback graph on a conspicuous place can especially achieve the desired effect in industrial safety (Mc Carthy, 1978).

In the present study, each group of employees will be invited to a 30-minute session in which safety information and motivational components will be presented to the attendants. The detailed package of training will be as follows (Duff et al, 1994):

i) The employees will be shown pairs of slides (35-mm transparencies, corresponding to the observation items on the check-list). The slides were taken from the actual scene of the workplace with the equipment used in the daily operation. Prompted by a slide with the unsafe act, the workers will be asked to describe verbally the hazardous behaviour in the scene. Afterwards, a safe act performed by the same operator will be shown, followed by an explicitly stated safe-behaviour slogan (e.g."Use both hands on the hand button to avoid putting the hand in-between the tools").

ii) Before the end of the presentation, the workers will be shown their baseline data in a graph on a 27" x 36" chart.

iii) During the intervention period, the workers will be presented weekly feedback in the form of posted charts accompanied by very plain and concise words, since many of the workers are relatively low in education. The researcher cannot take the workers' level of understanding for granted. This can be done by asking at random several workers to 'read out' the words on the chart and explain the slogan to confirm their understanding.

iv) Posters will also be used regularly as a feedback device. The posters will carry attractive, heavily loaded and up-to-the point message to achieve high impact. Various intervention devices utilized will include slides talks, leaflets, and posters.

4.3 Choice of Instruments

From the review of instruments commonly used by behavioural research in the area of occupational safely as mentioned in the literature review, the three most important research methods are interview, observation and questionnaire which have been widely utilized in risk assessment, baseline setting, training, goal-setting and feedback. in terms of attitude and behaviour modification.

4.3.1 The Interview As Data Collecting Method

In safety research, the interview is usually used for risk assessment to elicit important information concerned with safety strengths and problems with employees at all levels in a factory. They can be workers, supervisors, managers, safety and human resources, staff and other working personnel. As mentioned by Bright (1991, pp-58-69), the interview is a useful tool for gathering qualitative information as well as limited types of quantitative data, through direct face-to-face communication and interaction between the researcher/interviewer and the interviewee. This mode of direct inter-personal contact helps develop a fast bridge between the interviewer and the interviewee, thus making it easier for the interviewer to collect in-depth responses from the interviewee by means of probing questions. If rapport is established one might expect that the answers obtained would tend to be honest and thoughtful. However, with interviews, the information gathered cannot be totally clear of bias and subjectivity owing to the possible misinterpretation or unconscious influence from the interviewers. In this study, a semi-structured interview will be used with the individual workers, the supervisors and the factory manager. A set of prepared questions is used but the sequence and wording is at the discretion of the interviewer to decide. That is forced-response and open-end questions will be included.

"In a forced-response format, the respondent is asked to select a response from two or more alternatives; with the open-ended format, the respondent is allowed to construct the response. Besides, the item should give the respondent adequate direction. Sometimes optional wording or optional probes are given with items, for example:

> Of the following, which
> do you feel are strong points
> of the school in this district?
>
> a. quality of instruction
> b. facilities
> c. schedule
> d. control office administration
> e. school (building) administration (Wiersma, 1986, pp-183)"

There will also be supplementary questions to collect additional opinions from the respondents, if necessary (Bright, 1991, pp-59).

4.3.1.1 The Major Purposes of Interview

The interview is an instrument for sampling knowledge, opinions and thoughts from the respondents towards the researched objectives. From the data, the researcher can further categorize the information for generalization. The interview can help identify the aspects of performance prone to critical errors. Interviews can also be used for clarifying relationships and identifying variables for the sake of testing hypotheses. For example, in a worksite, interview is used to find out the existence of potentially hazardous acts or conditions that may be the causes of accidents. Details of unreported incidents can uncover the existence of potential work hazards related with human elements and environments, if anyone is willing to mention in the interview (Sulzer-Azaroff, 1987).

4.3.1.2 <u>The Limitation of Interview as a Research Instrument</u>

During the research for investigation, the researcher is supposed to be neutral and objective. He/she should avoid the imposition of personal influence or interference on the interviewee. He/she should ensure that the workers or supervisors are interviewed in a strictly scientific and objective way. Yet the involvement of personal influence through interpersonal communication is inevitable, thus leading to some possible distortion and unscientific influences, as far as the sources of information is concerned. This interpersonal reciprocal influence is understandable in everyday social interaction. This influence is conveyed in an unconscious manner during verbal and non-verbal modes of communications.

Another limitation of the interview is the impact from factors in relation to the participants' personal backgrounds such as differences in personality, intelligence, age, social class, culture, gender and so on. Establishing good rapport between the interviewer and the interviewees is crucial and there have to be 'openess' and 'trust' between both sides during the interview.

The mutual trust and the need for openness depends on the ease felt by the respondents. Sometimes the interviewer may meet with resistance to certain types of questions from the interviewees. In our everyday life, owing to the way we edit, summarize and construct our verbal responses and actions, we do not exhaust our sources of information and tend to unconsciously hold back some details during the interaction.

People's subjectivity in conveying the meaning is another limitation in the interview. The differences in personal interpretation and reconstruction of the world people see may create subjectivity and misunderstanding between people. Thus when using interview as a research instrument, it is imperative that the researcher should understand the possible sources of bias.

4.3.1.3- The Possible Conflict between Validity and Reliability

During the interview, when the same interviewer obtains data from different interviewees and when there is little variation and more consistency in the data collected, the reliability increases while the validity diminishes. The same situation is true when different interviewers obtain data from the same respondent. In order to secure honest answers and description of personal details, the researchers should try to compromise between validity and reliability. In the case of the present study, open-ended questions are integrated with the structured questions to maintain the reliability in the semi-structured interview. In the meantime, the use of some structured questions can retain the focus of the inquiry. As one of the open-ended questions for example, the respondents will be asked to describe an accident they have been involved in and the causes for the accident. Besides, the reduction of the interviewers to their minimum can reduce the differences of personal elements between the interviewers. Only one interviewer (the researcher) will be assigned. One major objective for using interviews in the study is to do the risk assessment in the plant before deciding what type of intervention is to be used. From the risk assessment, critical at risk items are identified and training is implemented accordingly to promote safe practices in the metal work.

4.3.2.0 Observation as an Instrument

In the present study, observation is the major method used for collecting data on safe and unsafe behaviours. Observation is thus used first to set up the baseline and then used to monitor the change of safety performance during treatment and post treatment.

4.3.2.1- What to Observe?

In a safety study, it is not feasible to wait for accidents to happen. Serious accidents are relatively rare and unpredictable. Thus the frequency of a serious event cannot be taken as a feasible measure. Although unsafe practices rarely lead to accident, most accidents are the consequences of unsafe practices happening somewhere in the chain of events. It is, therefore, valid to state that the frequency of unsafe acts can be an instrument for measuring safety performance in addition to safe acts.

The knowledge of the accident-related phenomena can contribute to accident prevention. The unsafe acts which happen much more frequently than do real accidents can provide a basis for preventive measures. The problem is that these kinds of non-absence or near-hits tend to be under-reported unless some methods have been devised to discover the occurrence of these hazardous acts. Direct observation is the most efficient way for recording and monitoring the unsafe practices. Carter & Menckel (1985) suggested that direct observation can best be performed by individuals directly involved in the operation. A trained external observer may be predisposed with the perception of what forms a near-hit and can only perform a limited number of observations whereas an internal observer who is actively involved in the activity is familiar with the work procedures and can increase the number of observations. As he/she is member of the workforce, the Hawthorn Effect can be reduced.

4.3.2.2 Types of Observations

There are five types of observations described by Bright (1991, pp-79-80): i) controlled observation, ii) non-participant observation, iii) structured observation, iv) unstructured observation and v) participant observation. The present study only focuses on the types of observations that are relevant to the study (i.e. i, ii, & iii). Unstructured observation and participant observation which are irrelevant to the current study will not be elaborated here.

4.3.2.2.1 controlled observation

In the controlled observation, beside the inclusion of non-participants (the observer does not participate in the production activities) structured observation (a pre-coded system for observation), standardized tests (e.g. achievement, aptitude, personality, attitude, mental stability, intelligence etc) and official records (e.g. evaluation report, personnel turnover rates, rates of absenteeism etc) are used. This can be regarded as a multi-channel observation to use in survey, case study and experimental studies.

4.3.2.2.2 non-participant observation

The observer stays out of the activities being observed in the non-participant observation and performs the observation in an unobtrusive manner with a structured record, for example, a Critical Behaviour Checklist in a metal work shop as mentioned earlier in this chapter. In the case of the present research to be conducted in the metalworks, the supervisors will act as the non-participant observers in terms of machine operation.

4.3.2.2.3 structured observation

In the structured observation, by means of a coding sheet that identifies the behaviours or features of the topics being researched, the researcher is able to collect information, according to the categories and phenomena set in the prior analysis of the situation or types of phenomena to be studied. To facilitate observing, rating scores for categorized behaviour are added afterwards in the analysis.

4.3.2.3 Observation Procedure

Based on the past researches on behavioural modification as summarized in Table (4.3) below, the frequency, duration of observation, total observation time for the whole study as well as the baseline period have been compared to set the criteria for the observation method of the present study:

A Summary Of The Observation Methods Of Some Of The Past Researches In Behavioural Modification Table 4.3

Studies	Duration of Each Observation	Total Observations Per Week	Total Weeks Of Observations	Baseline Period
Komaki et al (1978)	55 min	4	25 weeks	5.5 weeks
Sulzer-Azaroff & Santamaria (1980)	15-20 min	5	28 weeks	3 weeks
Komaki, Collins & Penn (1982)	15-20 min	3	46 weeks	5 weeks
Duff et al (1994)	45 min	3	40 weeks	8 weeks
Cooper (1994)	10-20 min	5	-------	4 weeks
Present study	15-20 min	3-5	25 weeks	8 weeks

1) An observation about 15-20 minutes will be spent in each department with the help of the checklist (Appendix 3) on which the observational codes will be listed. Each observation session will last for about 2 hours for all four departments and will be conducted 3 to 5 times per week by the observers going around the department, at different times, on different days to avoid predictability of the observation (Sulzer-Azaroff & Santamaria, 1980).
2) The observers will record the name of the department, date, and time of the day. The observers have to determine if the employees are performing their duty

safely or unsafely by verifying their acts against the items on the checklist. If possible, the observer should try not to let the individual or a group know that they are being observed. If they know that they have been singled out, they may behave unnaturally. There will be a negative impact on their work if they are worried about their record being abused.

3) Eight weeks of observations will be undertaken with each department. With regard to the total duration of observation, because the reality in the factory does not allow the researcher to have a long period of study for production concern, only 25 weeks for research have been tentatively agreed upon, after having discussed this issue with the top management.

4) The data collected will form a baseline figure for later comparison. Weekly figures will be calculated and averaged to show an overall index of departmental safety performance level which will be posted on a 3' x 4' feedback chart for the respective department. However, feedback charts as a treatment tool will not be shown in the baseline period that is mainly used for collecting data for their safety status at work before any form of treatment is administered.

5) Inter-rater reliability will be tested weekly by means of percentage agreement between the two observers who will be trained by the researcher.

4.3.2.4 The Measuring Instrument in Observation

In deciding the appropriate treatments to be given to the target groups, instruments for observation to assess the level of safety performance have to be developed. For this purpose, some procedures have to be followed:

i) A reliable performance measure is developed later in this chapter by identifying the controlling factors for causes of accidents and translating them into observable behaviours or situations which imply safe or unsafe events (based on the company's record of the previous two or three years and through an interview).

ii) A checklist of critical behaviours with behaviourally defined terms is constructed, providing a set of explicit instructions to remove ambiguity, so as to establish consistency in the scores between the observers, for the sake of measurement reliability.

iii) The checklist of critical behaviours is refined with the help of the factory manager, departmental supervisors or foremen and observers.

4.3.2.5 Scales of Measurement

A checklist with three columns will be designed:

a) Safe b) Unsafe c)Not Seen

If an item on the checklist appearing on the Safe column bears the score 1, it means all people are behaving completely safely, while the score 0 indicates that some or all people behave unsafely (Komaki et al, 1978; M.D. Cooper, 1994). Thus, the Safe column implies all or nothing measure. On the contrary, the Unsafe column will represent the frequency of incidents of hazardous behaviours. For each individual item, the unsafe column is calculated by counting the sum of the instances of unsafe behaviour, to exclude the possible occurrence of floor and ceiling effects in the bi-polary measurement (Cooper et al, 1993). The 'Not Seen' column represents the absence of a particular activity within a particular observation session. These neutral items will be eventually disregarded in the final percentage calculation. In short, the scores recorded can either be 1 or 0 on the 'Safe' column but the score on the 'Unsafe' column can range from 1 to infinity. Whenever a 1 appears on the 'Safe' column, 0 must be recorded in the 'Unsafe' column. On the other hand, a score of 0 in the 'Safe' column will yield a score ranging from 1 to infinity in the corresponding 'Unsafe' column. The final safety percentage obtained from each department has taken into consideration that some departments may have more workers.

Thus according to the 'all or none' criteria for determining the safety performance, all employees are required to work in accordance with all the applicable rules. And any single safety item violated, their performance will not be considered safe, as there will be an increased possibility of an injury that may happen any time. The percentage of employees in the individual department doing their work with total safety by means of observation will yield the safety score for that department.

4.3.2.6 The Application of Observation in the Present Study

The experimental nature of the present research requires the observation of safe and unsafe behaviour throughout the study with observation compatible with the participant type in a structured record. In this non-participant observation, the supervisors are invited to act as observers. And in this controlled observation, the non-participants (supervisors who are not involved in the production activities) and the researcher form a combined team with a more objective coding system.

4.3.2.7 Observers

As emphasized by Sulzer-Azaroff, observers should be chosen from people who are less likely to create any bias. One reasonable way to achieve this is to keep them ignorant of the details and expectations of the study and away from the daily working activities of the plant. In practice, outsiders as observers can serve this purpose. Yet outsiders are likely to contribute to a Hawthorn effect ---- in which safety behaviour might have improved simply as a result of being observed. Hence, to avoid the Hawthorn effect, external observers will not be hired in the current study as discussed earlier in this chapter. To compromise, personnel who have received observation training and supervision sufficient to keep their observation objective and accurate can be qualified as observers free from bias (Sulzer-Azaroff, 1987, pp-185).

In this study, to achieve the inter-rater reliability, two observers will conduct some observations and the average percentages between the observers will be obtained to see the agreement through Spearman Brown correlation coefficient. If the percentages are close, the reliability of the observation will be accepted. The observers should practice an observation pattern in which the order of the departments to be observed is irregular or the visits are unpredictable, then less Hawthorn effect will occur.

To give the correct training to the observers, Alavosius and Sulzer-Azaroff (1985)

> "used video taped demonstrations first and then accompanied observers to the actual site in which the transfers were conducted...... observers continued to practice until indices of agreement for each task component occurring in the proper order divided by total number of task components observed, sustained at above 0.85. Observer drift was managed by conducting similar comparisons

intermittently throughout the study. Any inaccuracy can be corrected via a retraining session similar to the initial series."

As a supporting means to controlled observation, the official and personal records in the factory, as recommended in the controlled observation, can be consulted to provide more comprehensive background materials related to the study.

4.3.3 Questionnaires as an Instrument

In most types of research approaches such as surveys, case studies, ex-post facto research, action research and ethnographic research, the use of one or more questionnaires is of utmost importance because of the flexibility of this instrument.

A questionnaire can be an effective means for gathering both quantitative and qualitative information. It is usually composed of highly structured questions, aiming at collecting specific types of data. Questionnaires are self-administered by the respondents and suitable for large scale research in which the face-to-face interaction or verbal communication between the researcher and respondents are, for most of the time, impossible. Thus clear and specific instructions are necessary to ensure the accuracy in completing the questionnaire, especially when mailed questionnaires are involved. And there is difficulty in following up responses to open-ended questions. Besides, the response rate of questionnaires can hardly be guaranteed, despite its usefulness and flexibility to meet the particular requirements of an individual researcher.

To elicit valuable and relevant information to meet the objective of the research, a questionnaire can be designed in such a way that the "top-down" process should be considered. In this process, the questions constructed are "progressively moving from a general to a more specific clarification of the research area and associated information requirement (Bright, 1991, pp-50)" without missing the focus of the research problem and its components. It must be admitted that great difficulties are often encountered in designing, reforming and in the choice of items in the questionnaire. During this stage, the importance and relevance of the items should be especially noted in order that ambiguity or confusion in the conceptualization of the research can be avoided.

In the present study, a questionnaire is used as a supplementary measuring instrument to observation to investigate the attitudes of the respondents toward safety at work. This instrument is convenient to be applied to a setting where a relatively substantial sample is involved.

4.4 **Development of the Instruments**

4.4.1 Interview Questions (Appendix 5)

Despite the relatively low reliability of interviews as a research method, this instrument is still useful for collecting in-depth data from the respondents who would otherwise be unwilling to reply to sensitive questions if asked to fill out a questionnaire. They may be too low in education levels to answer questions in the questionnaire. The interview will be used in the present study on two occasions. On one occasion, an interview used with the manager, supervisors and a group of workers of the target factory to identify the existence of hazardous behaviours, before any treatment can be prepared in the subsequent research stages. The task is to be achieved by means of a semi-structured interview in which some pre-set open-ended questions trying to investigate the existence of unsafe acts will be asked from a general perspective to specific issues (Siann et al, 1993). For example, concerning the general meaning of "work safety", the question below is formulated:

Q1 What do you understand about the words "work safety" ?

The researcher then wants to probe the respondent with questions on the definition of dangerous behaviour at work.

Q2 What do you think dangerous behaviours in work are ?

Q3 Give some examples. Are they very dangerous?

The author then tries to doubly verify the existence of habitually prevailing hazardous acts. The following question is thus generated:

Q4 In your opinion, is there any repetition in dangerous behaviour? Is it frequent? How?

A further question tries to investigate their unsafe practices of which they are not conscious:

Q5 Do you notice any people occasionally working around (prefer short-cut) proper procedures when hurrying up for delivery? Can you give an example?

Q6 And do you notice any of your colleagues occasionally behaving dangerously at work? Can you give an example?

The researcher thus tries to identify the existence of dangerous behaviours in the plant.

The ensuing question will ask about the time when accidents are likely to happen:

Q7 When do you think dangerous behaviour is likely to take place?

The researcher then attempts to know the general opinion of the respondents about the safety consciousness in his /her department and about other departments:

O8 Is your Department safety conscious?

Q9 Why do you say that?

Q10 Are other Departments more or less safety conscious?

Q11 Why do you say that?

The last question in the elementary interview intends to collect recommendations on improving safety performance:

Q12 What recommendations can you make for combating work accidents?

The different answers from the interviewees will then be summarized to understand the perception of the workers towards work safety and the safety status in the factory.

The other occasion to utilize the interview in the study is to interview a group of the workforce, the supervisors and the manager of the factory. The purpose is to verify the critical at risk items formulated according to the analysis of past accident and injury records of the company, from the safety inspection inventory of the international Safety Organization or HSE operation manual to ascertain the utility and practicality of the items developed. From the interview and discussion, the supervisor and the work force can provide valuable comments on the correctness of the critical at risk items that have been chosen. Often some additional items relating to behaviours not appearing in the accident records can be located.

The interview will also be used to enable the researcher to collect more detailed information on their unsafe behaviours and other contributing conditions to diagnose the real safety status in the plant.

4.4.2 Questionnaire Developed In the HSE Contract Research Report No. 81 (1996)

The set of questionnaires used in the current research is for measuring the attitude of the work force toward work safety before and after the intervention, with a view to finding if any attitude has changed as a result of the treatment to improve work safety. The questionnaire to be used in the present study has been adopted from some sections of a reliable and carefully produced questionnaire for and used in a key study in the U.K.(HSE Research No.81, 1996).

4.4.2.1 The Key Procedures in Developing the Questionnaire in the HSE Research No. 81 (1996)

The attitude questionnaire to be used in the present study is developed from the methodological approach of Facet Theory modeled on a similar approach in The HSE Contract Research Report No. 81 (1996). Facets were the basic conceptual units into which an area of interest was broken down. The approach started with the identification of the constituent parts, facets of a research area. Each facet was then sub-divided into elements which were an exhaustive list of all the possible components or values of a facet. The facets were combined to form a mapping sentence to provide a map or framework for generating the outline of questions in the questionnaire. There were a substantial number of combinations and each of the combinations was a basis of generating one unique question.

The development of the HSE Contract Research mentioned consisted of four phases. Phase I was to conduct a content analysis of the literature on occupational safety, existing audit techniques and previous research by the Safety Research Unit (SRU). The purpose was to develop a framework to serve as the basis of a Question set for attitude measurement. The framework generated from the content analysis served to be a useful means for classifying accidents and generating questions for the question set in the pilot study. The question set was then piloted to test its validity. During Phase II, attitudes question scores were obtained and correlated with an occupational accident rate (self-reported accident figures) to establish the relationship between safety performance and attitudes. In Phase III, the distribution of the revised question set was conducted at the sites, together with interviews of managers and the work force, in addition to plant observation. The data on accidents collected were correlated with the question set responses. In Phase IV of the project, further refinement and revision the questions were done by having the questions tested in twenty-five chemical sites to produce a final set of scales. Scale reliability was tested and satisfactory results were obtained.

4.4.2.2 <u>The Frame of Reference for HSE Report No. 81 (1996)</u>

The frame of reference of HSE Report No. 81 for generating the questionnaire was mainly drawn from the following sources:

i) Zohar's (1980b) work on the importance of organizational climate.

ii) Facets derived from the Project of British Steel conducted by the Surrey team----The questionnaire of British Steel had identified attitudinal factors related with accidents that demanded the multi-level commitments to safety.

iii) Technica's Manager System and Evaluation of the Human Contribution to Pipe Work and In-line Equipment Failure Frequencies----The classification scheme in Technica's (1989) study helped categorize the types of factors with accidents. These factors again were consistent with those originated in the foregoing studies.

For this reason, the list of factors is not elaborated here. In short, all the overlapping facets in the above studies were merged to avoid repetition.

iv) The International Safety Rating System (ISRS)

The International Safety Rating System (ISRS) was the last source for the questionnaire that presented an audit method to measure the safety performance of an organization by means of a scoring of the questions.

4.4.2.3 Validating the Facets of the Questions

In the original study, the distributed questions collected, were tested with a Smallest Space Analysis (Shye, 1985) to ensure that each facet was able to differentiate between questions which in turn could "be used to distinguish between those people, or groups, or organizations who (are) likely to have an accident and those who (are) less likely (HSE Report 81, 1996, pp-62)".

4.4.2.4 Reliability

To ensure that the scales generated were valid and reliable, in addition to the Smallest Space Analysis, the widely used Cronbach's Alpha Coefficient was utilized to measure the internal consistency of the set of questions. The Alpha was accepted at 0.6 level (HSE Report No. 81, 1996, pp-63) for the scales developed by means of SSA (Smallest Space Analysis).

Of the 16 scales, 10 yield Alphas over .8, 3 over .75, 1 at .71 and the rest over .6.

The results indicated that the alpha coefficients were all acceptable for this type of scale and hence for the process of scale generation.

4.4.2.5 Adoption of the Question Items from the HSE Report 81, 1996 for the Present Study

In the present study, most of the question items will be adopted from those in the HSE questionnaire, based on the following reasons:

i) The facets in questions have proved to be valid items measuring the attitudes of the respondents by means of the Smallest Space Analysis used.

ii) The alpha coefficients tested on the internal consistency of the attitude scales were acceptable above 0.6 level, showing the scales in the questionnaire to be reliable measuring tools.

iii) The questions had been repeatedly revised and refined to increase their discriminating and measuring power.

In spite of the above strict tests, the questions to be adopted in the present study will still be tested for its content validity by means of 'panel evaluation'. Again the test of reliability by alpha coefficient will be made to confirm the suitability of the questions to be adopted can be applicable to a setting other than the U.K. Although the author recognizes the fact that individual's attitude towards safety is closely related with all people in an organization which he/she is a part (HSE Report 81, 1996, pp-45), the large scope of the HSE study is far beyond the scope and resource of the present study. Therefore, questions in relation to manager and safety representative are to be discarded.

Besides, questions commenting on the general policy of the factory to be surveyed will be excluded, owing to the concern for provocation that will be likely to give rise to a lack of cooperation from the factory top management. One of the HSE (1996) questions---- "This company cares more about productivity than the people who work for it"---- for example, can provoke dissatisfaction in the metal-work where the researcher is going to conduct the empirical work, because productivity to maintain their business is of top priority in this factory.

4.4.3 Development of the Critical Behaviour Checklist

The safety precaution on the machines can contribute little to the overall safety in a factory if the operator does not recognize the importance of safety practices at work. As previously mentioned, observation of the frequency of occurrence of unsafe acts to establish a baseline will be a major method in the study. This will take place before feedback can be given to the workforce as one of the chain of steps to promote safety performance. To facilitate observation in a metalwork, a special critical behaviour checklist (CBC) (Appendix 3) should be developed according to Blake's (1963) description of the dangerous nature of operation in this industry (Appendix 6).

The analysis of at risk behaviour and the building up of the observation list is mainly an integration of the method from Geller (1995) and Fellner & Sulzer-Azaroff (1984a) with a view to coping with the actual work reality of the target metalwork. Geller's article provides a very clear step by step description of how a critical behaviour checklist should be developed. Their articles have also provided observation lists with illustrations of how the lists have been set and the items preliminarily assessed, setting examples for the present approach. As far as the individual working procedures are concerned, the production nature of paper as described in Fellner and Sulzer-Azaroff's study differs from that of metal products.

Thus only those items such as body protections and eye contact common to both trades have been retained when developing the CBC (Critical Behaviour Checklist).

Besides the practices adopted by previous researchers such as Fellner and Sulzer-Azaroff (1984a) and Geller (1995), several other sources such as the past injury record and the HSE (Health & Safety Executive) operation manual have been consulted and analyzed before an effective CBC can be generated.

4.4.3.1 Past Company Record

a) From the Company's accident record for the previous two years and a self-reported injury record in a questionnaire distributed to the workforce as described in the previous sections in this chapter, as well as the HSE operation manual, safety practices advocated by OSHA, the American Standards Institute (ANSI) and other related company manuals and recommendation (Reber and Wallin, 1983, pp-72), it is possible to identify contributing factors to accident causation in the target factory. After analysis, these accident factors can be sub-divided into observable behaviours or situations that are indicative of safe or unsafe events.

b) The accident data are then sorted by department to identify the different types of accidents within each department;

c) The accident data are categorized by place of injury on the body. The purpose is to allow identification of both the main types of accident and the types of task responsible for the causes and accidents. The records should also be classified according to the individual's behaviour or situation which contributes to the accident.

4.4.3.2 Common Unsafe Acts Identified in the Literature Review

In developing the CBC, the following unsafe acts highlighting different categories of human failure should be noted (Kavianian &Wentz, 1990, pp-237).

a. Operation without qualification or authorization

When an apparatus or machine is operated by an unauthorized person who does not possess the necessary operation knowledge, the chance is great for the occurrence of injury.

b. Lack or improper use of personal protective equipment

c. Failure to secure equipment:

Failure to secure equipment that is subject to automatic startup or unexpected movement will endanger the life of the workers.

d. Operating equipment at unsafe speed

Sometimes, an operator of a machine by-passes the normal procedures or regulates the machine to increase the speed for production at the expense of safety.

e. Failure to warn

f. Bypass or removal of safety device:

For the sake of convenience, some workers might remove safety devices from the equipment.

g. Using defective equipment

h. Use of tools for purposes other than those intended

i. Working on hazardous locations without adequate protection or warning

j. Improper repair of equipment:

Working on a machine that can accidentally be started up is dangerous.

k. Horseplay

Horse play is especially dangerous to the workers when being done in the plant.

l. Wearing unsafe clothing or decorative articles:

Working with gloves on moving machine parts or wearing watches, or wearing metallic parts when working with electricity is dangerous. (Kavianian & Wentz, 1990, pp-237-238)

4.4.3.3 Draft of the Critical Behaviour Checklist

From the above mentioned sources, the following safety regulations have been identified and from these regulations at risk items can be formulated. Some of these regulations have also been drawn from the company safety regulations from their past experience with accidents and injuries:

i) General Operation and Equipment

ii) Material Handling

iii) Personal Protective Equipment

iv) Housekeeping

(Appendix 2)

4.4.3.4 Validating the Checklist

The checklist should be further refined and verified by the departmental supervisors and managers in terms of the appropriateness of each item during interviews and discussions (Cooper, 1994). According to Fellner and Sulzer-Azaroff's (1984a) method of validation, the critical behaviour checklist will be given to the supervisors and manager for rating to decide the relative importance. Each item will be rated on the scale of 0 to 3, with '3' extremely important, '2' neutral, '1' not critical and '0' inapplicable. The items will be selected if they can fulfil the criteria: the items have occasioned an injury or obtained overall high rating from the group. However, in the present study, this method of rating is discarded. Instead the checklist will be used in its usual way scoring each item as 1 (seen) or 0 (not seen). The data analysis agreed can then allocate importance ratings at a later stage. In this way the likelihood of error in the input (the supervisors' rating of importance) can be reduced. Different weightings to chosen items can be tried as part of the analysis that may be more difficult if items have been pre-coded with an in-built weighing. The use of interview or discussion with supervisors and others as part of the procedure of establishing validity of the checklist is more important in this study.

4.5.0 Limitation of the Study

Since the experimental research involves the measurement of the effects of a treatment on the respondents and will involve a long span of time, probably years, there may be a risk of organizational changes in the factory or closing down owing to financial problems. The risk will affect the continuation of the research. The present study thus will avoid the experimental approach but instead will adopt one that is a combination of the ex-post facto and a survey. The ex-post facto research will not involve the manipulation of the variables but will attempt to detect the systematic relationship between the independent and dependent variables (Bright, 1991). The limitation of ex-post facto research is that there will be no randomization of subjects and may run the risk of neglecting the bias in some major characteristics in the subjects investigated. However, when being restricted by the real environments that do not allow the manipulation of the variables, ex-post facto research will be an alternative. The ex-post approach can be supplemented by the survey which will involve the descriptive process - using frequency/percentage count on identified variables to gather the facts about a situation, state or event. Likewise, the survey can be relational, trying to study the relationships between variables. After all, interview, questionnaire and controlled observation can be utilized in a survey for data collection.

4.6 A Summary of the Chapter

This chapter started with the review of all the relevant alternatives before the behavioural-attitudinal approach was finalized with justifications. Then followed an outline of the coming stages of the present research approach, namely risk-assessment, baseline monitoring, intervention with goal-setting and posted feedback and post measurement.

The subsequent pages tried to elaborate each stage of the investigation. Meanwhile, similar contemporary research methods for each stage of the approach on which the current study is modeled were described.

Then came the description and discussion in detail of the major research instruments (interview, observation and questionnaire) to be applied to the present survey with reference to their strengths and weaknesses, as well as the issues of their validity and reliability.

The development of the major measuring instruments (ie, interview questions, questionnaire, Critical Behaviour Checklist) in terms of their origin, frame of reference, step by step formulation and application were later summarized.

The later part of this chapter focussed on the building up of the measuring instruments. The manufacturing context in which the instruments were built was also considered. The drafting of the CBC, for example, was the result of the combined consultation of the company record, literature review and observations. In the meantime, the method of validating the instruments was decided. Finally, the limitation of the study was highlighted. The next chapter will be dedicated to the pilot study of the investigation.

CHAPTER V

PILOT STUDY

As an important stage in the whole research process, the pilot study provides a chance for the researcher to examine the suitability of the sampling, the measures and the procedures. A pilot study is especially important for the experimental design that demands careful scrutiny in terms of its validity and reliability before it can be confidently applied to the main study. In the current study, the pilot running is intended to examine the major instruments, namely the CBC (the Critical Behaviour Check-list) to be used for observation all through the survey and the adopted questionnaire for investigating the attitudes of the workers. These two instruments will be tested at the site with a limited number of respondents to evaluate all the items of the instruments for their representativeness and discriminating capabilities. Revisions will be made where necessary for final acceptance. Besides, the detailed steps for applying the instruments to the investigations in the mass survey will be examined to solve any technical problems that might incur.

5.0 Validity and Reliability of the Instruments

In research, reliable instruments allow the researcher to reduce the error of measurement to its minimum and maintain the consistency of the instruments in repeated tests or to prove that they can be replicated in a similar context other than that where the instruments are first used.

The appropriateness of interpreting the test scores or evaluation can reflect the validity that can determine the relevance and representativeness of the sample measured. By means of the safety performance scores, the items contained in the critical at risk checklist in the present study, for example, can help discriminate safe and unsafe behaviours as well as safe and unsafe situations. This instrument was piloted prior to the mass survey. It was translated into Chinese and given to a panel of experts in occupational safety in Hong Kong to verify the accuracy of the translation and the representativeness of the items of each scale to measure critical at risk behaviours and situations. The critical at risk checklist was then given to three judges (the factory manager, the supervisor and a worker recommended by the surveyed factory) to give their opinion of the importance of the instruments, before the pilot study. Some revisions were made accordingly after considering their opinions. Further advice was needed as to the suitability of the instruments before the instruments could be distributed for the mass survey.

In this chapter, each step of the pilot study in a chosen experimental site similar to the target one is described. The pilot test included:

i) the validation of the critical behaviour check-list to be used in the observation;

ii) the careful examination of the questionnaire in terms of the appropriateness of its length, its comprehensiveness compatible with the educational background of the respondents, relevance of the contents and last, the most important concern, reliability and validity.

All the above aspects would be examined before the critical at risk check-list and the questionnaire could be confidently applied to the large samples.

5.1 Validating the Critical Behaviour Checklist (CBC)

The Critical Behaviour Checklist as the major measuring instrument in this study is of utmost importance in the pilot for its validation. An interview with the factory manager, supervisors and a group of workers in the target metal work was made and the criteria for safe operation in the high risk departments (stamping and drilling) was discussed.

Factory A

Feedback from the factory manager, supervisors and a group of workers indicated that the items formulated on the CBC were compatible with those on the safety operation recommendations given by the management. However, they had the opinion that some technical terms should be rephrased in the descriptions familiar to the workers in the trade of metal stamping. For example, the term 'protective arms' were known to them as the 'sweeping hands". Meanwhile, some practical issues especially applicable to the situation of this work-site were also addressed. When handling the small articles such as the brackets, for instance, some workers had difficulty in preventing the articles from falling down from the working table unless they were put in a small container. All these issues were taken care of and reported in the following summary:

Section 1) (General Operation and Equipment)

Item 7 (Item 9-Finalized Version)

Attention should be paid to the proper translation of the word "clipper". This term was misleadingly translated into "fixture". This word should thus be rrevised. Besides, it should be emphasized that in this item the using of a pin or clipper to remove the semi-product from inside the die was a must for safe working.

Item 10 (Item 13-Finalized Version)

The respondents reminded the researcher that the operator was allowed to leave the machine running after having been given permission to take a short break (e.g. going to the toilet);

Item 14 (Item 17-Finalized Version)

The item that "the use of chairs, fork-lifts or other make shift devices as a work platform is prohibited. Always stand on a ladder when working more than 1 foot off the ground." would not fit the working context of the target plant, because it was unlikely that this dangerous practice would ever happen there. Instead of using chairs or fork-lifts or other makeshift devices as the work platform, they used steel racks which were quite secure. As for loading and unloading the tools, they used cranes. At their request, this item was deleted.

Section ii) (Material Handling)

Item 3: "Before attempting to drill, grind, or ream small objects, clamp or secure the item first. Avoid handing the object with one hand while performing the operation with the other. " The respondents felt that this practice was absent from their working reality, as they did not need to grind or ream small objects in both the stamping and drilling departments. This practice, in fact, should be applied to the department of tool making. This item was thus eliminated.

Section III) (Personal Protective Equipment)

Item 5: " Approved safety glasses or goggles should be worn when working beneath or with equipment around which the danger of falling or flying particles exist. " According to the opinion of the respondents, the nature of the work in the stamping and drilling department would not involve falling or flying particles that would endanger the eyes. For the last reason, this item was removed.

Section IV) (Housekeeping)

One supervisor pointed out that other than those items on housekeeping formulated in this section, the following item should be added:

"Workers if found to be in a bad mood or in a poor physical condition (lack of sleep or drunk) should not be allowed to work." Although it was unusual for workers to be found in a state physically or spiritually unfit for work, this happening was not unknown. This type of behaviour was extremely dangerous. The supervisor's suggestion was accepted and the item was added accordingly.

Other additional items not appearing on the CBC were also added, as recommended by the respondents:

Section I)

"The sitting posture of the machine operators must be appropriate for safety concern."

"Hands must be off the area where the press buttons are located when loading the semi-finished product onto the die." This is to prevent either hand from getting caught between the upper and lower parts of the die by accident.

"Workers should not put things under their feet as platforms for the sake of comfort." Workers may tumble over the platforms and hurt themselves.

Section II)

"Small particles should be placed in a small container and put in an appropriate place nearby before and after punching or drilling." Accidents may occur when the small particles fall into the gap of the moving machine.

"The material for production should be piled or placed neatly beside the operator before and after being processed." Reports of workers hurt by pieces of fallen material that is usually heavy and with edges sharp are not uncommon.

"The work platform should be clear of any particles after tool adjustment." The scattered tools may fall down and endanger the operator of the machine.

Section III)

"During working hours, staff are forbidden to loiter in the production areas for the sake of safety." Staff loitering in the production area have the chance of being hurt, when they are accidentally hit by material transported by the workers or by moving forklifts.

Section IV

"The worker who was responsible for transporting material should avoid standing on the empty forklift." Standing on the forklift is a dangerous behaviour, as the forklift may bump into anybody or an obstacle in the passage and result in an accident.

"Forklifts should be placed in the zone as specified by the yellow lines." Forklifts blocking the passage can pose danger to workers.

"No scrap, small particles, stain of oil or junk should be left underneath or in the vicinity of a machine." Workers may sometimes fall down and hurt themselves when stepping on the scraps or particles or on the oil.

5.2 Validation of the Questionnaire

As a supplementary instrument to the Critical Behaviour Checklist (CBC), a small size questionnaire was used to measure the workers' attitudes toward work safety. Items of the questionnaire were adopted from those in the HSE Research Report No. 81(1996) to measure the important aspects about work safety, for example, safety meeting and training. And only those items relevant with safe operation in metal stamping were chosen. A total of 34 items were adopted, forming 11 scales for attitudes in work safety. Before the scales were finalized, the items were given to 5 experts in the field of occupational safety to rate the question items in terms of content validity. They were safety managers from factories, having experience in occupational safety management from 5 to 15 years. They were all holding a master's degree with graduation diplomas in occupational safety from the local academic organizations. Accordingly, a 6-point scale ranging from 1 (poorly represents) to 6 (strongly represents) was used to evaluate the content representativeness of the question items. A minimum value of 4.0 as the decision criteria was used for judging representativeness to be acceptable. The means of the 34 piloted items ranged from 4.2 to 6.0. According to the result, all items were retained for the pilot.

<u>The 11 Safety Attitude Scales (34 Question Items) At the Pilot</u> Fig. 5.1 (also see Appendix 1)

Scale 1 Supervisor Satisfaction

Items: 30 (HSE 52), 31 (HSE 53)

30 My supervisors are satisfied with safety training given to their work group.
31. My supervisors are generally satisfied with safety in my plant.

Scale 2 Supervisor Knowledge

Items: 32 (HSE 54), 33 (HSE 56), 34 (HSE 57)

32. My supervisors know what safety equipment people in my plant should use.
33. My supervisors know what is discussed in plant safety meetings.
34. My supervisors know what safe working procedures people should be following.

Scale 3 Supervisor Encouragement & Support

Items: 28 (HSE 50), 29 (HSE 51)

28. My supervisors encourage me to report any safety problems I might notice.
29. I'm encouraged by my supervisors to go to meetings about job safety.

Scale 4 Shop-Floor Satisfaction

Items: 7 (HSE 10), 8 (HSE 11), 17 (HSE 21)

7. I'm satisfied with the safety equipment specified for my job.
8. I'm happy with the existing safety precautions for especially dangerous parts of the plant.
17. My work-mates are satisfied with the safety procedures in general.

Scale 5 Shop-Floor Environment: Hardware

Items: 2 (HSE 3), 4 (HSE 5), 15 (HSE 19), 16 (HSE 20)

2. Before I start work I check the safety equipment I might need.
4. Generally, I keep the area I work in tidiness.
15. My work-mates keep the area they work in tidiness.
16. The people I work with check any safety equipment they might use before starting work.

Scale 6 Work Group Support & Encouragement

Items: 24 (HSE 32), 25 (HSE 33), 26 (HSE 34), 27 (HSE 35)

24. The people I work with encourage me to work safely.
25. If I had a complaint about safety my work-mates would support me.
26. I encourage the people in my plant to work safely.
27. My work-mates would expect me to support them if they had a complaint about safety.

Scale 7 Shop-floor Training

Items: 10 (HSE 13), 18 (HSE 22), 22 (HSE 30), 23 (HSE 31)

10. I feel satisfied with the attention given to safety in any training I have had.
18. The people I work with are satisfied with the attention given to safety in any training they have had.
22. The people I work with know what safety training is needed for their jobs.
23. My work-mates are satisfied with the attention paid to safety in any training they have.

Scale 8 Global Self Safety

Items: 12 (HSE 16), 13 (HSE 17)

12 Overall, I think that I work safely.
13 In terms of safety, I'm happy with the way I usually work.

Scale 9 Safety Meeting

Items: 1 (HSE 1), 11 (HSE 14), 14 (HSE 18), 21 (HSE 29)

1. Whenever there are safety meetings to do with my job I go to them
11. I am satisfied with the safety meetings we have.
14. The people I work with go to safety meetings about their jobs.
21. The people I work with are satisfied with the input they have at safety meetings.

Scale10 Safety Working Procedures

Items: 3(HSE 4), 5 (HSE 8), 20 (HSE 25)

3. I know the written safe working procedures for my job.
5. If changes are made to the procedures for my job I know about them.
20. The people I work with understand the reasons for the safe working procedures they are supposed to follow.

Scale 11 Safety Information

Items: 6 (HSE 9) 9 (HSE 12) 19 (HSE 23)

6 I know the results of safety inspections to do with my job.
9 I feel satisfied with the safety information I get.
19 The people I work with are satisfied with the information they get about safe working.

5.3 Questionnaire Distribution in the Pilot Study

The scale of a pilot study is usually small but must be representative of the target population. The pilot sample subjects should not be selected from the mass survey in case the intended population is small. The present study for example, has the pilot conducted in a factory (Factory B) other than the one (Factory A) where the mass survey is to take place, because the population in the latter is relatively small, comprising only 359 subjects. The reason for doing the pilot study in factory B instead of Factory A was to avoid the Hawthorn effect in Factory A which will be reserved for the mass survey. If 50 workers were used for pilot running in Factory A, more than one eighth of the total population there would know the content of the questionnaire. They would spread the information from the pilot to those who had not yet been involved in the study, thus contaminating the main study, as the rest of the population would be affected by the Hawthorn effect. The alternative to prevent this was to do the pilot in another site with vital similar context.

60 questionnaires were distributed to Factory B, which was similar to Factory A in the nature of business. Factory B was also engaged in metal stamping, forming, drilling, welding and tool making for tele-communicative products. There were approximately 200 employees in the factory. Resembling Factory A, the majority of the workers there were recruited from neighbouring provinces to Kwangdong with similar cultural and educational backgrounds.

The pilot run for the questionnaires was duly done with Factory B. The questionnaires were given to the workers in the stamping and drilling departments. They were asked to complete the questionnaires right after lunch in order to minimize the interruption to their production. The filling out of the questionnaires for each respondent took over one and half an hours. Some workers had to rush when being urged to hand in the questionnaires in an hour and asked the researcher to give them extra 15 minutes. Soon after the collection of the questionnaires, an interview was given to supervisors and several workers to probe their comments on the questionnaires in terms of clarity, length, and relevance. Their responses were summarized as below:

5.3.1 The questionnaires were distributed to the workers before lunch and collected when they came back to work in the afternoon (12 noon----1.30). Since the overall education the workers had received was low (primary school), they had some difficulty in understanding some of the terms in the questions within the limited time.

5.3.2 Section A was more time consuming to fill out, compared with other sections. Section B and C were comparatively more difficult to understand.

The approximate time spent on each section was recorded:

Section A ---- 10-15 minutes

Section B ---- 10-20 minutes

Section C ---- 10-15 minutes

Section D ---- 10 minutes

Background Questions ---- 20-30 minutes

As the respondents only had limited time to fill out the questionnaires during lunch break, the total time needed for the completion of the questionnaires was too long. It was thought the time should be reduced after reviewing the length of the questionnaire.

5.3.3 As far as the overall length of the questionnaire was concerned, it was thought that the questions were too many in number. Three questions related with the management were thus deleted, as they were rather sensitive and might create resistance from the management. If the workers were asked to comment on their managers, the answers they gave might affect the reliability. Furthermore, after consulting the management about the academic background and the reading abilities of the workers, the numbers of questions were cut down to be more manageable. Only those questions that had alpha value above 0.5 (Fig. 5.2) and also those concerned with factors essential for work safety, for example, were chosen (Scale 6---Work Group Support & Encouragement; Scale 8---Global Self Safety; Scale 11---Safety Information were dropped). The reason for accepting the alpha value above 0.5 instead of 0.6 level was that the present study was of a much smaller scale compared with the HSE investigation that involved twenty-five chemical sites in the U.K. As a result, 25 questions comprising eight scales were finalized:

The 8 Safety Attitude Scales Fig. 5.2

Scale 1 Supervisor Satisfaction

Items: 21 (HSE 52), 22 (HSE 53)

21 My supervisors are satisfied with safety training given to their work group.
22. My supervisors are generally satisfied with safety in my plant.

Scale 2 Supervisor Knowledge

Items: 23 (HSE 54), 24 (HSE 56), 25 (HSE 57)

23. My supervisors know what safety equipment people in my plant should use.
24. My supervisors know what is discussed in plant safety meetings.
25. My supervisors know what safe working procedures people should be following.

Scale 3 Supervisor Encouragement & Support

Items: 19 (HSE 50), 20 (HSE 51)

19. My supervisors encourage me to report any safety problems I might notice.
20. I'm encouraged by my supervisors to go to meetings about job safety.

Scale 4 Shop-Floor Satisfaction

Items: 6 (HSE 10), 7 (HSE 11), 8 (HSE 21)

6. I'm satisfied with the safety equipment specified for my job.
7. I'm happy with the existing safety precautions for especially dangerous parts of the plant.
8. My work-mates are satisfied with the safety procedures in general.

Scale 5 Shop-Floor Environment: Hardware

Items: 2 (HSE 3), 4 (HSE 5), 12 (HSE 19), 13 (HSE 20)

2. Before I start work I check the safety equipment I might need.
4. Generally, I keep the area I work in tidiness.

12. My work-mates keep the area they work in tidiness.
13. The people I work with check any safety equipment they might use before starting work.

Scale 6 Shop-floor Training

Items: 9 (HSE 13), 14 (HSE 22), 17 (HSE 30), 18 (HSE 31)

9. I feel satisfied with the attention given to safety in any training I have had.
14. The people I work with are satisfied with the attention given to safety in any training they have had.
17. The people I work with know what safety training is needed for their jobs.
18. My work-mates are satisfied with the attention paid to safety in any training they have.

Scale 7 Safety Meeting

Items: 1 (HSE 1), 10 (HSE 14), 11 (HSE 18), 16 (HSE 29)

1. Whenever there are safety meetings to do with my job I go to them
10. I am satisfied with the safety meetings we have.
11. The people I work with go to safety meetings about their jobs.
16. The people I work with are satisfied with the input they have at safety meetings.

Scale 8 Safety Working Procedures

Items: 3(HSE 4), 5 (HSE 8), 15 (HSE 25)

3. I know the written safe working procedures for my job.
5. If changes are made to the procedures for my job I know about them.
15. The people I work with understand the reasons for the safe working procedures they are supposed to follow.

5.3.4 The overall contents of the question items were considered to be comprehensible except certain terms (e.g. short-cut, responsibility, involvement) which were too literal for them to understand with their educational level. These terms were thus revised until they were considered by the respondents to be more colloquial and easily understood.

5.3.5 The relevance of the questions was examined and words that were considered ambiguous were deleted or revised (followed by an explanation in a bracket) to take into consideration the educational levels of the workers.

5.3.6 The clarity of the questions was discussed and revised until the respondents did not experience any problems.

The modified questionnaires were then given to five workers to fill out in the factory and it was found that the time needed for completing the whole questionnaires had greatly reduced to 45 minutes. Besides the time concern, the questions removed were those that were related with the management and those questions were rather sensitive at this stage. However, the removal of those questions would by no means affect the whole picture of the investigation:

Section A---------------- 10 minutes

Section B----------------- 8 minutes

Section C----------------- 7 minutes

Background Section---- 20 minutes

5.4 The key elements critical for occupational safety in the metal workshop were listed in the table (5.1) below:

Table 5.1

Key Elements Critical for Occupational Safety in the Metal Work Common to Both the Questionnaire for Attitudes toward Safety and for the Critical Behaviour Check-list.		
Element	Description	Equivalent Scales in the Questionnaire (8 Scale Version)
a	Safety practices (procedures)	Scale 8 - Safety Working Procedures (Items: 3, 5, 15)
b	Training	Scale 6 - Shop-floor Training (Items: 9, 14, 17, 18)
c	Safety awareness of workers	Scale 7 - Safety Meeting (Items: 1, 10, 11, 16) Scale 5 - Shop-floor Environment (Items: 2, 4, 12, 13)
d	Safety awareness of the management	Scale 2 - Supervisor Knowledge (Items: 23, 24, 25) Scale 3 - Supervisor Encouragement & Support (Items: 19, 20)
e	Safety conditions in the factory	Scale 1 - Supervisor Satisfaction (Items: 21, 22) Scale 4 - Shop-floor Satisfaction (Items: 6, 7, 8)

These major components of work safety in the questionnaire are closely related to those included in the observation check-list, the major measuring instrument in the research. The notion for selecting the above components common for the two instruments was that after the intervention, if there was improvement in the safety practices of the workers, it was expected that there would be corresponding change in the workers' attitudes towards work safety.

5.5 Data Analysis for the Pilot

The questionnaires were coded after collection. The response rate was 88% (53 out of 60). The data collected from the questionnaire were then analyzed:

i) The data were used to calculate the scale score for each of the scales

For this purpose, the mean of the items that comprise the scale was calculated for each respondent. For example, to obtain a score for Scale 2, SUPERVISOR KNOWLEDGE, the means of questions 23, 24, 25 were obtained from each respondent.

ii) These means were then summed across the targeted departments and the overall scale mean calculated.

iii) This procedure was repeated for all scales and 8 scales which were compatible to the reality of the current experimental site were adopted from the HSE questionnaire for the mass survey (HSE, pp-104). A few items in the 8 scales with total item correlation though less than 0.4 were retained because of their importance in the basic occupational safety in metal work.

5.5.1 Reliability of the Scales in the Pilot Run

5.5.1.1 CRONBACH ALPHA RELIABILITY & TOTAL ITEM CORRELATION FOR ITEMS FORMING THE 11 SCALES IN THE PILOT STUDY FIG. 5.3			
Items of the Scales	**Description**	**Reliability Alpha**	**Total Item Correlation**
1. 30, 31 (HSE 52, 53)	Supervisor Supervision	0.6080	(52) - 0.4381 (53) - 0.4381
2. 32, 33, 34 (HSE 54, 56, 57)	Supervisor Knowledge	0.5107	(54) - 0.4159 (56) - 0.5318 (57) - 0.1076
3. 28, 29 (HSE 50, 51)	Supervisor Encouragement Support	0.5722	(50) - 0.4042 (51) - 0.4042
4. 7, 8, 17 (HSE 10, 11, 21)	Shop-floor Satisfaction	0.8408	(10) - 0.6378 (11) - 0.7983 (21) - 0.6856
5. 2, 4, 15, 16 (HSE 3, 5, 19, 20)	Shop-floor Environment: Hardware	0.6431	(3) - 0.3180 (5) - 0.4543 (19) - 0.4320 (20) - 0.4963
6. 24, 25, 26, 27 (HSE 32, 33, 34, 35)	Work Group Support & Encouragement	0.2991	(32) - 0.0178 (33) - 0.1428 (34) - 0.0535 (35) - 0.5517
7. 10, 18, 22, 23 (HSE 13, 22, 30, 31)	Shop-floor Training	0.7499	(13) - 0.5287 (22) - 0.6943 (30) - 0.3148 (31) - 0.6701
8. 12, 13 (HSE 16, 17)	Global Self Safety	0.4168	(16) - 0.2633 (17) - 0.2633
9. 1, 11, 14, 21 (HSE 1, 14, 18, 29)	Safety Meeting	0.6590	(1) - 0.4639 (14) - 0.4991 (18) - 0.5209 (29) - 0.3377
10. 3, 5, 20 (HSE 4, 8, 25)	Safety Working Procedures	0.6117	(4) - 0.4086 (8) - 0.4188 (25) - 0.4514
11. 6, 9, 19 (HSE 9, 12, 23)	Safety Information	0.3316	(9) - 0.0128 (12) - 0.2077 (23) - 0.3876

5.5.1.2 Cronbach Alpha Reliability For Items Forming The 8 Scales for the Mass Survey Fig.5.4		
Items on the Scales	Description	Reliability Alpha
1). 21,22	Supervisor Satisfaction	0.6080
(HSE 52,53)		
2). 23,24,25	Supervisor Knowledge	0.5107
(HSE 54, 56, 57)		
3). 19, 20	Supervisor Encouragement & Support	0.5722
(HSE 50,51)		
4). 6, 7, 8	Shop-floor Satisfaction	0.8408
(HSE 10, 11, 21)		
5). 2, 4, 12, 13	Shop-floor Environment: Hardware	0.6431
(HSE 3, 5, 19, 20)		
6). 9, 14, 17, 18	Shop-floor Training	0.7499
(HSE 13, 22, 30, 31)		
7). 1, 10, 11, 16	Meeting	0.6590
(HSE 1, 14, 18, 29)		
8). 3, 5, 15	Safety Working Procedures	0.6117
(HSE 4, 8, 25)		

The reliability alphas obtained in the 8 finalized scales after the pilot run were deemed to be adequate, based on the following grounds:

a) The questionnaire was an adaptation from the HSE version in an UK social context with relatively mature awareness in occupational safety. The application of similar scales to an area with a completely different social and cultural background and where work safety was still in its elementary stage was an important consideration. The Chinese society is largely predisposed by traditional agricultural life style which places collective interest over individual safety. This life view of Chinese culture reflected on work safety is the overall lack of concern of the workforce for safety. The negligence of personal safety is also consonant with the Communist doctrine of valuing collective interest.

b) The alphas recorded in this pilot were not low in comparison with Schibeci's (1987). The alpha reliability obtained from an attitude scale in Schibeci's "Effects of Classroom Environment on Science Attitudes. A Cross-cultural Replication in Indonesia" ranged from 0.53 to 0.69. According to Gardner's (1975, pp-15) opinion, "Internal consistency of a scale is not the most important criterion", as the researcher "could make the internal consistency very high by making all the constituent items nearly identical, but the scale would then embrace such a narrow range of situations that it would be of little value as a research instrument." As far as the present study is concerned, although the alpha values are not as high as those in the HSE (Report No. 81, 1996, pp-104) version, they are still large enough to suggest that the present version of each scale contains adequate internal consistency and that both versions are measuring overlapping aspects of safety attitudes.

5.6 Conclusion

The reliability alphas of the questionnaire scales in the pilot study were not as high as those in the original version in the HSE questionnaire used in the U.K. This difference in the results obtained may be explained by the huge sample size involved in the U.K. study whereas the samples surveyed in this study could only be limited to a relatively much small size. Besides, the survey was conducted in a context totally different in social and cultural background and culture from the U.K. This was likely to be more important than the sample size differences.

To conclude this chapter, it was found that it was extremely difficult for the author to invite metal houses to participate in the pilot study. They were too occupied with their production to spare time for the pilot study in which a substantial portion of workforce had to be involved. What was more important was that the factory managers were on their guard against the possible internal information being disclosed to their competitors under the pretext of research. For example, the author had approached over 10 factories before two factories were willing to participate. They had repeatedly reminded the author to observe the confidentiality.

The next chapter will be dedicated to the conduct of the mass survey in the factory.

CHAPTER VI

CONDUCT OF INVESTIGATION

This chapter describes in detail the field work investigating whether workers' attitudes and behaviours towards occupational safety could be modified after the implementation of an intervention to promote work safety with a multiple baseline design. The investigation will start with the preparation of the slides for training, setting the standard for discriminating the safe behaviours from the unsafe ones. The risk assessment by means of interview to be used with each stratum of the work force helps identify the current safety status of the target departments. The details of the safety status would, to a certain extent, predispose the contents of the intervention needed. Then the training of the observers followed, taking into consideration the proper procedures, the duration of time and frequency of observations. Meanwhile, inter-rater reliability as an important element in observation will be addressed. As a supplementary instrument, questionnaires will be distributed to the respondents for attitudinal investigation. And as far as the intervention for each department is concerned, contents and steps in the seminar for training, weekly feed-backs to reflect the workers' safety performance as well as incentives to be applied are described in turn. At the end of this chapter, the hypotheses are restated in their null form prior to the presentation of the results in Chapter 7.

6.0 The Preparation of Slides for Safe and Unsafe Behaviours

Before the mass survey, preparation was made to review the materials needed for the intervention. A meeting was held with the factory manger and supervisors, going through the items on the critical behaviour checklist and based on the checklist, slides on the safe (do) and unsafe (un-do) behaviours in the stamping and drilling departments were developed (Appendix 15). Before the introduction of the present study, the researcher was aware that that the Departmental Quality Control had made a few slides on the correct way of handling the material during stamping, drilling and welding in an attempt to minimize the production defects and maximize the yield. At the request of the researcher, the slides were reviewed with a slide projector. The content of each slide was commented on in terms of its compatibility with the safety requirements that had been developed in the critical behaviour checklist. It was found that a few of the slides on how to handle correctly the metal sheets and small metal particles could be adopted for part of the training package. It was decided that slides on items other than those taken for the quality management coincident with the safety operation would be added. The manager and supervisors promised that they would arrange an evening to vacate one or two stamping and drilling machines for picture taking purposes and would have a worker sit in front of the machines to demonstrate both the "do" and "un-do" operations. Accordingly, this task was done.

6.1 The Mass Survey

6.1.1 Subject and Setting

As mentioned in the 'Personal Rationale of the Study' at the beginning of this dissertation, the study was conducted in a metal sheet stamping plant which was engaged in fabricating metal chassis, covers and bottoms for computer-related and communicative products such as power supplies, satellite receivers and overhead projectors. The plant was located at the Special Economical Zone in Shenzhen China with 359 employees. Of the total number of employees, there were 108 male and 34 female workers in the four departments of production, namely Heavy-duty

Press, Small Press, Hand Press and Drilling. And their ages ranged from 18 to 32 or above. The majority of the ages fell within the range from 18 to 26. That means the workforce, in the four departments, were on average, quite young (Table 6.1). Meanwhile, workers who were more inclined to be involved in injuries and accidents were related with these four departments, among which Heavy Duty Press was the biggest one (Table 6.2).

A Statistical Record by Age for the Four Departments in the Metal-Sheet Stamping Plant Table 6.1

Sex / Age	Male	Female	Total
18-25	68	26	142
25-35	40	8	

A Statistical Record of the Number of Subjects in the Four Departments Studied in the Metal-Sheet Stamping Plant by Sex Table 6.2

Department	No. of Subjects	Male	Female
Heavy Duty Press	83	108	34
Small Press	29		
Hand Press	22		
Drilling	8		
Total	142	108	34

All the workers were working on a one shift (8-12, 1-5), six-day week. Any time after 5 p.m. would be counted as over-time and workers would be paid 50% extra in addition to normal hourly wages.

6.1.2 Risk Assessment (Interview)

To assess their occupational safety status, an interview was conducted with the manager, supervisors and a group of workers about their opinions on work safety and the possible existence of work risk in the target factory. Each interview took approximately 15 minutes. The factory manager was first reluctant to disclose details of internal operation for fear of incurring any negative consequences but when he was assured of the good intention of the research for improving occupational safety and health for the workers, he agreed to assist. And also with his permission, the researcher was able to interview the supervisors and a group of machine operators. Prior to the introduction of the first intervention, workers from the four departments were interviewed to investigate the safety status 'in house'. The interviewed operators were selected randomly by the supervisor on the site and interviews were conducted in the conference room. The interview was conducted on a one-to-one basis. The interviewer began each interview by introducing the fact that he was a researcher from the University of Hull. He assured each respondent of the confidentiality of the information collected from them and their names would not be released. The researcher recorded the respondents' answers against each question.

The interview with each respondent took 10 to 15 minutes. The detail was recorded below:

Report of the Interview

Q1. What do you understand about the word "work safety"?

Workers:

a) It's quite abstract. It might refer to abiding to proper safety procedures, and concentrating on one's work. The operators should report to the supervisor if they detect abnormality with the machine.

b) The operator should be careful at any work step.

Manager:

a) The operator should pay attention to their own safety, put the material properly on the die and use both hands to press the button and always keep the hands away from the vicinity of the mould and die when using either the hand-press or the foot-press.

b) The operator should avoid wearing gloves which would be likely to be caught in the moving parts of the machine.

Supervisors:

a) In the painting department, work safety is closely related with the layout of the production line, the poor design of which may cause a work accident. The worker must have the concept of safety, especially if they are dealing with the chemicals. They should wear mouthpiece, as some of chemicals may contain toxic gas such as chloroform that would have chronic damage to the nerve system.

b) Work safety means working in safe environment in which the machines and tools are in good working condition. The workers should operate the equipment according to instruction to ensure their own safety.

c) In the tooling department, the operators should pay attention to general work safety:

i) They should not wear gloves when working on the lathe. They have to clean up the iron chip and iron dust sitting within the gap of the moving parts or the vicinity of the machine, since flying chips will cause injury to the face and body of the operator.

ii) For working with a drilling machine, the operators have to make sure that the small parts are clenched tightly while the big ones are supported in the proper way, less they will drop.

iii) For the routing machine, when the material is thin and large, it must be fastened with clips. Meanwhile iron clips may be flying out and therefore the place must be fenced with metal sheet or a big piece of board.

iv) As for milling machines, which are always fully occupied in a tooling shop, the operator should often check that the grinding stones are free from any cracking which is hard to detect unless the operator can watch for carefully to the abnormal sound when grinding. Special care must be taken in operation, to ensure that no obstacles are on the grinding worktable. The long material must be fastened or clenched.

v) When transporting the moulds or tooling material, the operators must have consensus in actions during loading and unloading, less accidents will occur.

Q2. What do you think dangerous behaviours in work are?

Manager, supervisors and workers:

i) In the pressing department, for convenience, sometimes the worker would block one of the buttons with tape and use only one hand when they are supposed to use both.

ii) Or they would remove from the machine the protection which they think is a bother.

iii) The most dangerous thing is when they enjoy the feeling of continuity of the movement, they step on the foot brake, soon as they have removed the first article on the die and replace it with another. Any in-coordination between the hand and foot due to miscalculation of the time will be a tragedy.

iv) Lack of concentration when operating the machine could be dangerous.

v) To produce a better yield, some workers would adjust the speed of the wheel for acceleration without the approval from the supervisor.

vi) For convenience, the workers would use their hand instead of an auxiliary clip to take out the article from the die.

vii) Putting personal stuff, cloth, scrap chips on the working table may cause danger.

viii) When there are second and third workers sitting beside the machine operator to help him/her with bulky parts or for cosmetic inspection, the attention of the operator sometimes would be distracted because the situation would facilitate conversation.

ix) The operators do not know how to operate the machine properly if they do not learn well during the training.

x) Spilled oil on the floor after the routine filling on the machine holes for lubrication during maintenance would make a slippery floor and cause danger.

xi) The improper operation of the machinery by the operator could be a dangerous behaviour.

xii) The improper sitting postures of the operator may create danger.

xiii) Keeping long hair without tidying it up would endanger the female operators, when operating the machine.

xiv) Wearing sandals can be dangerous, as it cannot protect the feet from falling objects

xv) Operating other people's machine without being supervised is a dangerous behaviour.

Q3. In your opinion, will there be repetition in dangerous behaviour?

Workers:

Yes, a lot of the dangerous behaviours are repetitive and habitual. It does not necessarily happen to the same person again.

Q4. Will people occasionally work around (prefer a shortcut) proper procedures when hurrying up for delivery?

Workers:

a) Yes, if my pay is based on quantity. But I will follow the proper procedures if I am a salary earner.

b) Yes, very frequently.

c) Yes, I will try the short-cut if I have to speed up to meet the target yield.

Q5 And do you notice any of your colleagues occasionally behave dangerously at work?

Manager, supervisors and workers:

a) i) In the painting department, the workers sometimes empty the used chemical into the ditch and this act is dangerous.

ii) Smoking in the painting department is hazardous.

iii) There will be long term negative impact on the health of the workers who do not put on a mouth piece when renewing the fluid in the ultrasonic container.

b) In the stamping department, it is extremely dangerous for the operators to doze at the operation post, or when they cannot concentrate on their job. When the material is too large, it will be dangerous if the operator does not place the object properly on the die and later has the impulse to correct it with the hand.

c) During the maintenance, it would be a danger if the engineer fixes the machine without stopping it first.

d) Talking to colleague at the neighbouring post can be dangerous.

e) People sometimes use one hand to press the button when they should have used both.

Q6. When do you think accident is likely to take place?

Manager, supervisors and workers:

a) Noon will be the worst time, since the operators are not completely sober yet after coming back from the noon lap. Besides, the room temperature that rises at noon would also matter.

b) People cannot concentrate in the early morning when they have not wholly settled yet. Likewise their attention will be distracted before the end of the shift when they are thinking about the things they will do after duty.

c) The workers are less concentrating at the night shift when most of the management have gone.

d) The most dangerous time will be the hour close to the end of the shift when they are rushing for the expected production quantity.

e) The time for a possible occurrence of accidents would be eight to ten in the morning when they do not have enough warm-up and before going off duty when they are a little bit too relaxed.

f) Any time especially during the day when large quantity of goods has to be delivered.

Q7. What recommendations can you make for combating work accidents?

Manger, supervisors and workers:

a) Training can be a good means to combat work accident. Other elements must be taken into consideration: the length of working time and spiritual status which is more important than mechanical problems, as the former can be easily fixed.

b) The factory authority should have continuous improvement on the working environment.

c) The communication between the management and the working team is critical. The authority should try hard to retain manpower. If the turnover of the workers is high, it would be difficult to maintain skillful workers and the objective of work health and safety will be hard to achieve. Human issue is the top priority in the factory management.

A summary of the interview is listed below:

Since the environment in the production areas was so noisy that normal conversation could hardly be made possible, the conference room was the only place available. The conference room was thus chosen for conducting the interview. The Chinese workers were rather hesitant to give answers at first. It was likely that the respondents were skeptical about the subsequent usage of the results, though they were guaranteed the confidentiality of the information provided.

The conference room was considered a rather formal place for the staff other than the workers who normally could not gain access to the room. It was likely that they felt being intimidated in an environment unfamiliar to them. Nevertheless, the researcher still believed that the results of the on-site interviews were representative of the respondents' opinion about work safety in the factory. It helped identify work hazards at the site.

<u>Summary of the responses of the factory manager, supervisors and workers in Factory A (the target factory) to a semi-structured interview related with their views on work safety and health.</u>

1. When asked about their opinion on the concept of "work safety", the workers thought this concept was rather abstract and confusing. It indicated that the workers' perception about work safety was rather vague. However, the supervisor of the tooling department, Q.C. department and the factory manager could more clearly articulate a number of safety practices that workers should follow, for example, to use the safety guards and avoid skipping safety procedures such as using the two-hand buttons. The supervisor from the tooling department especially pointed out some specific aspects that the operators should observe in order to stay out of danger.

2. In response to the question about the definition of "dangerous behaviour", they defined "dangerous behaviour" as the working behaviour violating safety guidelines:

a) illegal removal of safety protection appendix on the machine

b) skipping the stipulated operating procedures necessary for safety protection or adjusting the speed of the motors

c) deliberately ignoring the normal operating pace with a view to rushing for production yield

d) lack of concentration

e) inadequacy in operating skills

f) negligence in using auxiliary tool

g) untidily disposing of heavy material without observing the potential danger from the possible collapse of the piles of material

h) intentionally leaving the machines running during maintenance

i) not putting the article in the die according to instruction

3. When asked whether dangerous behaviour was repetitive, their answers were affirmative. However, they thought that the repetitive behaviours did not necessarily occur again to the same person who had committed the dangerous act before.

4. It was interesting to note that when the interviewees were asked if they would work around normal procedures if rushing for delivery, most of them said they would, if their pay was counted on a piece basis.

5. When asked whether they witnessed any of their co-workers occasionally committing dangerous acts, they answered quite cautiously but with confirmation. For example, they disclosed that they sometimes noticed people one using hand to press the button of the stamping machine when they should have used both.

6. With regard to the time of the day when accidents would be more likely to occur, their answers were diverse. Those who considered noon the worst time claimed that people were still half asleep from their 'noon-nap'. But most of them agreed that early morning and end of the shift would be the most dangerous time when the workers' minds were either still occupied with the excitement from the night before

or pulled away by what they planned to do after work. In most cases, they were rushing to meet the target quantity set by the factory. Thus accidents would be most likely to happen, any time in the day when a large quantity of goods had to be delivered.

7. Concerning the recommendations for combating work accidents, they had a high expectation of the factory authority to incorporate training courses, improvement on working environment, and to try to minimize worker turnover, in addition to regular mechanical maintenance.

Conclusion of the Risk Assessment (Comment on the Interview)

From the interviews, it is clear that the concept of the machine operators toward work safety was rather vague and confusing. They could hardly articulate the concrete things needed for safe operation. The safety awareness of the manager and supervisors was equally weak, without a solid and comprehensive knowledge in safety management in operation and in the prevention of dangerous behaviours.

The existence of dangerous behaviours during operation was identified through the responses from the interviewees. For example, they noticed some workers by-passing normal working procedures for speed or using one hand instead of two to press the buttons to operate the machine.

And because of the inadequacy of safety management in the plant as disclosed in the interviews, the workers had a high expectation for the management to take necessary

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improvement measures for the general safety conditions such as the implementation of re-training courses for the workers.

The result of the risk assessment implied the need for an intervention to boost the safety awareness in the workforce as well as in the management. The present study would be likely to make the safety improvement possible.

6.1.3 Training of Observers

As scheduled, the training for observers started with July 1, 1999 as indicated in the milestone chart in Fig. 6.1

July, 99	Aug, 99	Sept, 99	Oct, 99	Nov, 99	Dec, 99	Jan, 2000	Feb, 2000
1 2 3 4	1 2 3 4	5 6 7 8	9 10 11 12	13 14 15 16	17 18 19 20	21 22 23 24	25 26 27 28
Training for Observers Heavy Duty Press Dept	A (Baseline)—8 Weeks		B (Intervention)—8 Weeks		A (Reversal)—4 Weeks		
Training for Observers Small Press Dept	A (Baseline)—12 Weeks			B (Intervention)—8 Weeks		A (Reversal)— 4 Weeks	
Training bservers and ress ept	A (Baseline)—16 Weeks				B (Intervention)—8 Weeks		A (Reversal)---4 Weeks
raining or bservers rilling ept	A (Baseline)---25 Weeks						

Fig. 6.1 Milestone Chart for the Research (Present Study) of 25 Weeks

A = Baseline/ Reversal

B = Intervention

The training for the observers was expected to last for four weeks as indicated on the milestone chart. In fact, it normally took two to three weeks for an observer to be well trained.

Two observers were hired (Two supervisors were recommended by the management to the researcher and their salary for the experimental period would be paid by the researcher). They were expected to work 8.5 hours a day, 6 days per week. The two observers were asked to attend a training that included the following package:

1) They were shown slides in a seminar, demonstrating both the safe and unsafe acts of operators working at the machines and also safe and unsafe situations at work.
2) Meanwhile, they were lectured in the basic structure and general operation of the press and drilling machines. The importance of proper material handling and housekeeping in relation to work safety was also explained to them.
3) The experimenter demonstrated to the observers the correct procedures of observing and recording the safe and unsafe behaviours at work in the four departments with the help of an observation check-list. Afterwards, they were asked to practice the observation and recording themselves. In the procedures of observation, each operator working on a machine or task was observed. All practices were observed for a particular operator before observation for another started. During a single operation, each practice was scored once for each operation.
4) A subsequent meeting was held to confirm their understanding of each step of the observation. During the meeting, each observer was asked to verbalize the detail of the observation procedures.

5) The inter-rater reliability was done for each subsequent observation until the reliability had reached 80%. To assess the agreement, both observers had to score the occurrence or non-occurrence of an unsafe practice in the same location of a particular zone. The percentage agreement was used as the sole index of reliability in this behavioural safety study. Inter-rater reliability continued to be conducted on a weekly basis when the baseline period started. The observers were told how the percentage of safety performance was calculated.

Right from the start of the observation training, the two observers had maintained a good relationship with the factory manager, the supervisors and the workers. Some of the workers showed curiosity about the activities of the two observers and asked what they were doing and why the latter were watching them but the workers soon got used to their observation. The observers told them that they were doing routine check-up on their quality by the order of the factory just as what other QCs (Quality Control) were doing. Their curiosity was then reduced.

6.1.4 Inter-Rater Reliability

A review was made to decide the progress of the two observers each week in terms of their method of collecting the data for and performing the inter-rater reliability tests. The inter-rater reliability tests were done twice a week during the first four weeks. The reliabilities were not satisfactory at first but gradually improved and in three weeks' time, the inter-rater reliability had reached 80% (Table 6.3) in the 7th and 8th observations. Meanwhile, their method of collecting the percentage of safety performance was examined weekly. They were also asked to verbalize the procedures of their work. Their performance was found to be satisfactory. The training for the observers was then deemed to be complete.

No. of Observations / Reliability Test	1	2	3	4	5	6	7	8
Agreement	64	67	70	74	85	102	103	109
Disagreement	64	61	58	54	43	28	25	17
Percentage of Inter-rater Reliability	50	52	55	58	66	78	80	86

Table 6.3 Inter-rater Reliability Test During Training

As far as the observation duration was concerned, the observers spent approximately 30 minutes on each department during every shift. However, for the heavy-duty department, owing to the large number of press machines, the time spent there was almost double that with other departments. It took over an hour to complete the scoring. The observations were undertaken at different times of a day during each shift on different days to ensure the unpredictability of the observation pattern. The figures for each day were calculated and averaged to provide an overall index of the individual departmental safety performance level.

Department	Number of Machines	Duration of Observation Per Machine	Total Time Spent in the Department Each Section
Heavy-duty Press	50	1 min.	1 hour
Small Press	14	1min.	14 min
Hand Press	40	0.5 min.	30 min.
Drilling	11	1 min.	11 min.

Approximate Total Time Needed: 2 hours

Table 6.4 Observation By Duration

6.1.5 Baseline Observation

The baseline observation started with the four departments (Heavy-duty Press, Small Press, Hand Press, Drilling) all at the same day the 1st week in August as scheduled after the training for the two observers was deemed to be complete. Data was collected for the four departments 3 to 4 days a week. The baseline for Heavy- duty Department lasted for 8 weeks and a baseline of 12 weeks for Small Press Department, 16 weeks for the Hand Press Department and the baseline for the Drilling was all the way through (25 weeks) (Fig. 6.1)

No. of Observations / Reliability Test	1	2	3	4	5	6	7	8
Agreement	100	105	107	104	108	102	106	104
Disagreement	28	23	21	24	20	26	22	24
Percentage of Inter-rater Reliability	78%	82%	83.6%	81%	84%	80%	83%	81%

Table 6.5 Inter-rater Reliability During the Baseline Period (July 27-31)

Week / Re-liability Test	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Agreement	135	134	138	138	134	136	141	132	133	126	134	141	135	143	133	140	137	137	139	136	140	142	140	139	137
Disagreement	33	30	26	26	30	28	23	32	31	28	30	23	29	21	31	24	27	27	25	28	24	22	24	25	27
Percentage of Inter-rater Reliability	80.0	81.7	84.0	84.0	81.7	82.9	86.0	80.5	81.1	82.9	81.7	86.0	82.3	87.2	81.1	85.4	83.5	83.5	84.8	83.0	85.4	86.6	85.4	84.8	83.5

Table 6.6 Inter-rater Reliability Test During Intervention and Reversal (Aug 2-5, 6-12, 13-19, 20-26. Sept. 3-8. 9-15, 17-23) (Sept 24-30, Oct1-3 being National Day Vacation, Oct 3-7, Oct 8-14, 15-21, 22-28, Nov 1-4, 5-11, 12-18, 19-25) (Nov 26-30, Dec 3-8, 10-16, 17-23, 24-30, 99, Jan 3-6, 7-13, 2000) (Jan 21-27, Feb 25-29, 2000)

The formal observation for the four departments to collect data for the baseline period started in early August. Data for safety performance at work was collected five times a week. In order to provide a more accurate graphical report of the safety performance, a result of the weekly mean percentage of observations was recorded to form a point on the graph. Example:

Week	1	2	3	4	5	6	7	8
Weekly Mean % Of Safety Perfor. / Depart. Observed								
Heavy-Duty Press	45.00	49.13	53.5	49.01	48.06	53.05	47.89	48.33
Small Press	65.75	57.88	68.5	71.44	64.69	67.14	61.22	60.49
Hand Press	69.44	74.50	74.75	66.75	66.50	67.96	65.05	69.05
Drilling	65.50	71.38	62.5	73.75	75.63	64.33	61.45	70.04

Table 6.7 Weekly Mean of Safety Performance (Aug 2 - Sept 30, 1999) Each figure in the above table represented the mean of the all the observations of safety performance of the workers in the respective department each week.

During the baseline period, the researcher visited the factory week every week, reviewing the method the observers were using to collect the data and perform the inter-rater reliability tests. The observers were asked to verbalize the procedures of their work. They were also required to report their method of recording the percentage of safety performance. They understood that the observations had to be done at a different time of the day to maintain the unpredictability of the visit to the production zones. And they were also reminded not to teach the workers the correct operation practices to avoid unnecessary interference to the experiment. After repeated tests by the researcher with the above requirements in terms of the appropriate way of observing and recording, the researcher found their performance to be satisfactory.

6.1.6 The Distribution of the Questionnaires in the Mass Survey

6.1.6.1 The Distribution before the Intervention

At the end of September, questionnaires were distributed to the four target departments for attitude investigation. All the workers in the four experimental departments were invited to complete the questionnaires. Having taken into account of their education, samples of questionnaires properly filled out with instruction in detail were posted on the noticed boards to assist them for the filling. Besides, in order to achieve the maximum response rate, the respondents were allowed to take the questionnaires home and return the next day. The response rate was quite satisfactory, reaching 89.4% (Table 6.8).

Department	Number of workers	Number of Questionnaires Returned
Heavy-Duty Press	83	71
Small Press	29	29
Hand Press	22	22
Drilling	8	5
Total	142	127

The Distribution of Questionnaires Table 6.8

6.1.6.2 The Reliability of the Finalized Questionnaire

CRONBACH ALPHA RELIABILITY & TOTAL ITEM CORRELATION FOR ITEM FORMING THE 8 SCALES IN THE PILOT STUDY AND THE FIRST ROUND OF SURVEY FIG. 6.2

Items of the Scales	Description	Reliability Alpha		Total Item Correlation	
		Pilot	*Rd.1*	*Pilot*	*Rd.1*
1. 21, 22 (HSE 52, 53)	Supervisor Supervision	0.6080	0.6522	(52) - 0.4381 (53) - 0.4381	(52) - 0.4880 (53) - 0.4880
2. 23, 24, 25 (HSE 54, 56, 57)	Supervisor Knowledge	0.5107	0.6495	(54) - 0.4159 (56) - 0.5318 (57) - 0.1076	(54) - 0.4895 (56) - 0.4722 (57) - 0.4285
3. 19, 20 (HSE 50, 51)	Supervisor Encouragement Support	0.5722	0.6855	(50) - 0.4042 (51) - 0.4042	(50) - 0.5266 (51) - 0.5266
4. 6, 7, 8 (HSE 10, 11, 21)	Shop-floor Satisfaction	0.8408	0.8290	(10) - 0.6378 (11) - 0.7983 (21) - 0.6856	(10) - 0.6607 (11) - 0.6617 (21) - 0.7436
5. 2, 4, 12, 13 (HSE 3, 5, 19, 20)	Shop-floor Environment Hardware	0.6431	0.6628	(3) - 0.3180 (5) - 0.4543 (19) - 0.4320 (20) - 0.4963	(3) - 0.4710 (5) - 0.5034 (19) - 0.4408 (20) - 0.4489
6. 9, 14, 17, 18 (HSE 13, 22, 30, 31)	Shop-floor Training	0.7499	0.8575	(13) - 0.5287 (22) - 0.6943 (30) - 0.3148 (31) - 0.6701	(13) - 0.6568 (22) - 0.7376 (30) - 0.6645 (31) - 0.7495
7. 1, 10, 11, 16 (HSE 1, 14, 18, 29)	Safety Meeting	0.6590	0.7334	(1) - 0.4639 (14) - 0.4991 (18) - 0.5209 (29) - 0.3377	(1) - 0.6858 (14) - 0.4976 (18) - 0.4546 (29) - 0.4780
8. 3, 5, 15 (HSE 4, 8, 25)	Safety Working Procedures	0.6117	0.6265	(4) - 0.4086 (8) - 0.4188 (25) - 0.4514	(4) - 0.4297 (8) - 0.4626 (25) - 0.4346

The reliability alphas obtained in the 1st round (rd 1) running compared with those obtained in the pilot running had an overall improvement (Fig. 6.2).

6.1.7 Intervention For Heavy-Duty Press Department

6.1.7.1 Preparation for the Seminar before the Intervention

Before the day of the intervention, a meeting was held in preparation for the event. During the meeting, a number of tasks were performed:

i) A chart for safety performance at work for the last two months (August and September) was drawn. There were nine points on the x axis representing the past nine weeks in which the data were collected from the observations, while the y axis represented the level of safety performance, the maximum of which was set at 100%.

ii) On the chart, a dotted line representing the averaged safety performance of the workers for the mentioned nine weeks was also set.

iii) It was agreed that starting with the following week, a chart reporting the workers' safety performance for the previous week would be posted at the notice board of the Heavy-duty Press Department. On this chart, there would be four/five points on the y axis representing the time of observations in that week.

iv) A seminar would be held with all the workers on the ground floor for Heavy-duty Press Department. During the seminar, workers would be given a hand-out, specifying the proper safe operation procedures and situations that should be observed.

The day shift normally would begin at 8 o'clock and a safety meeting for 15 minutes would be held three times a week before the work started. The factory manager promised that he could let us use the safety meeting. It was then decided that the safety meeting for the following morning (Friday morning) would be used for intervention. But because of the long list of safety precautions that had to be explained, the workers would be asked to come to the factory half an hour earlier than usual for the meeting. Approval was also obtained from the Assistant to M.D., the woman in charge of the whole plant.

6.1.7.2 The Seminar

One morning of the 9th week, the seminar was held as scheduled. As there were over 80 workers in the Heavy-duty Department, it would not be realistic to bring all the workers into the conference room which could hardly accommodate 10 people. In the meantime, it would be rather time consuming to bring small groups into the room for a seminar without interrupting the production. To solve these problems, all the workers were asked to gather outside the plant in the open space for the training.

The seminar was started by the researcher who explained to the workers that the research was conducted with the permission from the University of Hull and that the purpose of the seminar was to familiarize them with work safety. They were guaranteed their anonymity in participating in the safety promotion activities.

6.1.7.3 Slide Show and Explanation of Safety Guidelines in the Hand-out

They were then shown on a temporarily set up screen the 'do' and 'undo' slides taken from the actual production line, demonstrating both the correct operations of machines and situations in which work safety was observed and the acts or situations violating safety regulations. From time to time, they were reminded to refer to the hand-outs given to them in delineating all the accepted safe operations and situations corresponding to the scenarios on the slides. The hand-outs could be helpful for their later review. In fact, because of the unavoidable noise from the neighbouring factories, it was possible that workers standing at both ends of the crowd could find it hard to catch every word, when the researcher was making the presentation.

The workers were shown the chart recording their safety performance in the past eight weeks and they were also told the averaged level of safety performance reached with a view to keeping them informed of their current safety status and what should be improved.

6.1.7.4 Goal Setting

The workers were asked at random by the researcher to suggest difficult goals for the safety performance that they felt they could achieve and those goals were later averaged to form a departmental goal. Their averaged departmental goal was set at 60.

The seminar ended in half an hour. The workers were asked to go inside the plant to the production line to see the demonstration by the supervisor. The supervisor went through the items on the hand-out, demonstrating those that needed technical explanation. The demonstration took another thirty minutes.

6.1.7.5 Incentives

In order to further reinforce the understanding of the contents of the safety operation guidelines on the hand-out, the researcher announced that some prizes as incentives would be set up:

a) Ist prize (one)----$100 to be awarded to a worker who could memorize and verbalize the safety guidelines.

b) 2nd prize (two)----$50 to be awarded to those who could memorize and verbalize 80% of the safety guidelines.

c) 3rd prize (three)----$30 to be awarded to those who could memorize and verbalize 50% of the safety guidelines.

d) 4th prize (twenty-one)----$10 to be awarded to those who could memorize and verbalize the safety guidelines to a satisfactory level.

A notice containing the requirements and rules for competition was later posted the same day. The competition would last for 8 weeks.

During the first week of the intervention, there was not much change recorded in terms of safety performance compared to baseline data that recorded an averaged percentage of 50.19. The observers were asked to investigate the situation and found that most of the violations to safety on the Critical Behaviour Check-list were related with housekeeping. To reinforce the intervention, the researcher asked the observers to post the Safety Operation Hand-Out on the notice-board. On the hand-out, red marks were used to highlight the safety items violated. In addition, the researcher asked the supervisor of the Heavy-duty Department to summon the people responsible for housekeeping to address the housekeeping problems. The supervisor promised that he would bring up the safety issues in housekeeping during the safety meetings to be held on Monday, Wednesday and Friday.

In the subsequent weeks the observers reported that a drastic improvement had been noticed in the workers' safety performance reaching an average score of over 60% compared with the averaged score of 50.19% for the baseline period.

6.1.8 Intervention for Small Press Department

Another intervention was conducted with the Small Press Department on the 13th week, one month after the intervention was held with the Heavy-duty Press Department. During the fifteen minutes for routine safety meeting to be held every Friday morning at eight before the day shift started, the intervention meeting was held inside the conference room which could accommodate 13 workers in the Small Press Department. At the start of the seminar, the researcher explained to the workers that he represented the University of Hull to conduct the research and that the purpose of the seminar was to familiarize them with safety operations and situations. They were guaranteed their anonymity in participating in the safety promotion activities.

6.1.8.1 Slide Show and Explanation of Safety Guidelines in the Hand-out

They were then shown the 'do' and 'undo' slides taken from the actual production line, demonstrating to them both the correct operations of machines and situations in which work safety was observed and the acts or situations violating safety regulations. For further study, they were given a hand-out describing all the safe operations and situations recommended on the slides.

The workers were later shown the chart recording their safety performance in the past eight weeks and their averaged level of safety performance achieved for the baseline period.

6.1.8.2 Goal Setting

The workers were asked at random to suggest difficult goals for the safety performance that they felt they could reach and those goals were later averaged to form a departmental goal. Their averaged safety performance during the baseline was 63.82%. Their averaged departmental goal was agreed at 65%. Once the goal was set, it was explained that the goal would be marked on the chart in red that at the end of each week, the observer would update the chart to show their weekly performance in relation to this goal. Actual performance was marked in black. After eight weeks of measurement and updating of the chart, the charts would be removed from this department.

The seminar ended in half an hour. The workers were asked to go inside the plant to the production line to see the demonstration by the supervisor. The supervisor went through the items on the hand-out, demonstrating those that needed technical explanation. The demonstration took another thirty minutes.

6.1.8.3 Incentives

Similar incentive scheme was offered to the Small Press Department with a view to motivating them to understand and observe the guidelines for safety at work.

A notice containing the requirements and rules for competition was also posted on the notice board of this department the same day. The registration for participating in the competition was accepted till the first week of December (17^{th} week).

6.1.9 Intervention For Hand Press Department

A seminar for the training of safe operation and the promotion work safety was duly given to the Hand Press Department at week 17^{th} in similar procedures as those delivered to the Heavy Duty Press and Small Press Departments. A goal was agreed upon with workers to set up a departmental goal for safety performance that was accepted at 70. Meanwhile a chart showing their averaged safety performance for the baseline period at 64.02% was posted on the notice board in their department as mentioned in Chapter IV (Fig. 4.4). Incentives in the form of competition in studying safety guidelines with prizes were also given to Hand Press Department.

Measurement in the drilling department continued to the end of the experiment but without any intervention introduced. For the other three departments, during the reversal phase, no feedback concerning the performance in the respective departments was given to the workers once the charts had been removed.

6.1.10 Safety Contest

13 workers joined the contest and they were in turn asked to recite the rules and explain in their words. Most of them were unable to recite but could interpret the rules one way or the other. The response to the safety contest was not very enthusiastic as a whole, because they were not quite sure if they could fulfil the requirements for the contests, when they later revealed to the observers.

In order to find out if there was any change in the workers' attitudes toward work safety after the intervention, a second round of investigation by questionnaire (same copy as the first round) was conducted with the four departments surveyed. The questionnaires were distributed to the respective department after the intervention completed for the third department (Hand Press Department). Thus all four departments received the second questionnaires simultaneously.

6.1.11 The 2nd Distribution of Questionnaires after the Intervention (Table 6.9)

Department	Number of workers	Number of Questionnaires Returned
Heavy-Duty Press	73	68
Small Press	19	12
Hand Press	18	18
Drilling	6	6
Total	116	104

The return rate of the questionnaires issued was 89.65 %. Normally, in the mass survey, it is more than satisfactory if the return rate of the questionnaires can reach 60%. Sometimes only 40% can be collected.

The questionnaires after being collected were sorted out by department, coded and entered into the data file before a second round of reliability test was conducted:

6.1.11.1 CRONBACH ALPHA RELIABILITY & TOTAL ITEM CORRELATION FOR ITEMS FORMING THE 8 SCALES IN THE PILOT STUDY, THE FIRST AND SECOND ROUNDS OF THE MASS SURVEY FIG. 6.3

Items of the Scales	Description	Reliability Alpha			Total Item Correlation		
		Pilot	*Rd.1*	*Rd.2*	*Pilot*	*Rd.1*	*Rd.2*
1. 21, 22 (HSE 52, 53)	Supervisor Supervision	0.6080	0.6522	0.5935	(52) - 0.4381 (53) - 0.4381	(52) - 0.4880 (53) - 0.4880	(52) - 0.4221 (53) - 0.4221
2. 23, 24, 25 (HSE 54, 56, 57)	Supervisor Knowledge	0.5107	0.6495	0.6694	(54) - 0.4159 (56) - 0.5318 (57) - 0.1076	(54) - 0.4895 (56) - 0.4722 (57) - 0.4285	(54) - 0.5123 (56) - 0.5344 (57) - 0.4040
3. 19, 20 (HSE 50, 51)	Supervisor Encouragement Support	0.5722	0.6855	0.6306	(50) - 0.4042 (51) - 0.4042	(50) - 0.5266 (51) - 0.5266	(50) - 0.4724 (51) - 0.4724
4. 6, 7, 8 (HSE 10, 11, 21)	Shop-floor Satisfaction	0.8408	0.8290	0.7269	(10) - 0.6378 (11) - 0.7983 (21) - 0.6856	(10) - 0.6607 (11) - 0.6617 (21) - 0.7436	(10) - 0.4395 (11) - 0.6056 (21) - 0.6212
5. 2, 4, 12, 13 (HSE 3, 5, 19, 20)	Shop-floor Environment Hardware	0.6431	0.6628	0.7267	(3) - 0.3180 (5) - 0.4543 (19) - 0.4320 (20) - 0.4963	(3) - 0.4710 (5) - 0.5034 (19) - 0.4408 (20) - 0.4489	(3) - 0.5208 (5) - 0.5393 (19) - 0.4043 (20) - 0.4215
6. 9, 14, 17, 18 (HSE 13, 22, 30, 31)	Shop-floor Training	0.7499	0.8575	0.8143	(13) - 0.5287 (22) - 0.6943 (30) - 0.3148 (31) - 0.6701	(13) - 0.6568 (22) - 0.7376 (30) - 0.6645 (31) - 0.7495	(13) - 0.6619 (22) - 0.6353 (30) - 0.6353 (31) - 0.6083
7. 1, 10, 11, 16 (HSE 1, 14, 18, 29)	Safety Meeting	0.6590	0.7334	0.7037	(1) - 0.4639 (14) - 0.4991 (18) - 0.5209 (29) - 0.3377	(1) - 0.6858 (14) - 0.4976 (18) - 0.4546 (29) - 0.4780	(1) - 0.4949 (14) - 0.5382 (18) - 0.5206 (29) - 0.4143
8. 3, 5, 15 (HSE 4, 8, 25)	Safety Working Procedures	0.6117	0.6265	0.6044	(4) - 0.4086 (8) - 0.4188 (25) - 0.4514	(4) - 0.4297 (8) - 0.4626 (25) - 0.4346	(4) - 0.4008 (8) - 0.4348 (25) - 0.4038

The result indicated similar figures were obtained above (Fig. 6.3) in terms of alpha reliability and it further confirmed the reliability of the 8 scales chosen in the previous revision (Fig. 5.2) in Chapter V----the Pilot Study and Figure (6.3) in the first round of questionnaire survey.

6.1.12 The Reversal Period for the 4 Departments

The reversal period ensued after the completion of the intervention at the prescribed duration. All the posters or feedback charts showing the safety performance of the workers would be removed. However, baseline observation would still be maintained.

a) Heavy Duty Press Department

Posted feedback was removed on the 17th week.

b) Small Press Department

Posted feedback was removed on the 21st week.

c) Hand Press Department

Posted feedback was removed on the 25th week.

6.1.13 Conclusion of the Mass Survey

The survey was not completed until the 26th week as originally planned, because the 25th week scheduled to be the deadline of the whole experiment happened to coincide with the Chinese New Year. According to the Labour Law in China, all workers are entitled to holidays of one week for the Lunar New Year. The survey was thus suspended and data for the observation of safety performance could only be done after the work resumed on the 26th week. Through the survey, the workforce in the respective surveyed departments and the management of the factory were quite cooperative and supportive to make the survey possible. Their overall responses could be reflected in the final interview with the two observers by the researcher during the latter's last visit. Both observers were required to write a comment of the observations which were presented in the following section.

6.1.13.1 Comment from Observer A:

Right at the start, workers felt nervous and suspected that the two observers had a secret mission from the Security Department or the Labour Department of the Government to keep an eye on them. They felt they were trapped in the conflict between the pressure for quantity production from the factory and the surveillance from the Government. Gradually they got accustomed to the routine work of the observers and did not encounter any interference to their work. Their attitude started to change. They realized that the observers were there to help them to improve safety performance and to create an environment, although they did not know the detail of the survey. After a few weeks, they became more at ease and were even indifferent to the observations being done next to them by the observers.

When the performance feedback chart was put up, they thought that the observers really had some care for them. Their operation practices became more disciplined. However, with the pressure from the factory, they had to make a compromise between safety and production speed. After the removal of the feedback chart during the reversal period, they wondered why the observer did not care for them and take any necessary actions to enforce the safety operation. They behaved as they did before the intervention. On the whole, the survey was useful.

6.1.13.2 Comment from Observer B:

Workers felt that we did not care too much for them until the feedback chart was put up in the intervention. Then when the questionnaires were distributed, they had a more positive feeling on the work of the observers, thinking that the intervention to improve work safety was organized by the factory authority. Some workers thought the experiment was significant. When asked about their opinion on work safety in the questionnaire, they were glad to give constructive suggestions, hoping that their opinion could be considered. They provided causes for injures and accidents as well as possible solutions to safe operation procedures that should be followed. When accidents actually occurred, the workers expressed that a lot of the accidents could have been avoided. Since the occurrence of accidents was more frequent with night shift, the machine operators thought that there should be observers to supervise them at night. They thought that the observers had positive impact on their safety performance, when it was not possible that the management could be available for supervision all time. The presence of the observers could remind them of safety operation and they felt obliged to be reminded. They wished that some concrete actions could be taken by the observers to help them.

According to Observer B, as far as the Work Safety Hand-Out is concerned, in fact, a large number of the workers did not really understand all the safety operations. The competition was useful only to a certain extent to help them understand the safety requirements in depth, though a minority of 13 workers had participated.

The workers were also aware of the importance of safe operation procedures but to comply with the requirement for delivery, they were unable to follow strictly the safety guidelines.

Each time when the intervention started with a department, the responses of the workers in that department were quite positive. For example, the supervisor of the Small Press Department said that he appreciated the observations and he expressed that he had studied the feedback chart very carefully. He had repeatedly requested the operators to try their best to follow the safety instructions. To consider the safety of the operators, he had duly reduced the quantity of production required. The management had also made some adjustment on the production target in response to the opinion from the supervisors.

As for the Drilling Department, a lot of the items in the CBC did not apply to their operation steps. Their safety awareness was comparatively lower than that of other departments.

During the intervention for the Hand Press Department, the workers there gave some constructive opinions about the survey, though their responses were not as enthusiastic as those of Heavy-Duty Press Department.

In reality, the occurrence of accidents or injuries was often associated with items that were least expected to occur. The guideline such as "concentration on work" was considered unimportant and tended to be neglected by workers in the Small Press or Drilling Departments, because an accident due to "not concentrating" was less likely to happen. But in reality, this kind of accident did happen. For example, because of not concentrating, the operators in the Small Press Department often hurt their fingers when working with a glove on. Their fingers got caught when they accidentally stepped on the foot press.

To conclude, the duration of the survey was a little longer than expected, owing to the interruption of the Chinese New Year Holidays. However, the conduct of the survey, on the whole, was smooth and satisfactory with the co-operation of the management in the factory.

6.2.0 Data Analysis in the Mass Survey

The data collected from the observations and the questionnaire surveys were manipulated in the computer, using the SPSS program to test the hypotheses formulated in Chapter III:

6.2.1 Critical Behaviour Check-list (CBC)

The data in the CBC were processed to test hypotheses I and V:

Hypothesis I. There are significant relationships between the worker' behaviours in occupational safety and posted-feedbacks (posting the weekly result of the departmental safety performance on a conspicuous place) plus goal-setting (setting a goal for achieving safety performance).

Hypothesis V (Hypotheses II, III, IV are connected with the questionnaires only and will be discussed separately later). There are relationships between intervention and workers' behaviours in occupational safety and also their attitudes towards work safety

(in terms of the 8 dimensions).

6.2.1.1 For Hypothesis I, in order to trace the change of safety performance of the workers in the four departments, the means of percentage of safety performance and also ANOVA were applied.

6.2.1.1.1 Calculation of Safety Performance

Following each observation session the safety performance for each department involved will be calculated by dividing the number of employees performing completely safely by the total number of employees observed in that department and multiplied by 100 (Komaki and et al , 1978). That is the formula for calculating the percentage of safe hehaviour is obtained by dividing the sum of the completely safe acts of the workers by the total safe and unsafe acts performed by all workers and then multiplying by 100:

$$\text{\% of safety performance} = \frac{\text{total safe acts}}{\text{(total safe acts + total unsafe acts)}} \times 100$$

6.2.1.1.2 Comparison of Safety Performance in Baseline and Intervention

A percentage safety performance including the baseline and intervention periods by week and department will be recorded and brought into comparison with goal levels set by each department (Table 6.10)

Example		Baseline Period								Intervention Period								Reversal Period							
Department	Goal %	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Heavy Duty Press																									
Small Press																									
Hand Press																									
Drilling																									

Table 6.10 Percentaged Safety Performance By Week And By Department

6.2.1.1.3 ANOVA (Analysis of Variance)

Similar to the t-test, ANOVA is also used to assess the statistical significance of differences between groups. As the same as the t-test, the null hypothesis tested is the equality of dependent variable means across groups. (Hair, *et. al.*, 1995, pp-263). This statement is based on Levin and Fox's (1994) view,

> "The analysis of variance can be used to make comparisons among three or more sample means. This test yields an F ratio (F ratio shows variation between groups relative to the variation within groups. It indicates the size of difference between groups relative to size of the variation within each group) whose numerator represents variation between groups and whose denominator contains an estimate of variation within groups" (Levin and Fox, 1994, pp-266).

If we obtain a significant F value through the SPSS, it means that the null hypothesis is rejected. In other words, significant variations between groups are found.

"After obtaining a significant F, we can determine exactly where the significant differences lie by applying Tukey's method for the multiple method of comparison of means".(Levin and Fox, 1994, pp-266).

Tukey's HDS (Honestly Significant Difference) is one of the most useful tests for investigating the multiple comparison of means. As pointed out by Levin and Fox (1994, pp-262-263),

"By Tukey's method, we compare the difference between any two mean scores against HSD. A mean difference is statistically significant only if it equals or exceeds HSD. By formula:

$$HSD = q \sqrt{\frac{MS_{WITHIN}}{N_{group}}}$$

where q = a table value at a given level of significance for the total number of group means being compared

MS_{within} = within- group mean square

N_{group} = the number of subjects in each group (assumes the same number in each group)

Unlike the t ratio, HSD takes into account the fact that the likelihood of Type 1 error increases as the number of means being compared increases. Depending on the value of q, the larger the number of group means, the more conservative HSD becomes with regard to rejecting the null hypothesis. As a result, fewer significant differences will be obtained with HSD than with the t ratio. Moreover, a mean difference is more likely to be significant in a multiple comparison of three means than in multiple comparison of four or five means."

As far as the current study is concerned, there was a need to compare the means of three periods of time, namely the baseline, the intervention and the reversal to find out their between group differences. ANOVA was thus able to provide a more accurate analysis of the mean differences for performances of more than two sections of time.

6.2.1.2 To test hypothesis V, the results from multiple baseline investigation and those from the questionnaire should be juxtaposed to investigate the relationship between intervention and the workers' behaviours and also their attitudes. However, the data of the safety performance and those of the 8 dimensions of safety attitudes belong to two different systems because the former recorded the behaviours of the workers at three survey phases (baseline, intervention and reversal) whereas the latter referred to the measurements of the attitudes before and after the intervention. It is interesting to see whether the two sets of data could both confirm that the improvements were due to intervention.

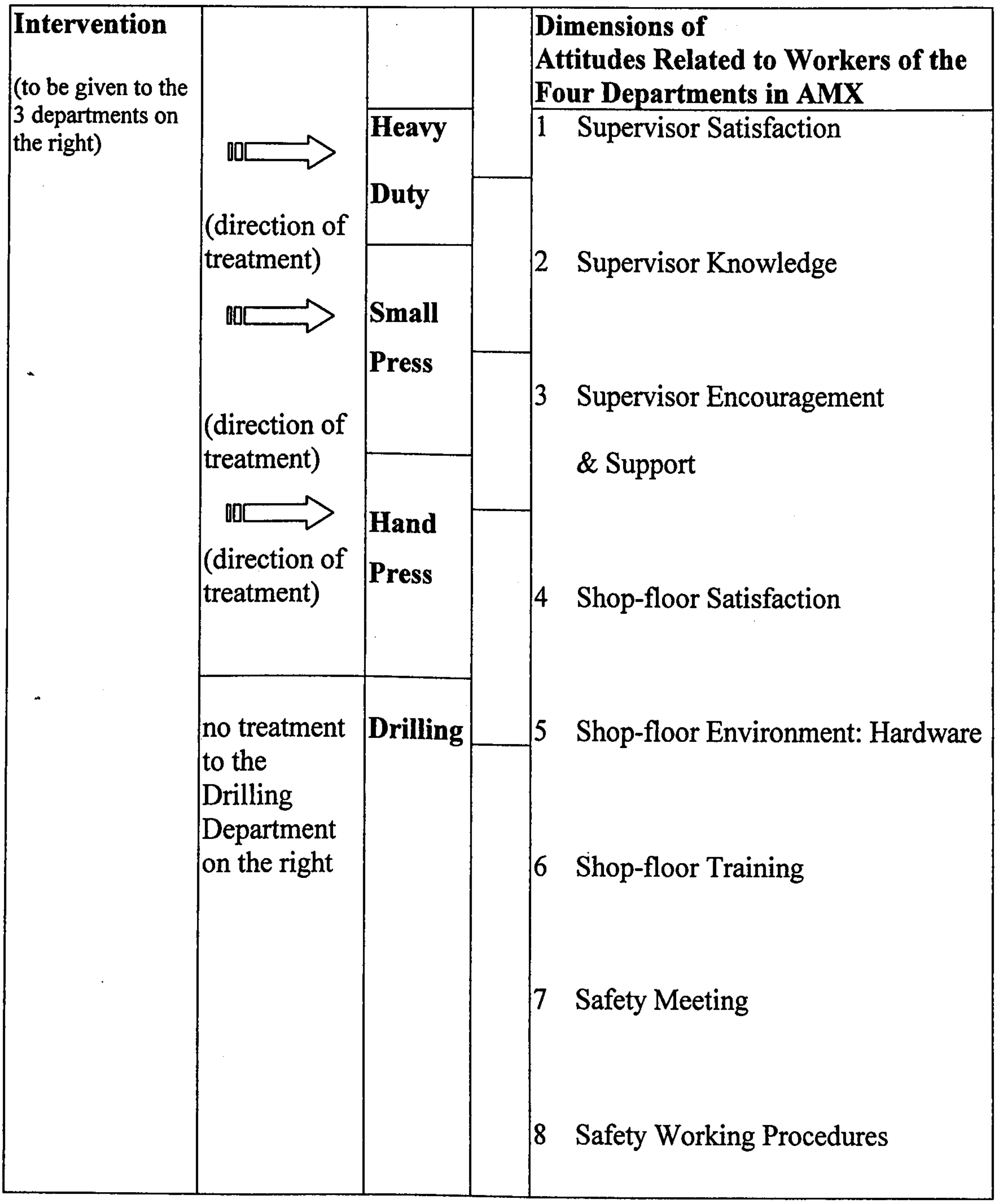
6.2.2 Data in the questionnaire were processed by means of SPSS to test hypotheses II, III and IV:

Hypothesis II. <u>There are significant relationships between the workers' attitudes towards occupational safety and posted-feedback plus goal setting.</u>

Hypothesis III. . <u>There are significant relationships between attitudes of workers who have had safety training and workers who have not in terms of occupational safety.</u>

Hypothesis IV. <u>There are significant relationships between attitudes of the workers with self-reported accident rates and those of their peers without occupational accidents.</u>

6.2.2.1 To test Hypothesis II, T-test was applied by comparing the means of first and second rounds of questionnaire surveys to detect the differences in the attitudes of the workers in the four departments towards occupational safety (Fig. 6.4).



<u>The Investigation of the Impact of Intervention on Attitudes of Workers toward Work Safety in the Three Departments</u> Fig. 6.4

In the above figure, the 8 dimensions of safety attitudes include:

1. Supervisor Satisfaction
2. Supervisor Knowledge
3. Supervisor Encouragement & Support
4. Shop-floor Satisfaction
5. Shop-floor Environment: Hardware
6. Shop-floor Training
7. Safety Meeting
8. Safety Working Procedures

The arrows indicate the influence of intervention on the eight dimensions of attitudes of the workers.

6.2.2.1.1 T-test

Correlated t-tests will be used to detect the difference for practices between baseline and posted feedback. This statistical method has been used by Fellner & Sulzer-Azaroff (1984a) to assess the impact of intervention and feedback in behavioural safety.

6.2.2.2 To test hypothesis III trying to seek significant relationships between attitudes of workers who have had safety training and workers who have not in terms of occupational safety, the data from the questionnaire were treated with Cross Tabulation Analysis with Fisher Exact Test to correlate the attitudes of the workers towards occupational safety in the four departments with their respective self-reported training. This could be achieved by comparing the scores of the scales to determine their being 'high' 'middle' or "low".

To test hypothesis IV, in an attempt to find significant relationships between attitudes of the workers with self-reported accident rates and those of their peers without occupational accidents, Cross-tabulation Analysis with Fisher Exact Test was conducted.

6.2.2.2.1 Fisher Exact Test

The Fisher Exact Probability Test is a useful non-parametric technique for analyzing data at the nominal or ordinal level of measurement when the independent samples are small in size. It is able to deal with discrete numbers which are limited in amount and are too small for the use of a Chi-square test (the observed frequency is less than 5 in the individual cells). The test provides exact probability values of events as extreme as, or more extreme than, those observed (Cohen & Holliday, 1996, pp-218). (Appendix 13)

Thus, the Fisher Exact test is more preferable to Chi-square test, because it can cover what the Chi-square is unable to handle.

6.3 Null Hypotheses

The research hypotheses stated in Chapter I were converted to their null form to be tested at the 0.05 level of significance. The null hypotheses are stated below:

I. There are no relationships between the workers' behaviours in occupational safety and posted feed-backs plus goal-setting.

II. There are no relationships between the workers' attitudes towards occupational safety (in terms of the 8 dimensions *) and posted feed-backs plus goal setting.

III. There are no significant relationships between attitudes of workers who have had safety training and workers who have not in terms of occupational safety (in terms of the 8 dimensions*).

IV. There are no significant relationships between attitudes of the workers with self-reported accident rates and those of their peers without occupational accidents (in terms of the 8 dimensions*).

V. Intervention is not related to both the workers' attitudes and their behaviours in work safety.

This chapter has ended the description of the mass survey at the research site and also listed the major statistical devices to be used for data analyses to be used, thus paving the way for the next chapter in which the results of the analyses will be presented.

CHAPTER VII

RESULTS

The last chapter elaborated on the process of the investigation by questionnaires on attitudes of the workers towards occupational safety and by observation on their safety performance before and after the implementation of intervention in the mass survey at the target metal house. The present chapter attempts to generalize and interpret the results in such a way that they can be logically presented. For this purpose, the results presented in this chapter were generated using the cross-tabulation, Fisher Exact test, t-test and ANOVA to pull together the various groups of data for correlation to detect if there were changes of behaviours and attitudes in the respondents through the multiple baseline design. Data connected with different categories from the 4 departments in the experimental site were analyzed individually to identify whether or not the within group changes were evident. The individual group data were also compared with those of other groups in an overall picture to examine whether or not the effect of interventions at different points of the survey had an effect. Meanwhile, the results were presented according to the order of the research hypotheses established in the early chapters as suggested by Figueroa (1980, pp-32) that "the best plan is to present the results in an order corresponding to that in the articulation of the research problems."

7.0 Control

The control group in the multiple baseline design allowed the researcher to make a comparison between the performance of the control group and that of other groups.

This comparison helped identify, after the introduction of an intervention, if there appeared a significant change of the safety performance in groups other than the controlled one. Throughout the survey, the control group was also measured but without any intervention implemented. In this study, the Drilling Department served as the control group.

Presentation of Results

Departments measured: Heavy Duty, Small Press, Hand Press, Drilling

7.1 Hypothesis I

There are relationships between the workers' behaviours in occupational safety and posted-feedback plus goal-setting

Source of Data: CBC (Critical Behaviour Check-list)

Data for the safety performance of the workers in the 4 departments were collected for a total of 78 sessions over a 26-week period of time. Table 7.1 demonstrated the percentage of incidents performed safely for each observation session in an overall picture. Meanwhile, Figure 7.1 showed the safety performance of the individual department.

As indicated in the overall graphic display (Fig. 7.1) which was generated from the data in Table 7.1, the departments under survey, namely Heavy Duty Press, Small

Press and Hand Press demonstrated a noted change of safety performance which was reflected in the steady rise of the data points:

Percentage of Safety Performance (MEAN) of the Four Departments by Week from Early August 1999 to February 2000 Table 7.1

		Mean % of Safety Performance for Department of			
Observation Period	**Date**	**Heavy-duty Press**	**Small Press**	**Hand Press**	**Drilling**
1st	*Aug. 2-5, 1999*	**45**	**65.75**	**69.44**	**65.5**
2nd	*Aug. 6-12, 1999*	**49.13**	**57.88**	**74.5**	**71.38**
3rd	*Aug. 13-19, 1999*	**53.5**	**68.5**	**74.75**	**62.5**
4th	*Aug. 20-26, 1999*	**49.01**	**71.44**	**66.75**	**73.75**
5th	*Sep. 3-8, 1999*	**48.06**	**64.69**	**66.5**	**75.63**
6th	*Sep. 9-15, 1999*	**53.05**	**67.14**	**67.96**	**64.33**
7th	*Sep. 17-23, 1999*	**47.89**	**61.22**	**65.05**	**61.45**
8th	*Sep. 24-30, 1999*	**48.33**	**60.49**	**69.05**	**70.04**
9th	*Oct. 3-7, 1999*	**48.38**	**62.61**	**64.15**	**57.8**
10th	*Oct. 8-14, 1999*	**45.98**	**62.76**	**63.59**	**64.8**
11th	*Oct. 15-21, 1999*	**51.78**	**62.73**	**58.2**	**62.83**
12th	*Oct. 22-28, 1999*	**63.19**	**64.43**	**64.11**	**57.28**
13th	*Nov. 1-4, 1999*	**65.66**	**65.2**	**62.51**	**59.44**
14th	*Nov. 5-11, 1999*	**67.65**	**71.76**	**62.91**	**69.52**
15th	*Nov. 12-18, 1999*	**66.9**	**72.21**	**60.9**	**59.25**
16th	*Nov. 19-25, 1999*	**67.53**	**73.38**	**62.24**	**61.89**
17th	*Nov. 26-30, 1999*	**69**	**76.54**	**57.11**	**64.24**
18th	*Dec. 3-8, 1999*	**68.45**	**72.63**	**66.74**	**67.53**
19th	*Dec. 10-16, 1999*	**70.51**	**75.81**	**71.83**	**65.89**
20th	*Dec. 17-23, 1999*	**73.25**	**75.44**	**81.53**	**60.5**
21st	*Dec. 24-30, 1999*	**66.13**	**75.91**	**79.36**	**63.1**
22nd	*Jan. 3-6, 2000*	**69.43**	**65.06**	**70.88**	**70.71**
23rd	*Jan. 7-13, 2000*	**72.74**	**63.98**	**66.73**	**66.64**
24th	*Jan. 21-27, 2000*	**59.71**	**66.7**	**85.21**	**59.81**
25th	*Feb. 1-11, 2000*	-	-	**67.44**	**61.33**
26th	*Feb. 12-17, 2000*	-	-	**68.58**	**66.85**
27th	*Feb. 18-24, 2000*	-	-	**67.02**	**57.81**

Graphic Display of Safety Performance of All 4 Departments by Sessions Figure 7.1

Graphic Analysis of the Safety Performance in the 4 Departments

For the Heavy Duty Department (Fig. 7.1.1), the intervention started with week 9 with a safety mean score of 48.38%. Safety performance is shown to have improved starting to go up to 51.78% on week 11 and reaching its highest point on week 17 (69%). The performance has remained high after the reversal period on week 18 (68.45%). The range is 20.62%.

For the Small Press Department (Fig. 7.1.2), following the introduction of the intervention on week 13 (65.2%), the data points gradually rose on week 14 (71.76%) till they reached their peak on week 17 (76.54%). The range is 11.34%. The performance then went steadily till week 21 (75.91%).

Similar intervention effect happened to the Hand Press Department (7.1.3) that also recorded a rather sharp improvement of safety behaviour. The performance went higher on week 18 (66.74%) than it was on week 17 (57.11%) before the intervention. Nevertheless, there were some fluctuations in the Hand Press Department. The performance steadily upward until it reached the peak on week 20 (81.53%). It then dropped to 66.73% on week 23. Although it dramatically sored to 85.21% on week 24, it went down again on week 25 (67.44%) and further dropped on week 27 (67.02%) in the reversal period. On the whole, there was an overall improvement in the safety performance in the Hand Press Department compared with that in the pre-intervention period.

The above graphic display has provided a general picture of the safety performance of the workers at each department at different periods of time. However, Lingard (1995, pp-107), claimed that "visual inspection of data may not be sufficiently sensitive to detect small, but important intervention effects" and one-way ANOVA seemed to be a more preferred statistical method to test the significance of a safety intervention for time-series data (Cooper et al, 1994).

7.2.0 ANOVA

As discussed in Chapter VI (the Mass Survey) in general, ANOVA is similar to t-test in terms of its application to assess the statistical significance of differences between groups. The difference is that t-test which addresses ordinal data seems to be more appropriate for comparing means between two groups of respondents while ANOVA is able to tackle more than two groups to find out the between-group differences (Levin and Fox, 1994).

The results obtained from the one-way ANOVA test was thus used as the statistical support to the graphic analysis to detect the significant differences between and within the groups, followed by the Post Hoc Test which provided more detail in the mean differences as the multiple comparisons.

7.2.1 Heavy Duty Press Department

The data collected from Heavy Duty Press (Table 7.2) demonstrated that highly significant difference was noted (F= 50.505, Significance = 0.000). As also indicated by the results from Post Hoc Tests (Table 7.3), the mean difference for intervention was much higher than that of the baseline (mean difference = I-J = -11.5195). That meant the intervention had positive impact on the safety performance of the workers. When data of the baseline period were compared with those of the intervention, it was found that the mean value of the latter was greater than that of the former, showing the great influence of intervention. But meanwhile, when compared with the baseline data, those for the reversal period showed unexpectedly high performance (mean difference: I-J = -20.4328). This unexpectedly high level of performance sustained at the reversal period may be explained by the lasting effect of intervention.

ANOVA TEST ON THE HEAVY DUTY DEPARTMENT TABLE 7.2

BETWEEN THE PERIODS 'BASELINE', INTERVENTION' AND 'REVERSAL'

	Sum of Squares	*df*	*Mean Square*	*F-value*
Between Groups	4909.421	2	2454.711	50.505***
Within Groups	3936.881	81	48.603	
Total	8846.302	83		

Remarks: *** : $p \leqq 0.001$

In the research of social science, it is commonly accepted that the level of significance for the probability can be set at 95%. The current research in social science thus follows the same criteria. * means the significant level of probability has reached 95%; ** over 95%; *** reached 99.9%

Statistical Significance

The significance of the statistical results was set as below:

*** a probability of 0.001 or less was accepted to be very highly significant result;

** a probability greater than 0.001 but less than or equal to 0.01 was considered a highly significant result;

* a probability of greater than 0.01 but less than or equal to 0.05 was regarded as a significant result;

and any probability greater than 0.05 was thought insignificant. (Lingard & Rowlinson, 1995, pp-118)

MULTIPLE COMPARISON OF MEANS BY TUKEY HSD TABLE 7.3 FOR THE HEAVY DUTY DEPARTMENT		
Period (I)	***Period (J)***	***Mean Difference (I-J)***
Baseline	Intervention	-11.5195***
Reversal	Intervention	8.9133***
Baseline	Reversal	-20.4328***

Remarks: **: p ≦ 0.001

7.2.2 Small Press Department

By means of ANOVA Test, significant result was obtained for the Small Press Department, showing the between group and within group differences in relation to the safety performance of the workers during the baseline, intervention and reversal periods (F = 19.790, significance = 0.000) (Table 7.4). The Post Hoc Tests also supported the results from the ANOVA, showing a significant mean difference between intervention and baseline phases (mean difference: I - J = -8.7347) (Table 7.5). Similar to the Heavy Duty Press Department, the safety performance of the workers was greatly influenced by the intervention. When compared with the data of the baseline period, the intervention period showed greater mean value. And resembling the results from Heavy Duty Press, owing to the effect from intervention which helped improve the safety practices of the workers, the reversal period also exhibited relatively higher level of safety performance compared with that of the baseline but lower than the intervention. This phenomenon of high performance could also be explained by the lasting effect as a result of the intervention implemented.

ANOVA TEST ON THE SMALL PRESS DEPARTMENT TABLE 7.4 BETWEEN THE PERIODS 'BASELINE', INTERVENTION' AND 'REVERSAL'				
	Sum of Squares	***df***	***Mean Square***	***F-value***
Between Groups	1469.787	2	734.893	19.790***
Within Groups	3304.964	89	37.134	
Total	4774.751	91		

Remarks: *** : p ≦ 0.001

MULTIPLE COMPARISON OF MEANS BY TUKEY HSD TABLE 7.5 FOR THE SMALL PRESS DEPARTMENT		
Period (I)	***Period (J)***	***Mean Difference (I-J)***
Baseline	Intervention	-8.7347***
Reversal	Intervention	-4.5536
Baseline	Reversal	-4.1810

Remark: ***: p ≦ 0.001

7.2.3 Hand Press Department

Likewise, the results obtained from the ANOVA and Post Hoc Tests for the Hand Press Department exhibited a significant difference in the safety performance after the intervention [ANOVA: F = 14.774, Significance=0.000 (Table 7.6); Post Hoc Test: Mean Difference (baseline vs intervention); I-J = -7.2016] (Table 7.7). The slight rise of the performance for the reversal period [Mean Difference (baseline vs reversal): I - J = -7.9827] also reflected the effect from posted feedback implemented earlier.

ANOVA TEST ON THE HAND PRESS DEPARTMENT TABLE 7.6 BETWEEN THE PERIODS 'BASELINE', INTERVENTION' AND 'REVERSAL'

	Sum of Squares	*df*	*Mean Square*	*F-value*
Between Groups	1388.046	2	694.023	14.774***
Within Groups	4838.661	103	46.977	
Total	6226.707	105		

Remarks: *** : $p \leqq 0.001$

MULTIPLE COMPARISON OF MEANS BY TUKEY HSD TABLE 7.7 FOR THE HAND PRESS DEPARTMENT

Period (I)	*Period (J)*	*Mean Difference (I-J)*
Baseline	Intervention	-7.2016***
Reversal	Intervention	0.7811
Baseline	Reversal	-0.79827***

Remark: ***: $p \leqq 0.001$

7.2.4 Summary of Hypothesis I

From the graphic comparison of the safety performance of the workers in the 3 departments (Fig. 7.1) complemented by the results from the ANOVA and Post Hoc Tests (Tables 7.2-7.7), highly significance differences were noted after the introduction of intervention. The null hypothesis that there were no relationships between the workers' behaviours in occupational safety and posted-feedback plus goal-setting was rejected in the Heavy-duty Press, Small Press and Hand Press Departments .

7.3.0 Hypothesis II (a, b, c, d, e, f, g, h)ı

There were relationships between intervention and workers' attitudes towards occupational safety.

ı(a, b, c, d, e, f, g, h) refers to the 8 dimensions of workers' attitudes towards occupational safety: a. Supervisor Supervision b. Supervisor Knowledge c. Supervisor Encouragement & Support d. Shop-floor Satisfaction e. Shop-floor Environment: Hardware f. Shop-floor Training

g. Safety Meeting h. Safety Working Procedures

Departments Measured: Heavy Duty Press, Small Press, Hand Press, Drilling

To detect the differences in the attitudes of the workers towards occupational safety before and after the intervention as measured by the questionnaires filled out by workers in the four departments, a t-test was applied. This enabled a comparison of the means of the two groups of responses to the questionnaire.

From Table 7.8, comparisons were made for the responses of the 4 departments to provide an overall picture of the first round (before intervention) and second round (after intervention) of mass surveys by questionnaires:

Attitudinal Scales	*Rd. of Survey*	HEAVY DUTY PRESS DEPT			SMALL PRESS DEPT.			HAND PRESS DEPT.			DRILLING DEPT.		
		N	*Mean*#	*P-value*	*N*	*Mean*#	*P-Value*	*N*	*Mean*#	*P-Value*	*N*	*Mean*#	P-Value
a)Supervisor Satisfaction	1 2	71 68	5.03 4.81	0.028*	29 12	4.50 5.33	0.002**	22 18	4.84 4.68	0.700	5 6	5.40 5.25	0.701
b)Supervisor Knowledge	1 2	71 67	4.95 5.08	0.331	29 12	4.89 5.11	0.462	22 18	4.95 4.81	0.596	5 6	5.00 5.38	0.422
c)Supervisor Encouragement & Support	1 2	71 68	5.21 5.06	0.383	29 12	4.90 5.33	0.233	22 18	4.89 5.33	0.065	5 6	5.10 5.25	0.760
d)Shop-floor Satisfaction	1 2	71 68	4.73 4.99	0.157	29 12	5.38 5.60	0.115	22 18	4.77 5.06	0.479	5 6	4.47 5.44	0.313
e)Shop-Floor Environment: Hardware	1 2	70 68	5.37 5.42	0.709	28 12	5.38 5.60	0.230	22 18	5.43 5.69	0.100	5 6	5.40 5.75	0.119
f)Shop-floor Training	1 2	69 68	4.80 5.26	0.003**	28 12	4.54 5.44	0.000***	20 18	4.50 4.36	0.767	5 6	5.00 4.67	0.667
g)Safety Meeting	1 2	71 68	5.27 5.33	0.588	29 10	5.33 5.88	0.005**	22 18	5.36 4.89	0.132	5 6	5.30 5.58	0.241
h)Safety Working Procedures	1 2	71 68	4.99 5.40	0.000***	29 12	5.13 5.50	0.001***	22 18	4.85 5.15	0.305	5 6	5.07 5.33	0.416

A Summary of T-test Results of the 8 Attitudinal Scale in Round One and Two of the Mass Surveys Table 7.8

Remarks:

\# The Mean of each attitudinal scales is an average of the total score of their concerned items.

* : $p \leqq 0.05$ ** : $p \leqq 0.01$ *** : $p \leqq 0.001$ Rd 1 and Rd 2 refer to the two attitude investigations by questionnaire

7.3.1 Hypothesis II (a)
There was a relationship between intervention and 'Supervisor Satisfaction'

Question Items (21, 22)
Scale 1-Supervisor Satisfaction

For 'Supervisor Satisfaction', by means of t-test (Table 7.8), significant differences were found only with the surveys in the Heavy Duty [Mean (rd 1) = 5.03; Mean (rd 2) = 4.81, p = 0.028] and in the Small Press [Mean (rd 1) = 4.50, Mean (rd 2) = 5.33; p = 0.002]. There was no significant result with other groups (Hand Press, Drilling). The null hypothesis that there was no relationship between intervention and 'Supervisor Satisfaction' was rejected with the Heavy Duty and Small Press department but could not be rejected with Hand Press and Drilling Departments.

7.3.2 Hypothesis II (b)
There was relationship between intervention and 'Supervisor Knowledge'.

Question Item (23, 24, 25)
Scales 2-Supervisor Knowledge

No significant result was detected with all groups from the test (Table 7.8) in the two rounds of questionnaire surveys. Therefore, the null hypothesis that there was no relationship between intervention and 'Supervisor Knowledge' could not be rejected with all groups.

7.3.3 Hypothesis II (c)

There was a relationship between intervention and 'Supervisor Encouragement and Support'.

Question Items (19, 20)
Scale 3-Supervisor Encouragement & Support

For 'Supervisor Encouragement and Support', there was no significant result collected through t-test with all groups of respondents. Thus, the null hypothesis that there was no relationship between intervention and 'Supervisor Encouragement and Support' could not be rejected.

7.3.4 Hypothesis II (d)
There was a relationship between intervention and 'Shop-floor Satisfaction'.

Question Items (6,7, 8)
Scale 4-Shop-floor Satisfaction

The results from t-test (Table 7.8) indicated that significant difference could not be found with any individual groups of respondents. As a result, the null hypothesis that there was no relationship between intervention and 'Shop-floor Satisfaction' could not be rejected with all departments.

7.3.5 Hypothesis II(e)
There was a relationship between intervention and 'Shop-floor Environment: Hardware'.

Question Items (2,4,12,13)
Scale 5-Shop-floor Environment: Hardware

As indicated from the results collected from t-test on Table 7.8, no significant difference was noticed from any group of responses and the null hypothesis that there was no relationship between intervention and 'Shop-floor Environment: Hardware' could not be rejected.

7.3.6 Hypothesis II (f)
There was a relationship between intervention and 'Shop-floor Training'.

Question Items (9, 14, 17,18)
Scales 6-Shop-floor Training

Through t-test, significant results (Table 7.8) were secured with the Heavy Duty Press [Mean (rd 1) = 4.80, Means (rd 2) = 5.26, p = 0.003] and highly significant with the Small Press ([Mean = 4.54 (rd 1), Mean (rd 2) = 5.44, p = 0.000], while there were no significant differences with other departments. Hence, the null hypothesis that there was no relationship between intervention and 'Shop-floor Training' was rejected with the Heavy Duty Press and the Small Press Department but could not be rejected with the other two departments.

7.3.7 Hypothesis II (g)
There was relationship between intervention and 'Safety Meeting'.

Question Items (1, 10, 11, 16)
Scale 7-Safety Meeting

Through the use of t-test (Table 7.8), only the Small Press Department was found to carry a significant result [Mean (rd 1) = 5.33, Mean (rd 2) = 5.88, p = 0.005], while all other groups did not show any significant differences in their responses with intervention. Thus, the null hypothesis that there was no relationship between intervention and 'Safety Meeting' could not be rejected with all departments except the Small Press.

7.3.8 Hypothesis II (h)

There was a relationship between intervention and 'Safety Working Procedures'.

Question Items (3, 5, 15)
Scale 8-Safety Working Procedures

As indicated on Table 7.8, highly significant results from t-test were obtained from the Heavy Duty [Mean (rd 1) = 4.99, Mean (rd 2) = 5.40, p = 0.000] and the Small Press [Mean (rd 1) = 5.13, Mean (rd 2) = 5.50, p = 0.001] departments. In the meantime, the remaining departments involved did not exhibit any significant difference in their responses. The null hypothesis that there was no relationship between intervention and 'Safety Working Procedures' was automatically rejected with the Heavy Duty and the Small Press Department but could not be rejected with the other two departments.

7.3.9 Summary of Hypothesis II (a, b, c, d, e, f, g, h)

From the comparison of attitudes of the workers towards work safety in terms of the 8 dimensions (8 scales), the result indicated that there were relationships between intervention and the workers attitudes in terms of

-'Supervisor Satisfaction' in the Heavy Duty and the Small Press Department

(but not with other departments);

-'Shop-floor Training' with the

Heavy Duty Press and the Small Press

(but not with other departments);

-'Safety Meeting' with the Small Press

(but not with other departments);

-'Safety Working Procedures' with the

Heavy Duty Press and the Small Press

(but not with other departments).

Meanwhile, no relationship was found between intervention with other attitudinal dimensions ('Supervisor Knowledge', 'Supervisor Encouragement & Support', 'Shop-floor Satisfaction' and 'Shop-floor Environment: Hardware'). Intervention seemed to be most influential on workers' attitudes in 'Safety Meeting' and their 'Safety Working Procedure' in the Heavy Duty Press and the Small Press groups.

7.4.0 Hypothesis III (a, b, c, d, e, f, g, h)

In the current study, to seek the existence of significant statistical differences between data groups designed at nominal level, cross-tabulation analysis with Fisher Exact test were applied. These tests were used to identify the relationship between the safety attitudes of the workers who had been formally trained to possess operation skills and attitudes of their peers without formal training. In order to accomplish the task, their scores of responses from the background questions in the questionnaire had to be categorized into "high" "middle" and "low".

Attitudinal Scale	Workers with Vs Workers without Self-reported Training			
	Heavy Duty	Small Press	Hand Press	Drilling
a) Supervisor Satisfaction	*0.017	0.192	0.225	0.400
b) Supervisor Knowledge	0.120	0.173	0.124	0.800
c) Supervisor Encouragement & Support	0.923	0.837	N/A	1.000
d) Shop-Floor Satisfaction	0.114	0.082	0.104	0.800
e) Shop-Floor Environment: Hardware	0.059	0.083	0.138	0.400
f) Shop-Floor Training	0.056	0.118	0.325	0.800
g) Safety Meeting	*0.025	0.128	0.084	0.800
h) Safety Working Procedures	0.114	*0.019	0.125	0.400

Summary Table of Fisher's Exact Test for the Differences in Attitudes Between Workers with Formal Training and Those without Table 7.9

*: $p \leqq 0.05$ **: $p \leqq 0.01$ ***: $p \leqq 0.001$

Remarks: N/A: Not available. The inapplicability of the data was caused by the responses clustering on the same level of score of the scale and the clustering consequently disabled the crosstabulation analysis and Fisher Exact test. This phenomenon will be further explained in the following chapter (Discussion, pp-324).

7.4.1 Hypothesis III (a)

Question Items (21, 22)
Scale1-Supervisor Satisfaction

By scrutinizing the cross-tabulation analysis with Fisher Exact Test on Table 7.9, significant difference in attitude was found between workers with formal training and those without in the Heavy Duty Press Department (also Table 7.10, P=0.017,) by means of questionnaire investigation before the intervention.. The null hypothesis that there was no relationship between the attitude of workers with self-reported training and that of their peers without formal training in terms of 'Supervisor Satisfaction' was rejected with the Heavy Duty department in the 1st questionnaire survey but could not be rejected with other departments. Workers who had been formally trained were more in number than those who did not have any formal training with reference to their positive attitudes towards safety

TABLE (7.10) CROSS-TABULATION OF THE ATTITUDE TOWARDS 'SUPERVISOR SATISFACTION' BETWEEN WORKERS WITH SELF-REPORTED TRAINING AND THOSE WITHOUT SELF-REPORTED TRAINING IN THE HEAVY DUTY PRESS DEPARTMENT

	SUPERVISOR SATISFACTION			
	Low	*Middle*	*High*	*Total*
Workers with Formal Training	14	19	19	52
Workers without Formal Training	8	5	2	15
Total	22	24	21	67

*p = 0.017**
probability 0.017<0.05.

7.4.2 Hypothesis III (b)

Question Items (23, 24, 25)
Scale 2-Supervisor Knowledge

From the results collected from the cross-tabulation analysis with Fisher Exact test (Table 7.9), no significant difference in attitude was detected between the two groups of workers with and without formal training in all departments in the first round of questionnaire investigation. Hence, the null hypothesis that there was no relationship between attitude of workers with self-reported training and that of other workers without formal training in terms of 'Supervisor Knowledge' could not be rejected with all departments.

7.4.3 Hypothesis III (c)

Question Items (19, 20)
Scale 3-Supervisor Encouragement & Support

From Table 7.9, the Fisher Exact test results indicated an absence of significant differences in attitude of workers with self-reported training and attitude of those without self-reported training in all departments towards 'Supervisor Encouragement & Support' before the intervention.

As a result, in terms of 'Supervisor Encouragement & Support', the null hypothesis that there was no relationship between attitude of workers with self-reported training and that of workers without the same training could not be rejected with all departments in the first questionnaire survey.

7.4.4 <u>Hypothesis III (d)</u>

Question Items (6,7,8)
Scale 4- Shop-floor Satisfaction

No significant results could be detected with attitude of the two types of workers in all departments in the first attitudinal investigation (Table 7.9). <u>The null hypothesis that there was no relationship between attitude of workers with self-reported training and that of workers without training in terms of 'Shop-floor Satisfaction' could not be rejected with all departments.</u>

7.4.5 <u>Hypothesis III (e)</u>

Question Items (2,4,12,13)
Scale 5-Shop-floor Environment: Hardware

No significant difference in attitude could be collected by means of Fisher Exact test for workers with formal training and those without in all departments in the first questionnaire survey (Table 7.9). Thus, <u>in the questionnaire survey, the null hypothesis that there was no relationship between attitude of the two types of workers with and withour self-reported training in terms of 'Shop-floor Environment: Hardware' stayed with all departments.</u>

7.4.6 Hypothesis III (f)

Question Items (9, 14, 17, 18)

Scale 6-Shop-floor Training

From Table 7.9, the result through Fisher Exact test showed the absence of significant statistical differences in attitude between workers with formal training and that of their peers without formal training in all departments in the first round of mass survey. The null hypothesis that there was no relationship between attitude of workers with self-reported training and that of workers without training in terms of 'Shop-floor Training' could not be rejected with all departments in the first round of questionnaire investigation.

7.4.7 Hypothesis III (g)

Question Items (1,10,11,16)
Scale 7-Safety Meeting

As indicated in Table 7.9, significant statistical differences were found with the safety attitude of workers and that of their peers in the Heavy Duty Press (also Table 7.11, p = 0.025) in the first attitude survey but did not seem to be associated with the attitude of both types of workers in other departments. Further investigation into Table 7.11 for the Heavy Duty Press department showed that workers who had received formal training had more positive perception towards 'Safety Meeting' than those who had not. The null hypothesis that there was no relationship between the attitude of workers with self-reported training and that of those without training towards 'Safety Meeting' was rejected with the Heavy Duty Press Department in the first attitude survey but could not be rejected with other departments.

TABLE (7.11) CROSS-TABULATION OF THE ATTITUDE TOWARDS 'SAFETY MEETING' FOR WORKERS WITH SELF-REPORTED TRAINING AND ATTITUDE OF WORKERS WITHOUT SELF-REPORTED TRAINING IN THE HEAVY-DUTY PRESS DEPARTMENT

	SAFETY MEETING			
	Low	*Middle*	*High*	*Total*
Workers with Formal Training	14	20	18	52
Workers without Formal Training	6	2	7	15
Total	20	22	25	67

*p = 0.025**

probability 0.025<0.05.

7.4.8 Hypothesis III (h)

Question Items (3,5,15)

Scale 8-Safety Working Procedures

By means of Fisher Exact test (Table 7.9), significant differences in attitude were obtained between workers with formal training and those without in the Small Press Department (P = 0.019) in the first round of questionnaire survey but were not found with workers of other departments. Supporting data in detail could be found in Table 7.12 for the Small Press Department. Workers who had been formally trained tended to have more favourable attitudes toward 'Safety Working Procedures' than their peers who had not. The null hypothesis that there was no relationship between attitude of workers with self-reported training and their peers without training towards 'Safety Working Procedures' was rejected with workers in the Small Press Department in the first attitude survey but could not be rejected with workers of other departments.

TABLE (7.12) CROSS-TABULATION OF THE ATTITUDE FOR SAFETY MEETING IN WORKERS WITH SELF-REPORTED TRAINING AND ATTITUDE OF WORKERS WITHOUT SELF-REPORTED TRAINING IN THE SMALL PRESS DEPARTMENT

	SAFETY WORKING PROCEDURES			
	Low	***Middle***	***High***	***Total***
Workers with Formal Training	0	3	14	17
Workers without Formal Training	3	2	4	9
Total	3	5	18	26

*p = 0.019**

probability 0.019<0.05.

7.4.9 Summary of Hypothesis III (a, b, c, d, e, f, g, h)

As far as the impact of formal training on the workers attitudes was concerned, trained workers from high risk departments seemed to have more favourable attitudes towards work safety in 'Supervisor Satisfaction', 'Safety Meeting' and 'Safety Working Procedures'. Thus the results demonstrated that there were relationships between attitudes of the formally trained workers and those of their peer workers without formal training towards occupational safety in terms of

- 'Supervisor Satisfaction' with the Heavy Duty Press but not with attitudes of workers in other departments;
- 'Safety Meeting' with the Heavy Duty Press but not with attitudes of workers in other departments
- 'Safety Working Procedures' with the Small Press but not with attitudes of workers in other departments.

Meanwhile, no relationship was found between attitudes of the workers with formal training and that of the workers without formal training towards other attitudinal dimensions ('Supervisor Knowledge', 'Shop-floor Satisfaction', "Supervisor Encouragement & Support', 'Shop-floor Environment: Hardware' and 'Shop-floor Training') in all departments.

7.5.0 Hypothesis IV (a, b, c, d, e, f, g, h)

In order to find out the differences in attitudes towards work safety between workers with self-reported accident rates and those without, cross-tabulation analyses with Fisher Exact tests for the first round of questionnaire investigation with the workers were applied. The tests were used to examine the relationship between the attitudes of the two types of workers towards work safety in all four departments, as indicated on Table 7.13.

Attitudinal Scale	Workers With Vs Workers without Self-reported Accident Rates			
	Heavy Duty	Small Press	Hand Press	Drilling
a) Supervisor Satisfaction	0.124	0.153	0.429	N/A
b) Supervisor Knowledge	*0.032	0.177	0.304	N/A
c) Supervisor Encouragement & Support	0.067	0.360	0.468	N/A
d) Shop-Floor Satisfaction	*0.024	0.744	0.422	N/A
e) Shop-Floor Environment: Hardware	0.067	*0.033	0.422	N/A
f) Shop-Floor Training	0.175	0.606	0.537	N/A
g) Safety Meeting	0.105	0.184	0.289	N/A
h) Safety Working Procedures	0.442	0.439	0.201	N/A

Summary Table of the Fisher's Exact Test for the Difference in Attitudes of Workers with Self-reported Accident and Those without Self-reported Accident in the Four Departments in the Mass Survey Table 7.13

*: $p \leqq 0.05$ **: $p \leqq 0.01$ ***: $p \leqq 0.001$

Remarks:

N/A: Not available. It was caused by the responses clustering on the same level of score of the scale and the clustering consequently disabled the crosstabulation analysis and Fisher Exact test. This phenomenon will be further explained in the following chapter "Discussion". (See pp-324 below)

7.5.1 Hypothesis IV (a)

Scales 1-Question Items (21, 22)
Supervisor Satisfaction

By means of cross-tabulation analysis with Fisher Exact test on Table 7.13, none of the departments reported any significant results in relation to the difference in attitude between the two types of workers. The null hypothesis that there was no relationship between the attitude of workers with self-reported accident rates and that of their peers without self-reported accident rates in terms of 'Supervisor Satisfaction' could not be rejected with all departments.

7.5.2 Hypothesis IV (b)
Scale 2- Question Items (23, 24, 25)
Supervisor Knowledge

The results in Table 7.13 indicated that no significant difference in attitudes towards 'Supervisor Knowledge' was identified with all departments except the Heavy Duty Department examined in the first round of questionnaire survey between workers with self-reported accident rates and those without. Details could be found in Table 7.14 (p=0.032). The null hypothesis that there was no relationship between attitude of workers with self-reported accident rates and that of their peers without accident rates towards 'Supervisor Knowledge' could not be rejected with all departments except the Heavy Duty Press Department in the first round of questionnaire survey.

TABLE (7.14) CROSS-TABULATION OF THE ATTITUDE TOWARDS 'SUPERVISOR KNOWLEDGE' BETWEEN WORKERS WITH SELF-REPORTED ACCIDENT RATES AND THAT OF OTHER WORKERS WITHOUT SELF-REPORTED ACCIDENT RATES IN THE HEAVY-DUTY PRESS DEPARTMENT

	SUPERVISOR KNOWLEDGE			
	Low	*Middle*	*High*	*Total*
With Occupational Accidents in the Past Two Months	0	5	16	21
Without Occupational Accidents in the Past Two Months	2	22	23	47
Total	2	27	39	68

*P = 0.032**

probability 0.032<0.05.

Workers without occupational accidents tended to have a higher safety attitude.

7.5.3 Hypothesis IV (c)

Scale 3-Question Items (19, 20)

Supervisor Encouragement & Support

By analyzing the figures in Table 7.13, no statistical significance in safety attitude of the two types of workers could be identified with all departments. Thus the null hypothesis that there was no relationship between attitude of workers with self-reported accident rate and that of their peers towards 'Supervisor Encouragement & Support' could not be rejected with other departments.

7.5.4 Hypothesis IV (d)

Scale 4-Question Items (6,7, 8)

Shop-floor Satisfaction

Likewise, the result from Table 7.13 did not identify any significant difference in attitude between workers with self-reported accident rates and those without towards 'Shop-floor Satisfaction' in almost all departments. The only department that exhibited significant response was the Heavy Duty Department (Table 7.15, p=0.024). The null hypothesis that there was no relationship between attitude of workers with self-reported accident rates and that of their peers towards 'Shop-floor Satisfaction' was rejected with the Heavy Duty Press Department in the first round of survey but could not be rejected with other departments surveyed. Workers who did not have accident rates and possessed positive attitudes were the majority compared with the other type of workers.

TABLE (7.15) CROSS-TABULATION OF THE ATTITUDE TOWARDS 'SHOP-FLOOR SATISFACTION' BETWEEN WORKERS WITH SELF-REPORTED ACCIDENT RATES AND THAT OF OTHER WORKERS WITHOUT SELF-REPORTED ACCIDENT RATES IN THE HEAVY-DUTY PRESS DEPARTMENT

	SHOP-FLOOR SATISFACTION			
	Low	*Middle*	*High*	*Total*
With Occupational Accidents in the Past Two Months	6	14	1	21
Without Occupational Accidents in the Past Two Months	4	38	5	47
Total	10	52	6	68

*p = 0.024**

probability 0.024<0.05.

7.5.5 Hypothesis IV (e)

Scale 5 - Question Items (2, 4, 12, 13)
Shop-floor Environment: Hardware

The figures from the result in Table 7.13 exhibited significant statistical differences in attitude with workers having self-reported accident rates and these without in the Small Press Department (p = 0.033) (Table 7.16) in terms of 'Shop-floor Environment: Hardware'. However, the result did not show any significant figures related to the difference in attitude between the two types of workers towards 'Shop-floor Environment: Hardware' in other departments. The null hypothesis that there was no relationship between attitude of workers with self-reported accident rates and that of their peers without accident rates towards 'Shop-floor Environment: Hardware' could not be rejected with all departments except the Small Press Department in the survey.

TABLE (7.16) CROSS-TABULATION OF THE ATTITUDE TOWARDS 'SHOP-FLOOR ENVIRONMENT: HARDWARE' BETWEEN WORKERS WITH SELF-REPORTED ACCIDENT RATES AND THAT OF OTHER WORKERS WITHOUT SELF-REPORTED ACCIDENT RATE IN THE SMALL PRESS DEPARTMENT

	SHOP-FLOOR ENVIRONMENT: HARDWARE			
	Low	*Middle*	*High*	*Total*
With Occupational Accidents in the Past Two Months	1	1	3	5
Without Occupational Accidents in the Past Two Months	8	11	2	21
Total	9	12	5	26

*p = 0.033**

probability 0.033<0.05.

7.5.6 Hypothesis IV (f)

Scale 6-Question Items (9,14, 17, 18)
Shop-floor Training

A scrutiny of the Table 7.13 could not locate any significant result in safety attitude with the two types of workers in all departments under investigation. Therefore, the null hypothesis that there was no relationship between the attitude of workers with self-reported accident rates and that of their peers without self-reported accident rates in terms of 'Supervisor Satisfaction' could not be rejected with all departments.

7.5.7 Hypothesis IV (g)
Scale 7-Question Items (1, 10, 11, 16)
Safety Meeting

The result from Table 7.13 showed no significant difference in attitude between workers with self-reported accident rates and those without towards 'Safety Meeting' in all departments. The null hypothesis that there was no relationship between the attitude of workers with self-reported accident rates and that of other workers without self-reported accident rates could not be rejected with all department in terms of 'Safety Meeting' in the first round of survey by questionnaire.

7.5.8 Hypothesis IV(h)
Scale 8-Question Items (3, 5, 15)
Safety Working Procedures

No significant result could be identified as indicated on Table 7.13 in all departments in the first survey by studying the figures collected. The null hypothesis that there was no relationship between attitude of workers with self-reported accident rates and that of their co-workers without accident rates could not be rejected with all departments surveyed.

7.5.9 Summary of Hypothesis IV (a, b, c, d, e, f, g, h)

With regard to the relationship between the workers' attitudes towards work safety and their accident rates, workers in the Heavy Duty Press and the Small Press departments without accident rates tended to have more positive attitudes towards 'Supervisor Knowledge', 'Shop-floor satisfaction' and 'Shop-floor Environment: Hardware'. The results indicated that there were relationships between workers with self-reported accident rates and those without in terms of their safety attitudes in

- 'Supervisor Knowledge' with the Heavy Duty Press Department but not with other departments;

-'Shop-floor Satisfaction' with the Heavy Duty Press Department but not with other departments

-'Shop-floor Environment: Hardware' with the Small Press Department but not with other departments.

Meanwhile, there was no relationship found between workers with self-reported accident rates and those without self-reported accidents with reference to other dimensions of their attitudes toward work safety.

7.6.0 Hypothesis V

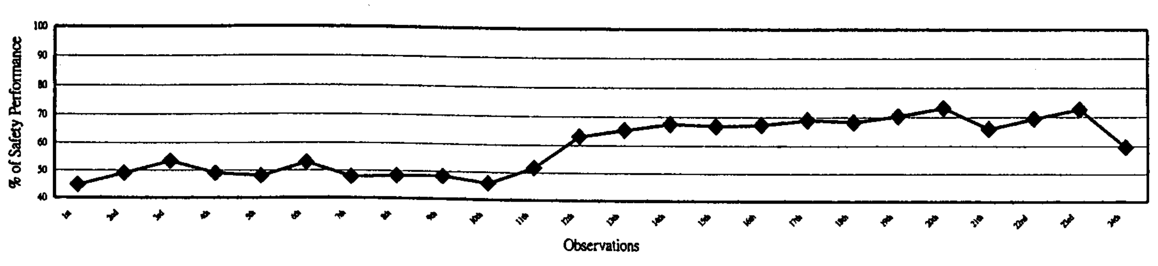
Intervention is not related to both the workers' attitudes and their behaviours in work safety

7.6.1 Heavy Duty Press Department

From Figure 7.1.1, the graphic display, obvious improvement (difference: 20.62%---- between the lowest and highest points) was noticed during intervention. The inspection of the attitudes of the workers towards work safety during pre and post intervention phases (Table 7.8) (see above pp-281) demonstrated significant differences in 'Supervisor Satisfaction', 'Shop-floor Training', 'Safety Working Procedures'. It appeared that both the workers' attitudes towards work safety and their safety performance may have been influenced by the intervention in the above dimensions.

% of Safety Performance of the Department of Heavy Duty Press from Early August 1999 to February 2000 by Week

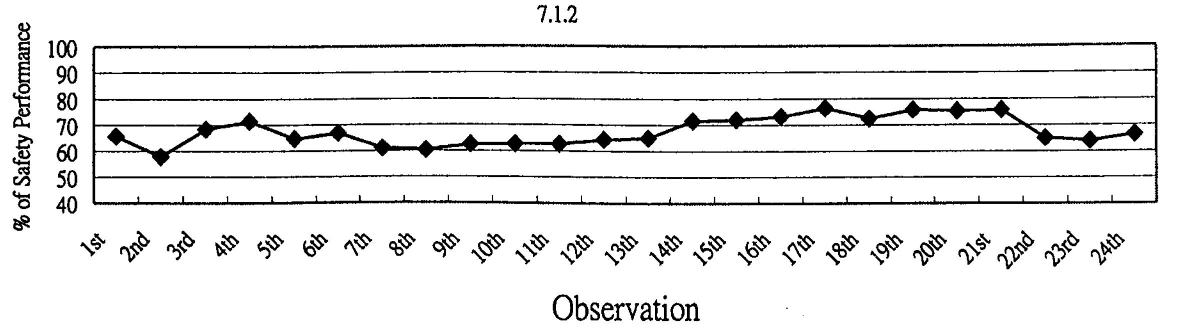
Figure 7.1.1



7.6.2 Small Press Department

The result from Figure 7.1.2 indicated a rather consistent satisfactory performance (difference: 11.34% between the lowest and highest points) after the introduction of intervention. Meanwhile, the scrutiny of the contrast the attitudes of the workers between pre and post intervention periods (Table 7.8) showed significant difference in their attitudes in 'Supervisor Satisfaction', 'Shop-floor Training', 'Safety Meeting', and 'Safety Working Procedures'. It was therefore, likely that both the workers' safety performance and their attitudes may have been affected by the treatment implemented.

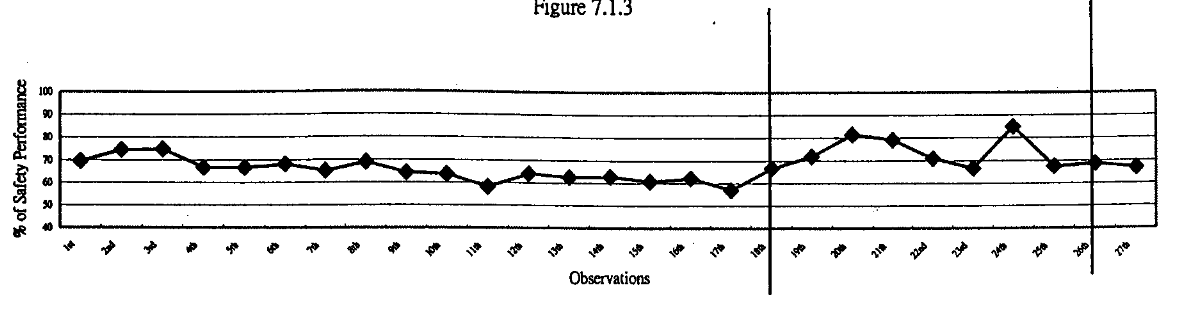
% of Safety Performance of the Small Press Department from Early August 1999 to February 2000 by Week Figure 7.1.2



7.6.3 Hand Press Department

According to Figure 7.1.3, the visual display of the workers' safety performance (66.74%----85.21% on week 24) indicated an obvious change of observation points on the display. On the other hand, by studying the results on Table 7.8, there did not seem to be any difference in all the dimensions of their safety attitudes, though both the workers' safety performance and their attitudes in work safety might have been influenced by the intervention.

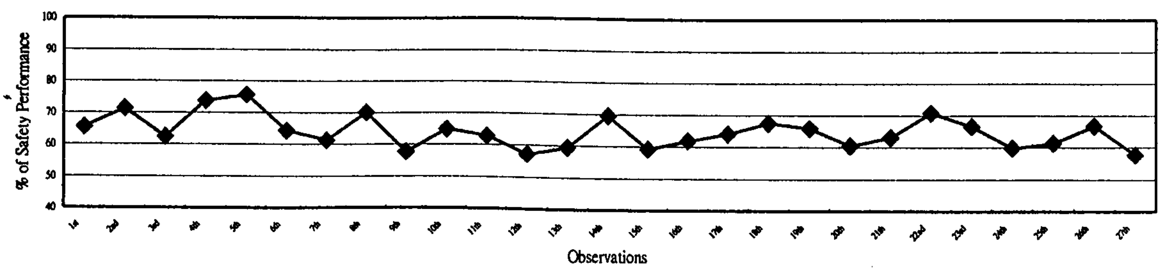
% of Safety Performance of the Hand Press Department from Early August 1999 to February 2000 by Week Figure 7.1.3



7.6.4 Summary of Hypothesis V

By inspecting the overall visual display in Figure 7.1 and individual figures (7.1.1, 7.1.2, 7.1.3), all three departments (Heavy-duty Press, small Press and Hand Press) exhibited significant behavioural change, after the introduction of intervention, while the performance improvement could not be detected with Drilling department (figure 7.1.4) as expected when no intervention was involved.

% of Safety Performance of the Drilling Department from Early August 1999 to February 2000 by Week
Figure 7.1.4



Concurrently, no attitudinal changes were identified with the workers in the Hand Press and the Drilling Department but some change had been observed in the Heavy-duty Press and Small Press Department in some attitude dimensions. Since the change occurred during or after the intervention, it seemed to suggest that intervention had a positive impact on both the performance and the attitudes.

7.6.5 Summary of this Chapter

This chapter had identified some significant correlation between intervention with workers' safety performance, with their attitudes towards safety at work, between the safety attitudes of workers' with self-reported training and those of the workers who did not have self-reported training, between attitudes of the two types of workers, the ones with self-reported accidents versus those without.

A summary of all the correlations is shown in Table 7.17. The first four hypotheses have been listed in turn together with their respective p-values and indications of significance. However, for Hypothesis V, as the result is a mere logical inference by juxtaposing the two sets of data, there was only a 'yes' or 'no' to suggest the significance rather than the actual figures listed in terms of the relationship between the intervention and both the safety performance and attitudes.

7.6.6 A Summary of the Outcomes on Hypotheses I to IV Table 7.17

Hypo.	Independent Variable	Dependent Variable	Dept.	P-Value	F-Value	Fisher Exact Test	Sig. Diff.
I	Feedback with Goal-setting (Intervention)	Safety Performance	H.Duty	0.001	50.505		***
			S. Press	0.001	19.790		***
			Hand P	0.001	14.774		***
II	Feedback with Goal-setting (Intervention)	Supervisor Satisfaction	H. Duty	0.028			*
			S. Press	0.002			**
		Shop-floor Training	H.Duty	0.003			**
			S. Press	0.001			***
		Safety Meeting	S.Press	0.005			**
		Safety Working Procedure	H.Duty	0.001			***
			S.Press	0.001			***
III	Self-reported Training (Workers w Vs Workers w/o)	Supervisor Satisfaction	H. Duty			0.017	*
		Safety Meeting	H. Duty			0.025	*
		Safety W. Procedures	S. Press			0.019	*
IV	Self-reported Accidents (Workers w Vs Workers w/o)	Supervisor Knowledge	H. Duty			0.032	*
	Self-reported Accidents (Workers w Vs Workers w/o)	Shop-floor satisfaction	H. Duty			0.024	*
	Self-reported Accidents (Workers w Vs Workers w/o)	Shop-fl. Environment: Hardware	Small Press			0.033	*

Remark: *: p ≦0.05, **: ≦ 0.01, *** ≦ 0.001

7.6.7 A Summary of the Outcomes on Hypothesis V Table 7.18

Hypo	Independent Variable	Dependent Variable	Dept	Suggested Existence of Relationship
V	Feedback with Goal-setting	Safety Performance	H. .Duty	Yes
		Supervisor Satis. Shop-floor Training Safety Working Pro.		
		Safety Performance	Small Press	Yes
		Supervisor Satis. Shop-floor Training Safety Meeting Safety Working Proc.		
		Safety Performance	Hand P.	Yes

The coming chapter will focus on the discussion of the results obtained from the investigations at the site with regard to its contribution as an addition to the contemporary researches in the field.

CHAPTER VIII

DISCUSSION

8.1.0 <u>Introduction</u>

Following the results from Chapter VII, the present chapter attempts to examine the implications of the findings in relation to the literature and the cultural context in China. The discussion of the results follows the same order of presentation as the previous chapter. The text that follows will give a general review of the typical problems encountered in the major processes of the research. The final section will be dedicated to the discussion of the feasibility of establishing a safety culture in a developing country.

8.2.0 **Findings in Relation to the Hypotheses**

8.2.1.0 Hypothesis I

<u>There are relationships between the workers' behaviours in occupational safety and posted-feedback plus goal-setting</u>

As far as the impact of the intervention in the form of posted-feedback plus goal-setting on the behaviours of the workers was concerned, the overall results recorded significant change in the workers' safety performance from both the graphic display and ANOVA Test. The marked improvement of behaviour all occurred with the three departments, namely Heavy Duty, Small Press and Hand Press where interventions were introduced at different points of time. The improvement of safety behaviour stayed through the intervention period with all three departments.

As for the Drilling department, in the absence of any intervention, there was no evident change of the workers' safety behaviours recorded all through the survey.

From Table 8.1 the safety performance of the Heavy Duty Press, Small Press and Hand Press departments during the baseline period and intervention periods was brought into comparison by averaging the means (Table 7.1, pp-272) of each period.

Table 8.1 A Comparison of Safety Performance between the Baseline and Intervention Periods

Department	Baseline Averaged Means	Intervention Averaged Means	Difference of Averaged Means	Highest Point (Inter-vention)	Lowest Point (Intervention)	Difference between Highest & Lowest Point (Intervention)
Heavy Duty Press	49.25	61.45	12.20	69.00	51.78	20.62
Small Press	64.14	72.87	8.73	76.54	65.20	11.34
Hand Press	65.28	73.72	8.44	85.21	66.74	18.47
Drilling	64.51	No intervention	N/A	N/A	N/A	N/A

The figures on Table 8.1 shows that the Heavy Duty Department had achieved the most obvious improvement, reaching a difference of 12.20% (baseline: 49.25; intervention: 61.45). In comparison with the Heavy Duty Department, the improvement level in the Small Press Department was less obvious, with 8.73% in difference between the baseline (64.14) and the intervention (72.87). Meanwhile, similar improvement in safety performance was noted in the Hand Press Department, showing 8.44% in difference between the baseline (65.28) and the intervention (73.72). The Drilling Department has witnessed a flat averaged mean of 64.51% in performance. The table above strongly implied that the levels of improvement within each department were equally comparable, mirroring noted improvements of the respondents' behaviours. And the between department comparison from the table also indicated that the within department improvements were important, making an averaged increase of over 8% in the individual departments. The most evident improvement in the Heavy Duty Department (12.20%) could be attributable to the greater success from feedback plus goal setting. This noticeable success could also be proved by the larger fluctuations of the performance points on the visual display (fig. 7.1, Chapter VII). The difference from the lowest and the highest points of performance within the intervention period was 20.62%, compared to 11.34% in the Small Press Department and 18.47% in the Hand Press Department. These fluctuations in the respective departments reflected the active response of the workers.

The results paralleled the findings in numerous past behavioural studies related with safety performance (Adam, 1975; Kim & Hamner; 1976; Sulzer-Azaroff et al, 1994) as mentioned in the literature review. Feedback and goal-setting proved to be an effective paring of antecedent and consequent in behavioural management.

This approach reinforced the concept in the behavioural studies of Skinner (1974) and Sulzer-Azaroff et al (1994). They argued that behaviour is the function of its consequences and that behaviour is influenced by the context of the events and the antecedents and consequences. The antecedents refer to happenings that precede the behaviour----the requirements of the job. The consequences means happenings that follow the relevant performance---- the reward of the accepted behaviours or discouragement for unwanted behaviour in the form of posted feedback plus goal setting.

8.2.1.1 Direct Observation

The results also indicated that continuous direct observation over a substantial period of time was rewarding in detecting the changes of behaviours in the subjects (workers), as direct observation is free from the distortion that may be caused by the self-reported questionnaires. The preliminary and continuous measurement of the observable behaviours paired by a regular coding system as applied in the present study is crucial in this behavioural approach for monitoring of minor changes. The internal consistency of the measurements once or twice a day and three or four days a week contributed to the success of the observations. The pre-designed simple check-list facilitated the recording of the behaviours, as shown in the 'conduct of investigation' in Chapter VI.

The results also conformed to the findings in Zohar et al's (1980) important study in using the reinforcement contingencies----feedback in his study to increase earplug usage. From the results of the Heavy Duty Press, Small Press and Hand Press Department, the safety performance of the workers remained high not only at the intervention stage as expected but also carried on into the reversal period (18th week) for the Heavy Duty Press Department. The significantly lasting effect of the intervention in the Heavy Duty Press Department was also reminiscent of Zohar et al's (1980) study in which the follow-up period witnessed a continuous rise of the use of earplug at a final 85-90% level. However it must be noted that the results in the present study were collected from a totally different context where similar investigations had never been attempted before. Zohar et al's (1980) study was done in a metal fabrication plant with 2000 workers in Israel that was a highly technologically advanced country. The research had benefited from a workforce with high quality and "low work injury rates and overall safety performance" for which the factory had won annual awards. The high safety awareness of the top management had helped make the success of the investigations more possible. Even before any intervention was done, they had already recognized the problem of the noise in several departments and were determined to deal with it by encouraging the workers to use the earplug, though in vain. The promotion of the increased use of ear protectors in noise through information feedback by Zohar et al (1980) was more than a success, because the intervention effect had been carried on over a lengthy reversal period for five months. It could be that workers who were predisposed with the already established safety reputation could easily be motivated by the feedback to form the habit of using the earplug. Given the favourable conditions in this Israel factory with high safety awareness as mentioned above, continuous monitoring to maintain the established safety habit was not a problem.

However, in the AMX's (AMX stands for the metal house under investigation in Shenzhen) reality, the overall situation related with work safety was so unpromising that continuous monitoring of safety behaviours was difficult. The norms for accepted work behaviours were hard to establish, owing to the following reasons:

i) The management was weak in safety awareness as mentioned in the interview with the manager and supervisors (documented in Chapter VI----Mass Survey). They did not possess adequate knowledge in safety management. Their inadequacy in safety awareness had posed an impedance for motivating the workers to observe work safety

ii) Most workers in AMX were educationally disadvantaged. The low literacy level of the workers in AMX was representative of the workers in this type of rural industry in Shenzhen. At the initial stage of the intervention, the researcher found that the majority of the workers had great difficulty reading the chart and comprehending its implication. Some of them could not write or speak understandable mandarin (the national language of China). Only through repeated explanation from the observers, could all of them be able to comprehend the feedback chart which they claimed, was rather abstract. Besides, they found it hard to memorize all the safety rules. They were very passive in participating in setting the goal for safety performance, as they were accustomed to being told to work. As mentioned in Chapter II, the Chinese were socialized by the traditional Chinese culture to observe the social norms. The indoctrination of "obeying the authority" dominated the workers behaviours and forbade them from freely expressing their opinion. The above educational inadequacy of the rural Chinese workers was different from their peers in the Western context, as exemplified in Komaki et al's (1980) study. Their study was done in a vehicle maintenance division of a large western city's department of public work where the average educational level of the workers was comparatively much higher than their counterparts in China. They did not encounter any problem understanding the contents of the slide presentation, verbal explanation and written rules. Their safety performance showed significant improvement after the feedback chart was provided.

8.2.1.2 The Lasting Effects of Intervention

However, the unexpectedly high level of safety performance in the Heavy Duty Department being extended into the reversal period could be still attributed to the lasting effects from intervention, though the reversal period was short. These effects point to the importance of continuous monitoring of the workers' safety performance, despite the difficulties and limitations mentioned above in relation to the quality of the workers and their cultural background.

8.2.2.0 Hypothesis II (a, b, c, d, e, f, g, h)[1]

There were relationships between intervention and workers' attitudes towards occupational safety.

[1] (a, b, c, d, e, f, g, h) refers to the 8 scales of workers' attitudes towards occupational safety: a. Supervisor Supervision b. Supervisor Knowledge c. Supervisor Encouragement & Support d. Shop-floor Satisfaction e. Shop-floor Environment: Hardware f. Shop-floor Training g. Safety Meeting h. Safety Working Procedures

In the Heavy Duty Department, the results showed a negative change of workers' attitudes towards work safety in terms of "Supervisor Satisfaction" and significant positive change in "Shop-floor Training" and "Safety Working Procedures" (Table 6.8) during the first and second rounds of mass survey by means of questionnaire. "Supervisor Satisfaction" refers to "how much the workers perceive the satisfaction from their supervisors with the safety training for the workers (HSE, 1996, pp-57-58). It was understandable that as the more demanding the supervisors became about the safe operation from the workers, the more the workers would feel that their supervisors were not satisfied with the safety training for them. Though the workers were aware of the importance of safe operation, it was likely that the increasing pressure from the intervention through the feedback on their safe operation posted weekly would bother them. They felt so nervous to be watched by the supervisors most of the time and internal pressure to meet the safety goal that they could hardly take a break. The results implied that the workers were becoming more concerned about the safety conditions, training and safety practices in the factory (refer to Chapter V, 5.1--Key Elements Critical for Occupational Safety......). It must be noted that included in the intervention package besides the safety instructions in which the proper safe operation procedures and situations were emphasized, were demonstrations of safe operation and feed-back plus goal-setting for reflecting their performance. Through the intervention, the workers were imbued with the basic knowledge needed for safe operation and in the meantime became more aware of the importance of work safety and subsequently positive change was reflected in their related attitudes. Concurrently, there was improvement in the corresponding safety condition in the factory in terms of safety housekeeping.

The change of the workers' attitudes mentioned above supported the theory of Katz (1985, pp-615) and that in the OECD Report (1993). According to the theory by means of training, positive attitudes can be inspired and the success of attitude modification depends largely on the continuous efforts to encourage the target persons to accept new information. In the case of the workers in the current metal shop under experiment, the combined training and continuous posted-feed back plus goal-setting seemed to have a positive influence in modifying the related safety attitudes of the workers.

8.2.2.1 The Priority of Production

However, intervention did not seem to have any or much effect on the change of workers' attitudes toward work safety in terms of the other scales of the questionnaire ("Supervisor Knowledge", "Supervisor Encouragement & Support", "Shop-floor Environment: Hardware", "Safety Meeting"). The workers in most departments did not seem to have high confidence in the supervisors' knowledge about the use of safety equipment and the proper safe working procedures. A look into the report from the observer in Chapter VI would reveal that the supervisors were too occupied most of the time with production targets to care for work safety. Work safety was regarded as only a formality. And during the "Safety Meeting", more emphasis was given to warning the workers of possible damage to material if it was mishandled than to the safety of the operators. Thus the workers would naturally perceive that the existence of "Supervisor Encouragement and Support" as hardly related to work safety. The overall lack of concern for work safety could be derived from the social values in the Chinese community. These social values will be discussed in the sections to follow.

8.2.2.2 Social Value With Regard to Under-Reporting of Minor Injuries

The workers' hesitation to report accidents and injuries was largely predisposed by the social values. As mentioned in Chapter II, the Chinese social values appreciate personal self-sacrifice for the goals of the collective and discourage the emphasis of personal suffering. Minor injuries such as scratches on the skin are considered too trivial to report. This is typical of Chinese social ethics and is especially prominent in the communist society.

A government article once expressed their contempt towards people "who pursued comfortable life, high pay, reluctant to participate in dangerous jobs, caring too much about their bodies and making a fuss of minor injuries or sickness. " (Tsai et al, 1984, pp-195)

8.2.2.3 <u>A Gap between Management and Workers</u>

The lack of difference in workers' attitudes in the above scales could also be that in the traditional Chinese factory, there was a gap between the management and the workers. The order and the ordered relationship between the management and the workers gave both parties little chance to understand each other. As far as the "Shop-floor Environment: Hardware (equipment)" scale is concerned, the workers would think that the maintenance of the equipment in its safe condition as well as safe housekeeping should be solely the responsibility of the management. They did not realize that the safety status of the equipment was closely related with their own safety.

With regard to "Safety Meeting", when a deadline has to be met for delivery as the survival of the factory, safety meeting would naturally be considered a second priority in the daily itinerary of the factory. The generally low safety awareness of the workers is also partly attributable to the Hong Kong (Chinese) work ethic in this types of factory where the management team mainly come from Hong Kong..

One very important factor that should not be ignored when doing research in factories with Hong Kong backgrounds is the consideration of the impact of the Hong Kong work ethic on the local administration. The administrative style would largely reflect the Hong Kong work ethic, though in actual operation it will be modified by the local social and cultural influence. In fact, the current operational reality reflects the adapted Hong Kong work ethic replanted in a traditional Chinese soil.

The concept of work ethic in general can be understood from Levin and Yeung's (1996, pp-136) explanation:

"the concept of the work ethic refers to a subset of a broader set of work values and that this subset itself has many dimensions" characterized in three central features :

> "(i) Work as an end in itself which, it is expected, will be rewarded eventually with material success; (ii) pride in good quality workmanship, hard work, an instinct of workmanship, satisfaction in work; iii) adherence to the discipline of work: punctuality, obedience, diligence, industriousness" (Barbash, 1983, pp-233).

As far as the Hong Kong work ethic is concerned, Levin and Yeung (1996, pp-137) argued that Hong Kong work ethic is featured by the unbelievable industrial way they are working:

> "A popular view of Hong Kong Chinese is that they are continuously striving to get ahead materially and socially, with getting ahead usually defined as seeking higher pay or sometimes as status mobility through achieving subcontractors or employer status in those sectors where small business thrive."

Meanwhile, Hong Kong people are short-sighted about their future, having witnessed in the postwar Hong Kong the political turbulence in the neighbouring Mainland in the last decades. They only care for short-term economic achievement. As commented by Lau (1982, pp-70-71) the Hong Kong Chinese indulge in "uncontrollable compulsion to have immediate material consumption and their intolerance of delayed gratification in the future" and reluctant to "commit resources to the uncertain long-term future".

That can explain why the Hong Kong employers running factories in China regard workers' safety secondary to the yield of production. The mid-level management from Hong Kong who have been accustomed to the "fast-pace" of the Hong Kong working style have also helped reinforce the priority for production yield and subtly conveyed this message to the Chinese workers. This work ethic of the Chinese can hardly be comprehended by the Westerners.

For example, in AMX, the factory manager, the QC supervisors and the tooling supervisors were all from Hong Kong. They had to station all week in the factory. They went back to Hong Kong to spend the weekend with their family and report to the headquarters in Hong Kong on Monday and returned to the factory the next day. The factory was busy all year around. Even during Chinese New Year Holidays, the factory could only afford a break for four days. The management was all the time under the pressure for production target and quality. For the latter, because a finished product normally involves five to six process steps, any error in the series of steps would result in the scrap of the piece of metal. In AMX, therefore, the management was so occupied with the urge for the yield and concern for the reduction of scrap that relatively little time was allowed for promoting occupational safety. Besides, to demonstrate their good performance as the index for salary increase in the following year, the key persons in the management of the Hong Kong based factories such as AMX, for example, tended to hide negative occurrences in the factory. Accidents and injuries were definitely regarded by the employer as a reflection of the inadequacy or disorganization of the daily management. The employer was also worried that accidents would arouse the attention of the Labour Bureau and bring about unnecessary interruption to the production. Therefore, the local factory management tended to report events favourable to them and under-report negative events.

The overall results obtained also pointed to the need to focus on the specific aspects of attitudes rather than the ones in a broader framework in the study of occupational safety as mentioned in the OECD Report (1993, pp-36).

8.2.3.0 <u>Hypothesis III</u>

<u>There are significant relationships between attitudes of the workers with self-reported training and those of their peers without self-reported training towards occupational safety.</u>

8.2.3.1 Training

As one of the background questions in the questionnaire, the workers were asked about whether they had been formally trained after having joined the metal shop. The attitudes of the two types workers, Those with and those without formal training would be brought into comparison to detect the existence of any differences before the intervention as an indication to justify the safety training as part of an intervention to be implemented later. The results obtained demonstrated that respondents with formal training in the Heavy Duty Press Department exhibited significantly more positive attitudes towards "Supervisor Satisfaction" than their peers without formal training in the first round of survey (Table 7.9 & 7.10). The difference in responses could be that in terms of "Supervisor Satisfaction", the former in the Heavy Duty Press Department recognized the importance of general work training for beginners in the factory through their own experience from training. This training was vital to them to master the basic proper operation even without the additional safety intervention for operation to be conducted later.

8.2.3.2 An Important Department

To a metal house, the Heavy-duty Press Department was the most high-risk department because it was involved in shearing, stamping and forming of heavy metal sheets. The machines there ranged from 60 to over 100 tons. Any accident could be disastrous because of the large size of the metal sheet. Therefore, two or three workers were needed to handle each process. A lot of serious accidents and injuries occurred to the workers were a result of the mishandling or in-coordination of the hands and eyes. Owing to the high cost of the material with a thickness normally over 0.8mm, careful handling and precise operation were crucial. For all these reasons, comparably more training was offered to workers in the Heavy-duty Press Department. Normally, the workers were first trained in the Small Press Department for a short period of time to become familiar with each operation and procedure for the machine before they were transferred to the Heavy Duty Department, if needed. And because of the greater danger in the Heavy Duty Press Department, the supervisors there tended to spend relatively more time watching and coaching the workers for machine operation. Hence, the workers would think that they had more demand from the supervisor at the initial stage in the Heavy Duty Press Department. It follows that in the Heavy Press Department the workers who had received formal training would have more sense of safety and would naturally perceive more satisfaction from the supervisor than their peers who had not. On the other hand, workers without self-reported training, out of a sense of insecurity, tended to have less confidence in their work and would feel negatively about the satisfaction from their supervisors.

However, to the author's knowledge, very often owing to the urgency of production pressure, many of the workers had only gone through a brief coaching for beginners at the Heavy Duty Department before they were asked to join the workforce. Any objective criteria to evaluate and qualify their skills were virtually non-existent. There was no such a department as 'Training'. That could explain why there co-existed some workers who had received formal training and some who had not.

8.2.3.3 <u>General Safety Awareness of the Supervisors and Workers</u>

The other finding is that in the Heavy Duty Press Department workers with self-reported training showed significantly more positive attitudes in the first round of survey towards "Safety Meeting" than their co-workers without formal training. It was likely that through the frequent occurrence of accidents and injuries witnessed, they came to realize the importance of the safety meeting that served as a source for safety information in protection against accidents.

The lack of significant differences in other dimensions of the attitudes in the two types of workers mentioned could be that the workers did not perceive the close relationship between the on-job training and work safety. As released by the workers, they were rather disappointed with the factory about training, as most of the Hong Kong based factories were more concerned for delivery and quality rather than the general work safety, the improvement of which would evidently increase the cost of manufacturing. In fact, there was only little on-job training offered to the workers, let alone professional interventions. Workers were only given some simple entry level training to have a feel of the buttons before they were needed immediately on the operation post or to replace those who had resigned. The management did not have the awareness to see the necessity of a long-termed and in-depth systematic training for the green hands. Maybe they thought the operation of the machine was a matter of simple steps. The results for this hypothesis confirmed that an intervention to integrate safety concerns in the whole training package was in urgent need to qualify safe and skilful workers instead of having some workers to fill the head counts.

.<u>The N/A Issue</u> (See above pp-288, 297)

When the data of the result were analyzed, it was found that some responses had clustered on the same level of mean score and thus invalidating the cross-tabulation analysis. That is some respondents chose all the "undecided" items. It could be that they did not want to take time to study other items on the questionnaire seriously. They might either be worried about any negative consequences incurred if they expressed they opinions or they did not think they had the obligation to fill out the questionnaire.

8.2.4.0 <u>Hypothesis IV</u>

<u>There are significant relationships between attitudes of workers with self-reported accident rates and those of their peers without self-reported accident rates.</u>

8.2.4.1 <u>Some Relationship between Experience of Accidents and Attitudes in Workers</u>

The results obtained from the testing of Hypothesis IV confirmed the existence of a relationship between the attitudes of workers who experienced accidents and those who did not, towards occupational safety in certain dimensions of their safety attitudes. As mentioned in Hypothesis III, the Heavy Duty Press Department was the most important department in the work-site where most of the expensive bulky facilities were located. The technical processes were both complicated and demanding. Sometimes, two or three operators were needed to help blank or form the material. Meanwhile, the frequent change of product model in a metal shop demanded a compatible busy shifting of the punching tools. These activities needed the co-coordination of the tooling engineers, the supervisors and the engineers from the quality control department. To start the production for the new models, a series of new operation instructions had to be formulated and given to the operators by the supervisors. Because of the frequent contacts between the supervisors and the workers, the workers would naturally feel that the supervisors were concerned for their safety. The workers free from occupational accidents would have more confidence in the supervisors' safety knowledge and would thus think more favourably about the 'Supervisors' Knowledge (about safety conditions in the factory)' than their peers with accident experience (Table 7.14).

Meanwhile, workers without accident experience in the Heavy Duty Press Department appeared to posses more favourable attitudes towards 'Shop-floor Satisfaction' (Table 7.15) which was largely related with the factory's willingness to observe the maintenance and upholding safety environment.

In the Small Press Department, the management was especially demanding on the tidiness and careful disposal of the semi-finished products in the process of forming. Respondents who did not experience accidents seemed to favour work safety in terms of "Shop-floor Environment: Hardware". Owing to the complicated working steps involved, workers in the Small Press Department generally incurred relatively higher accident rates. Despite the concern from the management, accidents continued to occur. Workers who did not have any accidents would naturally feel better about the 'Shop-floor Environment: Hardware' while their counterparts who had accidents would not.

There was an absence of significant differences in the attitudes between workers with occupational accidents and those without towards other dimensions of the attitudinal scales. Their attitudes could be associated with their over-optimism about their own involvement in accidents. As reflected by the two observers, workers in AMX generally perceived the production activities were only a matter of simple procedures. They tended to less expect that accidents would happen to them and felt too relaxed to pay enough attention to safety. For example, in the Hand Press Department, accidents and minor injuries were frequent (Table 8.2) because of the relatively simple steps in operation. Furthermore, the indifference of the majority of the workers in most departments to safety precautions also supported the rationale in the literature that people were always over optimistic about the possible occurrence of accidents on them. They subjectively believed that there always existed the 'unfortunate others" who were more likely to be involved in accidents (Perloff & Fetzer, 1986; Weinstein, 1980, 1987). Thus, once there were accidents on them, they would be caught by surprise. They thus learned from their mistakes in the accidents and really benefited from the intervention.

The results obtained from Hypothesis IV indicated that there was a need for an intervention through which it was hoped that both the safety behaviours and attitudes of the workers could be improved.

8.2.4.2 Minor Impact from Intervention and Avoidance of Reporting Minor Injuries in the Hand Press Department

However, it is important to note that intervention by means of feed-back and goal setting organized by the researcher seemed to be more effective with the Heavy Duty and Small Press departments (Heavy-duty: 54.2% : 50.4%; Small Press: 22%:16.6%

Table 8.2) but did not appear to have too much with the Hand Press Department as far as the impact on their reduction of accidents or minor injuries was concerned (Table 8.2.).

Round of Survey	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Department	**Heavy-Duty P.**		**Small Press**		**Hand Press**		**Drilling**	
No. of Respondents	83	73	22	12	22	18	8	6
Self-reported 'Days off' Due to Accidents by Workers	133	60.5	11	16	14	18	7	7
Got Hurt or Had Minor Injuries Reported by Workers	45 (54.2 %)	36.8 (50.4%)	5 (22%)	2 (16.6%)	13 (59.1%)	11 (61%)	4 (50%)	3 (50%)
'Days Off' Due to Injures of other Work-Mates as Reported by Workers	167	155	60	69	33	35	45	39

A Comparison of the Number of "days off' due to Accidents or Injuries Involved by the Respondents in the Respective Departments for the two Surveys Table 8.2

There was no great change in the overall number of workers who experienced accidents when figures of the respondents "Got Hurt or Had Minor Injuries' between the first round and second round of questionnaire surveys. For example, in the Hand Press Department, when 59,1% accident rate in the first round was compared with 61% in the second round (refer to the percentage of workers who got hurt or had minor injuries on the 5th column of Table 8.2). The lack of reduction in accidents or minor injuries might be due to the simple steps in operating the small machines. Normally, this department was dealing with the forming of very tiny metal parts such as the small metal brackets used for clamping the battery or spare parts inside the power suppliers. The worker had to feed the metal parts into the mould with his/her left hand and rotate the small wheel to lower the die with his/her right arm for forming. The whole process only lasted for two seconds. The loading and forming demanded co-ordination of the two hands and concentration. The simple working steps and the less seriousness of the injuries occurred to the fingers often escape the close attention of both the workers and the management. They tended to neglect the potential danger from the high frequency of strokes of the press machines. Furthermore, the monotony in rotating the small wheel by hand to punch tiny articles could be responsible for accidents. The workers in the Hand Press Department did not perceive the immediate association of their own involvement in the accident and injuries with work safety. And from Table 8.2, it indicated that respondents reported much fewer than their work-mates their own 'Days-Off' due to accidents. For example, in the Heavy Duty Department, the number of self-reported 'Days-Off' due to accidents in the first round of survey was 133 while those reported by their peer workers in same round was 167. And in the same department, in the second round of survey, the total self-reported number versus that reported by the peers was 60:155. In the meantime, their avoidance of reporting accidents and injuries could be explained from the social, historical and cultural perspectives in the following sections.

8.2.4.3 The Party's Priority for Production

As mentioned in Chapter II, the communists emphasize the top priority of production as the support of the country's economy and this policy can be dated back to the Civil War period (Fung, 1956, pp-44). They needed production to back up the economy of New China. They understood the importance of quantity, quality and cost in production. This mentality has been carried over to the present days. For this reason, people are encouraged to work hard. Minor injuries are insignificant. It is sometimes a shame to mention minor injuries. Some of the workers in AMX were brought up with the indoctrination of communist ethics.

Besides, the fear of negative consequences also accounted for workers' accidents being under-reported in AMX, which was a family business. The workers were intimidated by the autocratic pattern of administration in the factory and were too reluctant to openly reveal their grievance, especially about work safety, for fear of being identified as trouble-makers. They dearly needed the job to support their family, as most of the workers swamped in from poor mountainous countries, where the land could hardly be cultivated.

The existence of accidents and workers' reluctance to reveal their injuries was a result of the confrontation between the workers and the employers. Even in socialist China, it is hard to imagine that the contracts between the employers and the employees are often formulated in unequal terms in favour of the employers. They, as the owner of capital "represent concentrated economic power, a legal entitlement to dominate and hence the employer can virtually dictate the broad outlines of the employment contract" (Hyman, 1975, pp-24). The employment relationship is one of inequality. The employer is empowered "to issue orders, while imposing on the workers the duty to obey" (Hyman, 1975, pp-24). In the case of AMX, workers tried to hide their minor injuries to avoid being reprimanded and subsequent unpleasant consequences. They might be considered a burden to the workforce, because of their perceived incompetence.

8.2.4.4 Confrontation between the Employer and Employees

As argued by Hyman (1975), it is difficult to remove the confrontation between the employers and the employees. The owners, as the minority privately possessing much of the production system, are more concerned for the company policy in pursuit of maximum returns than for the improvement of the working environment and the wages. The improvement will mean an added cost and reduced profit to the owners who are reluctant to offer wages and conditions more than the minimum standard needed for the recruitment and retaining of labour. The efficiency closely related with high returns sometimes tempts the owners to ignore the hidden danger arising from the monotony in repeated daily operation. The more divided the work process, the more risk will be incurred, owing to the fragmented activities from the piece work.

Hyman's (1975) description of the confrontation between the employer and employees is also applicable to the situation in AMX. There is an obvious disparity or inequality in the incomes paid to the top management and to the workers. The former are rewarded with much higher pay with corresponding much better working conditions and a package of attractive fringe benefits while the latter have to tolerate minimum earning and are exposed to poor working conditions. From the figures shown in the appendix 10, a worker can only earn basic RMB 500-600 a month including the overtime pay whereas the managerial staff can receive over RMB 2000 a month. The top management from Hong Kong can obtain 20 times the monthly pay as can a local worker. As an owner revealed to the researcher that the averaged salary paid to an Engineer Manager sent from Hong Kong was over RMB 15000. It happens that "the occupations with the least formal autonomy, in the most subordinate positions receive the lowest earnings" (Hyman, 1975).

8.2.5.0 Hypothesis V

There are significant relationships between intervention and workers' attitudes towards occupational safety and their safety behaviours.

This hypothesis tried to confirm if it was possible to modify the behaviour and attitudes of the respondents through the application of posted feedback plus goal-setting. As the questionnaire survey for the attitudes and the direct observation of the safety behaviour belong to two different categories of data, only indirect inference was possible by examining the two sets of data (nominal data obtained by direct observation and interval data collected by means of questionnaires). It was also the intention of this study to test if a combined attitudinal and behavioural approach could be applied to the research of occupational safety. The results were most encouraging. All three departments under investigation had exhibited significant behavioural change after the intervention (Figs. 7.1.1, 7.1.2, 7.1.3). As expected, the Drilling Department without any intervention did not show any significant change (Fig. 7.1). Meanwhile, by inspecting Table 7.8, which recorded the results for Hypothesis II, some attitudinal change was documented with respondents in the Heavy-duty and Small Press departments. The results supported the suggestion of Cooper' (1994) and Millar and Tesser (1986-pp-271) that the intervention in the form of posted-feedback can bring about change in safety behaviour and some attitudes change towards work safety ("Supervisor Satisfaction", "Shop-floor Training" and "Safety Working Procedures"). As a matter of fact, both the Critical Behaviour Check-list and the question items in the questionnaire contain common elements which are measuring similar things (Chapter V, 5.1):

.Supervisor Satisfaction ---- safety conditions in the factory

.Shop-floor Training ---- training

. Safety Working Procedures ---- safety practices (HSE,1996, Report, pp-72, 73, 75)

They both addressed the important elements in occupational safety, pointing to the same direction. The two processes (namely the direct observation and questionnaire investigation of attitudes) were mutually complemented, though direct observation was the major instrument for the survey.

8.3.0 **General Comments on the Survey**

When exploring the factors affecting the safety performance of the workers, consideration should also be given to the safety awareness of the management and the local official administrative institution. The overall safety performance of the workers in the factories in China cannot be improved without the supporting management measures in safety from the factory authorities and the Government. Besides, environmental and physical factors should also be taken into consideration.

Underlying the workers' unsafe behaviours which led to accidents and injuries, it must be stressed that the management and environmental factors uncovered in the experimental site conformed to the findings of other researches (Hale & Hale, 1970 and Hacker, 1986)).

8.3.1 Sense of Priority of the Factory Management

As pointed out by the Da Kung Pao (a newspaper in Hong Kong) in March, 1988, the workers in Shenzhen had to work unbelievably lengthy hours (10 hours a day) without days off. As some of the accidents are often the result of fatigue from work, only with the enlistment of the employers to willingly lower their quota for production or increase the man-power at the expense of their profit, can the situation be improved.

8.3.2 Distressing Working Condition

Also mentioned in Da Kung Pao, the public in Hong Kong felt greatly sympathetic for the distressing working conditions of the factories in Shenzhen. The workers are often working in an environment without air-conditioning and with poor lighting, monotonously repeating the same working procedures of a task in a whole shift, not to mention their crowded living dormitory with unbearable sanitary facilities. The uncomfortable living environment is often the reason for inadequate sleep. As witnessed by the researcher in AMX, 8 to 10 workers were packed in a small room less than 150 square feet. Without any air-conditioning, only two public bathrooms were provided for both sexes.

Besides, the workers in AMX, were working under intolerable circumstances in the production lines:

> "In the Heavy-Duty Department, press machines were packed in rows leaving very narrow passages between which workers were sitting on high stools. Piles of raw material were stacking next to the stamping posts. Thus, the exhaustion from lengthy working hours and lack of sleep together with an inhuman working environment were the culprits for operation mistakes." (witnessed by the author)

As argued by Hale and Hale (1970), people would fail to receive messages of danger while working under time pressure or in poor physical state.

Many workers in AMX thought the organization was not very concerned for their safety. The management held safety meeting every week mainly for the sake of controlling the product quality:

"The production target was too high and accidents happened often when workers were working under pressure especially when their skills were not mature. " (Report from observer B)

"However, with the pressure from the factory, they (workers) had to make a compromise between safety and production speed." (Comment from observer A----6.1.13.1)

8.3.3 Inadequate Vocational Training

The other reason responsible for frequent accidents and injuries in Shenzhen factories is the inadequate vocational training. For example, as revealed by workers in AMX, the factory only offered to the new workers minimum in-service training for two or three days before they were sent to work, while formal vocational training for the man-power in the technical college was unheard of. In fact, a formal training should include the education of safe working conditions, personalization of safety operation practice, encouragement of employee participation and enforcement of safety rules as mentioned by Grimaldi and Simon (1975, pp-135).

8.3.4 Safety Awareness of Local Authorities

In addition the over emphasis on company profit, there is an overall lack of safety awareness of the local authorities in Shenzhen, being accused of pursuing quick economic prosperity without due concern for industrial safety. There is no protection, whatever, offered to the workers for their rights and benefits such as refusing to work overtime or protesting against the gloomy working conditions (Leung, 1988). As most of the workers in Shenzhen are temporary workers from other provinces, they are discriminated against and exploited. They are forced to do chores with low pay while the natives from the local villages would assume more important positions (Chan, 1996). In AMX, the posts of administration and finance were highly recommended to be reserved for people from the Rural Council. Many daily disputes between the factory and various government departments such as the Custom, Labour Bureau, the Bureau of Industry and Commerce and the Fire Bureau could be more easily settled by the 'Laison Officers' recommended by the Rural

Council. Other than AMX, for example, similar unfairness was also uncovered in other factories known to the researcher.

8.3.5 Environmental Factors Important in a Metal House

According to Hoyos (1995, pp-237), outside stimuli mediate the reception of assimilation. In a metal house such as AMX, the environment that is too noisy to make a normal conversation possible would lower the operators' abilities to read information associated with hidden danger----the wrong calculation of the timing of the stroke and eventually lead to accidents. In the production line of AMX, each time when the die came down and cracked the metal sheet, the blow would create an explosive sound. Besides the thundering noises which made a person feel nervous, the room temperature which was over 30 c added to the stress on the workers. It was hard to imagine how the workers could suffer 8 to 13 hours there.

As a result of the failure to clearly watch the moving rhythm of the stamping, owing to the distraction from the noises, there were accidents from the in-coordination of the hand and foot.

Example:

"Event 2

Time: 10.30 a.m Mid-August

Department: Heavy Duty Press

Detail: An operator did not pay attention to the timing of the stamping and left his hand under the die. He got his hand seriously injured while the die descent suddenly.

Cause Analysis:

i) The operator did not pay attention to the timing of the stamping strokes.

ii) The operator failed to use the clip when feeding the material.

iii) There was a failure of the brake. " (Report from observer B)

8.3.6 Low Safety Awareness of the Workers

Despite their unsafe acts, people do not necessarily get hurt from the first near-miss in a series of accidents which tended to be ignored by people until the latter eventually get caught in the injuries (Heinrich, 1959, pp-29). Workers in AMX, as revealed in their responses during the interview and also reported by the observers, did not believe that an accident would happen to them and thought they could always get away. They only cared for instant consequences as reported by the author in an interview with the workers and described in an observation report from the observer of the research team:

Author: "In your opinion, will there be repetition in dangerous behaviour?

Worker: Yes, a lot of the dangerous behaviours are repetitive and habitual. It does not necessarily happen to the same person again." (Report from an interview with the worker)

"Some operators ignored the danger in fetching or adjusting the position of the products between the die and mould." (Report from observer B)

8.3.7 The Lasting Effect in the Reversal Period

It was noticeable that the intervention effect was carried over into the reversal period for the the Heavy Duty Press departments. There is a need, therefore to conduct continuous measurements by means of observation on the behaviours of the workers, as emphasized by many researchers (Smith, 1976; Komaki, Barwick & Scott, 1978; Robert and Wallin, 1983) to sustain the behavioural change, because intervention effect and safety habits are not formed overnight.

8.4.0 A Review of the Major Processes in the Survey and the Difficulties Encountered in Doing the Research in AMX

8.4.1 A Review of the Major Processes of the Survey

8.4.1.1 Risk Assessment

When risk assessment was done in AMX, it was found that most official documents for recording daily minor injuries or accidents were virtually absent. The factory director revealed they only kept record for serious accidents when they had to file with the Labour bureau for worker compensation. Even with serious accidents, they did not keep detailed reports except a simple note for the name, date and part of the body injuried. Nor was there any detailed description of the story of the event and the cause of the accidents. Though the company record should be the primary source of safety information for consultation in the research, the author was unable to rely on the official record of the factory for information related with accidents and injuries, because of their incompleteness. The other alternative was to use interviews to uncover the past safety history of a work-site. In the present study, the interviews proved to be powerful tools for identifying issues connected with the safety awareness of the management as well as the existence of dangerous behaviours or practice at the work-site as underscored by Sulzer-Azaroff, (1987), Eves (1994) and Minter (1996) (as mentioned in the Literature Review in Chapter III). For example, through interviews with each stratum of the work force in the factory, substantial dangerous behaviours in by-passing the normal working procedures to facilitate delivery had been uncovered.

However, relying totally on either the management or the workers information was dangerous. They should be mutually supportive. In the case of the interview in AMX, the management tended to hide some of the details of the accidents and under-stated the seriousness of the dangerous practices in the factory, for fear of a negative image brought to their factory. As for the workers, they felt being intimidated by the management and said little about the real status in the factory. In either case, the author had to use patience. He had to attempt repeated informal interviews and private chats to elicit more authentic information on safety. The hesitation of both the management and the workers in responding questions on work safety at the initial stage of the research could also be ascribed to social and cultural explanation as mentioned in Chapter II.

8.4.1.2 <u>Goal-Setting</u>

Similar to Lingard and Rowlinson's (1995) finding in which the project managers were not open to input from workers in the safety meeting, the workers in the present research were rather reticent in giving their opinion on goal-setting. Only after strong demand from the author, could goals be collected from a few workers in each department. This hesitation to participate could also be attributable to the persistence of paternalistic Chinese culture in which silence in public is encouraged as a respect for the patriarchal order of the society.

8.4.1.3 Feedback

Conforming to Cooper's (1994) safety theory, feedback proved to be a powerful behavioural change agent in AMX to objectively demonstrate to the relevant departments the level of the collective efforts they had reached compared to their goals. Their weekly safety performance was posted on a notice board at a prominent place. The workers were often heard contrasting their own achievement against that of the previous weeks. When feedback result occasionally fell short of their expectation, they would feel a little frustrated and remind each other to work harder.

8.4.1.4 The Effectiveness of Incentive

The use of an incentive in the intervention did not seem to be as obvious as expected. When monetary incentives were used to motivate workers to further understand the contents of the safety operation guidelines, the response from the workers was not very enthusiastic. It might be that the majority of them were low in education level and had problem memorizing the regulations.

Besides the above concerns, there were tremendous difficulties in doing safety researches in factories in China, especially in a Hong Kong-run factory such as AMX. There was underlying resistance from both the management and the workers. They were skeptical about the intention behind the research despite the fact that prior approval had been obtained from the employer by the researcher.

8.4.2.1 The Management's Concern

The management in the Hong Kong-based factories was sensitive to any investigation and were unfamiliar with the research to be conducted in the factory. According to the observers' feedback, the management was worried that interference might be caused to their production when the research was being done in the factory. They did not feel comfortable with the direct contact between the research team and the workers, less the discontent of the workers towards the factory would be aroused. In general, safety management in terms of the protection for the workers, facility safety and environmental improvement were not up to standard in most of the rural factories in China. Meanwhile, the income and fringe benefits of each factory was confidential. In the absence of comparison, the workers who were kept in darkness about the employment package in the peer factories could be controlled more easily. Thus mobility of workers could be kept to the minimum.

Most Hong Kong-based factories including AMX did not welcome visitors, as many factories were suspected by the custom as being involved in the illegal importing of raw material from abroad to evade the heavy customs duty that amounted to 35% of the product value.

Besides, the management who were under great pleasure to meet production targets and general performance and so sometimes manipulated their reports to make them look more decent. For example, in AMX, they tended not to report minor accidents and disorder in the factory. They were inclined to exaggerate events that were positive (increase of yield) and kept the production problems or accidents encountered in low profile. To them, work safety was secondary and having a safety meeting was only a formality to satisfy the safety requirement from the local Labour Bureau. They would think that the accidents were the result of negligence at work. The anarchy in the factory would affect the employer's evaluation of the management, their salary adjustment and promotion opportunities. In fact, sometimes the owner of the factory was ignorant of the occurrences of accidents in the factory, as he only came once in a while from Hong Kong.

Meanwhile, the factory management also faced a great pressure from their clients for speedy deliveries. They were too occupied with the production to spare time for work safety. Most metal houses in Shenzhen including AMX received their orders from big Hong Kong electronic assembly houses which would send their QCs (Quality Control) to do the buy-off right at the factory to ensure the acceptability of the quality and prompt delivery.

The co-operation from the management in AMX with the research team was thus rather superficial. Besides, the management members were quite reluctant to reveal the detailed status of AMX.

8.4.2.2 The Workers' Concern

The workers were also doubtful about the purposes of the research team. They suspected that the team was sent by the government departments to check up on them. They also did not like to be watched. Occasionally they would take a break by slowing down their work or chatted with the neighbouring workers because of the monotony and tiredness of the operation. In fact, the workers were under a conflict between meeting the production quota and observing safety regulations, a conflict between livelihood and personal safety. They were concerned for the immediate return to support their family. Besides, their disadvantaged educational grounds had posed a hindrance for them to perceive the advantage of health and safety at work. It was therefore crucial for the research team to establish personal relationship with the management and the workers to lower their anxiety and suspicion. For the workers, during daily contact, staying neutral to their operation, the observers had established a mutual trust with the workers during the baseline period. And the observers felt it much easier to approach them at the intervention stage.

8.4.2.3 The Status –Quo

That the management in AMX was satisfied with the status-quo related to work safety and unwilling to change was rather distressing. Most of the time in the weekly safety meeting was dedicated to quality concerns. The other problem for the safety in AMX was that one third of the machines there were over 20 years old and so they were a problem for maintenance. The uncomfortable physical environment with poor lighting, no air-conditioning, together with the noise pollution, crowdedness and seats which were far from comfortable, should deserve immediate concern from the management in AMX.

8.4.2.4 Environmental Consideration

As the metal work was surrounded by other neighbouring factories great noises were heard, thus creating difficulty for the seminar during training, when a presentation on safety practices and safety guidelines was being done. To make up for this, the workers attending the seminar were reminded to read the safety hand-outs at their living quarters. During working hours the noises from the stamping machines were so loud that normal conversation was made very difficult. The author had to talk to the factory manager or other line supervisors or worker, when having the private chats for an investigation or interview.

8.4.3.1 <u>The Difficulties Encountered by the Observers</u>

Owing to the limited resource and disagreement from the employer of AMX, observations of workers on the night shift were not covered. However, according to the report from the two observers (refer to Chapter VI----Mass Survey), many workers requested that the observers should be present at the night shift to remind them of safety operation, since the occurrence of accidents was more frequent with the night shift. The other problem the observers experienced in AMX was the difficulty in their merging with the major factory workforce. They felt being alienated instead of being part of the working team. Probably people found out that the two observers were working for the author but not for the factory. Thus, the observers were in such an embarrassing position that although they were doing the frequent observations in the production lines, they were not empowered to get involved in the daily administration.

Among all the problems encountered, nothing is more important than addressing the cultural issues that have imposed tremendous impact on the whole research. The conflicts between the local culture and the imported ones are often neglected by researchers who are always preoccupied by the assumption that things will work well.

8.5.0 The Cultural Issues

8.5.1 The importance of Organizational Culture in Relation to Safety

As mentioned in Chapter II, to understand safety culture, there is a necessity to know more about the general culture of which safety culture is a significant part in an organization (Eves, 1994). It must be reiterated here that the organizational culture is still a neglected concept in China. It is important for China in the future, because it is a reflection of the performance and characteristics of Chinese enterprises. The basic components of organizational culture refer to the values, beliefs and ideology that have a tremendous impact on the safety behaviours of the workforce in the organizations (Barnowe, 1990, pp-330). However, as mentioned by Barnowe (1990), the strong deeply rooted values and assumptions in the Chinese culture are resistant to change. The organizational culture has become both a behavioural norm and something for the individuals within the organization to observe, shaping the direction of their behaviours (Barnowe, 1990, pp-332). Meanwhile, the Chinese traditional values as part of the cultural features rooted in China's history can provide a backdrop for understanding the organizational culture. Thus to know more about the development of a safety culture in the developing countries such as China, it is necessary to explore the local culture as well as the religious background.

As discussed in Chapter II, Confucius requested people to respect the established hierarchies and correct behaviours with emotion well controlled in a society where good personal relationships are appreciated. And these key elements have been observed and persisted over time with people's Republic of China, Taiwan, Hong Kong and among the overseas Chinese (Lockett, 1990, pp-270). Confucianism when merged with the feudal ideas as identified in socialism in the Post-1049 period, can be detrimental to society. Though the official policy in the PRC encourages the introduction of responsibility systems down to individual level and the import of foreign management approaches, the intention was met with resistance. The group orientation in Chinese culture underscored the respect for hierarchy, thus to a certain extent, undermining the adoption of Western management methods. The obligations towards relatives as the characteristic of Chinese culture prevailed in the Chinese industries. In AMX that was a family-owned business, for example, relatives were brought in to help key positions, irrespective of their academic background and abilities. This practice was a great contrast to that in the West, as mentioned by Huat (1990, pp-279):

> "Western managers who are used to recruiting from the open market may frown upon such requests as favoritism or nepotism especially when the recommended candidates fall short of the expected criteria."

As a result of the abuse of personal relationship, the appointed factory director in AMX was ignorant of modern management and work safety. She was unable to give any advice in the safety meeting. In contrast, such personal relationship, kinship or social obligations are seldom considered in the workplace in the West. The recruitment of employees is subject to open competition, on the basis of (his/her) qualifications, experiences and potential contribution to the enterprise (Huat, 1990, pp-284). In the Western enterprise, corporate identity and contractual obligation of loyalty to the organization are thought helpful to consolidate the efficiency of management in the enterprise. On the contrary, the Chinese enterprises are characterized by the lack of horizontal coordination among each stratum of workers. In AMX, the vertical relationship between the management and the workers was incompatible with the modern management concept that was mainly evolved from the western cultural assumptions.

8.5.2 Confucianism and Management Style

As mentioned in the second chapter of this dissertation, the fundamental teaching of Confucius, namely the Five Constant Virtues: humanity, righteousness, propriety, wisdom and faithfulness was magnified in the five relations: "sovereign and subject, parent and child, elder and younger brother, husband and wife, and friend and friend." (Hsiao et al, 1990, pp-303). Of the five relations, filial piety and loyalty stand out to shape the paternalistic management style in the Chinese industries. The parent-child relation in company management can be reflected in the vertical relation in AMX. "Like a father takes care of the family", the owner of AMX was supposed to take care of all the people in the company, including their fringe benefits and company facilities. (Nedwed, 1972, pp-134-137)

As pointed out by Hsiao et al (1990), Confucian teaching once discarded by the Communist Party after the "Liberation" and replaced by Marxism-Leninism and Maoism, still continues to influence the Chinese after the cultural revolution which had shattered people's belief in Communism. There was a compromise between communism and Confucianism with the revival of Confucian thinking and customs.

As argued by Hsiao (1990, pp-308), the traditional concept of filial duty has "implanted an attitude among the workers to obey authority without resistance on the part of the workers themselves, as well as their family not only because the punishment for not doing so is harsh, but also perhaps because they want to practice filial duty to the Communist Party, which acts as a father substitute in the mind of the workers. Thus, as in ancient times, serving the feudal lords was of utmost importance, while the development of the productive capacity of the workers was not......As a father substitute, they do not need to be well trained in economic laws or familiar with making economic decisions, nor to stress their efficiency."

In addition to the merged communist and Confucian thinking and customs reflected in the attitudes of the Hong Kong based Chinese workers with regard to work safety, they are also influenced by the Hong Kong work attitudes.

8.5.3 Work Attitudes of the Hong Kong and PRC (China Mainland) Culture on Work Safety

There is a paradox about the work attitudes of the Hong Kong Chinese in that they are both altruistic and individualistic (Ng, 1990, pp-317). Altruistic attitudes towards work cherishes "the virtues of collective harmony and development" and can apply to the workers in AMX. The clash of traditional and modern values under the impact of industrialization had to be recognized, as Hsu (1955, pp-318) held:

"The pattern of cultural dependence directs all...... to seek their security through persons, through the alliance of superior and subordinate. This means further that when seeking a resolution of difference, the tendency is to compromise rather than to adopt all or nothing position. The individual's true tendency is not to fight with the owners and managers for higher wages or better working conditions, but to achieve these by joining their ranks or influencing them through family connections, friendship, and neighborhood or communal ties."

The other feature of the Chinese and Hong Kong work attitude is that they tend to resort to psychological adaptability "to decision and innovations ordained from above" (Ng, 1990, pp-322). Ng (1990) commented

> "it appears that consent at the grass-roots level is more the manifestation of a quiescent readiness of shop-floor workers to reconcile themselves with authority than a collectivist spirit of team work and moral involvement a common enterprise."

Thus, the compliance to authority in the workers in AMX, for example, tended to inhibit their attempts to voice their opinion on work safety. In the meantime, the Chinese workers' attitudes towards safety are also influenced by their religious views that are largely connected with passiveness.

8.5.4 The Influence of Diverse Philosophies in China on the Work Attitudes of the Chinese

Buddhism and Taoism, as competing philosophies to Confucianism, play an important role in the Chinese culture in terms of the metaphysical and religious dimension. The Chinese at the grass root levels often attribute their accidents and mishaps to "secular affliction, uncertainties and crises vis-a-vis nature and social life" (Ng, 1990, pp-322)

Ng (1990) argued:

> "A major theme of Taoist thinking is that of emptiness. This refers to the individual's quest for sympathy with nature. This pacific orientation of the self, applied to work situation, provides an explanation of the Chinese work mentality of conflict aversion involving maintenance of amicable ties with one's superiors, subordinates and peers at work, as well as quiescent submissiveness to authority."

Taoism convinces people to solve problems in secular life by

> "accepting the universe as a whole and responding to different aspects of it, participating in and accepting change, one transcends the finite and avoids the suffering which is caused by attachment to achievement and desires for specific things." (Murphy & Murphy, 1968, pp-164)

This underlying philosophy of passiveness becomes the coping strategy of many Chinese, for example, the workers in AMX, to deal with the mishaps, accidents or

> "frustrations, disappointments and despair. It gives rise to a pacific description in approaching human deeds and behaviour; the image of self-preservation, patience, endurance, quiescence and hence harmony." (Ng, 1990, pp-322)

This absolute passiveness of accommodation with "authority and uncertainties in the world of work" (Ng, pp-323) can explain the endurance and quiescence of the workers in AMX involving in accidents and injuries.

8.5.5 The Circular Thinking Process Used by the Traditional Chinese Five Elements of the Universe in Relation with Work Safety

As explained by Huaizu (1992, pp-100), the traditional Chinese thinking relies on the circular network in which the five elements (metal, wood, water, fire and earth) represented the interrelated factors in the universe. The circular decision process evolved from the element can provide "the explanation of physiological societal and natural phenomena. The physical universe and are mutually promoted and restricted" (Huaizu, 1992, pp-100). This overall control over consequences is contrast to the linear Western "step-by-step consideration consequences in terms of single preceding factors or decisions." (Huaizu, 1992, pp-101)

The Chinese are inclined to associate changes in natural phenomena with the fluctuations in a country. In contrast, the Western decision theory "is applied to each problem's specific factors and so there is no suggestion that the character of one problem need any implications for another problem" (Huaizu, 1992, pp-102)

The Chinese tradition advocates the importance of merging oneself with the group, even sometimes there is a need to abandon one's opinion, or go against one's own will for the good of the group or friendship(Huaizu, 1992, pp-103). Harmony between the former and the latter has to be maintained, because "a person who stands out from the group will be criticized and may be prevented from reaching his or her own goal." However, individual expression in the West is highly respected and individual ability and originality are given opportunities to develop to the full. The different attitudes in decision making can be embodied in Huat's (1990, pp-282-283) comment:

> "A typical Westerner believes in self-determination and that he is the master of his own destiny. With his own effort, he can cause events to happen and to shape his own future. In comparison, a Chinese person traditionally believes in fate and assumes that everything is preordained. This may have been an extension of his religious beliefs and to some extent, his inability to understand the unknown and the mystical inclination to appease the spirits. Unpredictable events will happen regardless of one's efforts.
>
> The Westerners' belief in self-determination implies the setting goals and achieving them by one's own efforts. The approach is realistic and action-oriented. The Chinese fatalistic approach results in passive expectation. He may work hard and believes that the outcome is affected by many unknowns beyond his control. These include natural disaster (or accidents at work) (pp-283) human interference or bad planning. Hard work seems futile when

heavenly blessing may bring a windfall or the right influential connection may produce better results than expected."

Overshadowed by the beliefs in destiny, the Chinese are often not in a position to learn from their accidents for future prevention. Nor will they speak up during the safety meeting to express their concern for safety. This passiveness due to the preoccupation with religious views can exactly explain the indifference and reticence of the workers in AMX towards safety at work.

8.5.6 How is Culture Related to Safety

As mentioned in the literature in a previous chapter, a safety culture is an inseparable part of the general culture in an organization (Eves, 1994). A good safety culture can articulate the responsibility for safety at "strategic management level; distributed attitudes of care and concern throughout an organization; appropriate norms and rules for handling hazards; and on-going reflection on safety practice." (McDonald et al, 1997, PP-95)

However, it is imperative to have some understanding of the existing safety culture before any risk management initiatives can be effectively delivered to the organization. The promising approach should be a combined bottom-up and top-down approach, in the former, the analysis of errors and safety events can be a starting point. Meanwhile, the top-down approach that is a system-oriented assessment from the level of organization to examine the organization's rules, procedures, structure and processes can be a powerful supplementary channel. That is both the organizational safety culture and the safety management initiatives have to be understood before any accident report system or better training for safety can be implemented (McDonald et al, 1997, pp-95).

8.5.7.0 Developing a Safety Culture

To build up a safety culture for example, in AMX or in other Chinese industries, the following issues have to be addressed:

8.5.7.1 The Setting up of a Reporting System

Incident and accident reporting systems provided a profile the real status of safety in the organization as a precaution for future occurrence as well as problem solving. An information system with a safety management system

> "suggests a number of dimensions for the analysis of such a system: its goals; the channels and boundaries which regulate the flow of information; the roles and competencies of the agents who articulate the system; and the contingencies which govern their action (McDonald, 1997, pp-97)"

Accompanying the accident or incident reporting system, the following goals must be formulated:

". Ensuring operational safety;
. Ensuring occupational safety and health;
. Fulfilling legal reporting obligations;
. Reducing costs associated with accidents and improving quality;
. Establishing legal liability and responsibility."

The successful establishing safety culture is partly dependent upon the support from both the operational department and the safety department in minimizing the conflict that might arise from the costs incurred.

To build up a safety culture, a multidisciplinary work team is needed to ensure an information channel for preventive safety measures. The work team in the work-site will involve various boundaries such as work safety, medical, technical development, engineering and personnel in an effort to develop and implement plans to redesign the work flow with a view to reducing injury and disability (Kerkloh, 1992)

8.5.7.2 Flow of Information

Accident reports coupled with a routine employee appraisal process should be duly provided to the personnel department to elicit the information of the people involved in accidents. Allowance should be given to a confidential reporting system helping people to overcome the worry of blame and liability (McDonald, 1997, pp-99)

8.5.7.3 The Development of Training and Management Support System

An integrated approach to accident and incident reporting can be effectively implemented. Four complementary training courses can be developed respectively for the manager, supervisors, trainers and operatives in terms of the clearly defined "reporting responsibilities and procedures for reporting, analysis and feed back as well as for risk management and the design and evaluation of counter measures." (McDonald, 1997, pp-100)

Building up a safety culture in developing countries such as China by implementing an information system and a risk management system in addition to a posted feedback seems to be feasible as long as the limitations mentioned can be addressed.

8.5.8.0 The Concern for the Differences in Cultures

It must be borne in mind that the cultural assumptions of Western management theories with regard to work safety may not be appropriate to the Chinese organization and have to be modified to take into consideration of the long lasting ethical, religious or national values within the organizational culture. (Lockett, 1990, pp-272) The adoption of the Western model, which has evolved from cultural values and assumptions vastly different from the Chinese is subject to the speedy training of a new generation of managers to assimilate the Western management and safety concepts into the Chinese context. (Lockett, 1990, pp-287) Given the fact that there is always a lack of compatibility of the cultures to be applied to another area such as the developing countries, the local culture has to be respected. The co-existence of different cultures should be recognized.

8.6.0 A Conclusion of this Chapter

Other than conforming to the contemporary studies, the importance of the combined behavioural and attitudinal approach in this study has advanced the contribution made by many contemporary researchers in occupational safety. Through the surveys in a rural metal house in Shenzhen, the Special Economic Zone, the author has identified some important issues, especially a cultural impact associated with occupational safety typical of the Chinese context and these social and cultural impacts on industrial safety and health have not been given due attention. Nevertheless, cultural issues are of utmost importance for developing occupational safety in developing countries.

In this respect, this study has expanded the overall picture in the literature concerning conducting safety research in developing countries. In the meantime, taking into account the wide tolerance and elasticity of the Chinese culture that is capable of ingesting foreign cultures and thoughts, it is possible for researchers to build up a safety culture in the Chinese industries. This can be made possible by bridging the well-established Western concepts in occupational safety with the existing Confucian traditions and customs in the Chinese culture, though not without difficulties.

The present chapter has examined and discussed the findings in the results for each hypothesis with reference to the wider sense in the literature and cultural aspects typical to the Chinese setting. The interpretation has also addressed the management mode of AMX concerning safety. This chapter then gave general comments on the survey in terms of the co-operation between the factory and the research team, and the difficulties encountered in the major research processes. Environmental concern and general safety awareness of both the management and workers were discussed. The last and the most important part of the chapter was devoted to the longitudinal discussion of the impact of the traditional culture and religions on AMX in terms of the safety management in contrast to that of their

Western counterparts. Meanwhile, the development of a safety culture was suggested.

CHAPTER IX

CONCLUSIONS, IMPLICATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

9.1.0 **Summary**

This chapter will give an outline of the study to refresh the readers' memory. Results of each hypothesis will then follow in the same section. Thereafter, the chapter will highlight the contributions of the study in occupational safety and address some of the actual limitations experienced in the research. Finally, suggestions for further studies and reinforcement of a safety culture will be presented.

9.1.1 **Outline of the Study**

The main objectives of this study were to test the feasibility of applying the behavioural modification technique in improving the workers' safety behaviours. As a supplement to behavioural modification, this research also attempted to measure the attitudes of the workers towards work safety.

To these ends, two sets of measuring instruments were employed in this study. The first one was a self-constructed observation form for recording the safety behaviours of the workers before, after and through the intervention that was used to influence the workers' behaviours. The second measuring instrument was a questionnaire to examine the respondents' attitudes towards work safety pre and post intervention.

A multiple baseline design was used for implementing the interventions to the three departments under investigation at different points of time, while the fourth department was immunized from the intervention for controlling purposes.

The respondents were workers from a medium size metal house in Shenzhen Special Economic Zone in China. A sample of 142 men and women belonging to the Heavy Duty Press, Small press, Hand Press and Drilling Department were chosen from the total population of 359.

Visual display, t-test, Fisher Exact test and Analysis of Variance (ANOVA) were employed to determine the significance of the differences in behaviours as well as attitudes before and after the intervention through feedback plus goal-setting.

9.1.2.0 **Results**

9.1.2.1 Hypothesis I

There were relationships between the workers' behaviours in occupational safety and posted-feedback plus goal-setting in the Heavy-duty Press, the Small Press and the Hand Press Departments .

9.1.2.2 Hypothesis II

There were relationships between intervention and the workers' attitudes in terms of

-'Supervisor Satisfaction' in the Heavy Duty and the Small Press Department;

-'Shop-floor Training' in the Heavy Duty Press and the Small Press Department;

-'Safety Meeting' in the Small Press Department;

-'Safety Working Procedures' in the Heavy Duty Press and the Small Press Departkment.

Meanwhile, no relationship was found between intervention with other attitudinal dimensions ('Supervisor Knowledge', 'Supervisor Encouragement & Support', 'Shop-floor Satisfaction' and 'Shop-floor Environment: Hardware'). Intervention seemed to be most influential on workers' attitudes in 'Safety Meeting' and their

'Safety Working Procedure' in the Heavy Duty Press and the Small Press groups. The 'Safety Meeting' could help awaken their safety awareness.

9.1.2.3 <u>Hypothesis III</u>

There were relationships between attitudes of the formally trained workers and those of their peer workers without formal training towards occupational safety in terms of

-'Supervisor Satisfaction' in the Heavy Duty Press Department;

-'Safety Meeting' in the Heavy Duty Press Department;

-'Safety Working Procedures' in the Small Press Department.

Meanwhile, no relationship was found between attitudes of the workers with formal safety training and those of the workers without formal training towards other attitudinal dimensions ('Supervisor Knowledge', 'Shop-floor Satisfaction', 'Supervisor Encouragement & Support', 'Shop-floor Environment: Hardware' and 'Shop-floor Training') in all departments.

9.1.2.4 <u>Hypothesis IV</u>

The results indicated that there were relationships between workers with self-reported accident rates and those without in terms of their safety attitudes in

- 'Supervisor Knowledge' in the Heavy Duty Press Department;
- 'Shop-floor Satisfaction' in the Heavy Duty Press Department;
- 'Shop-floor Environment: Hardware' in the Small Press Department.

In the meantime, there was no relationship found between workers with self-reported accident rates and those without self-reported accidents with reference to other dimensions of their attitudes towards work safety.

9.1.2.5 Hypothesis V

Both the workers' behaviours in occupational safety and aspects of the safety attitudes were significantly related to the intervention.

The results from Hypotheses I, II and V seemed to suggest that interventions had a positive impact on both the performance and the attitudes of workers in the Heavy Duty Press, Small Press and Hand Press departments, though the change of their attitudes was limited to certain scales only.

As supplements to Hypotheses I, II and V, the results from Hypotheses III and IV that confirmed the differences in attitudes between the two types of workers, one with training or experience of occupational accidents and others without, had rendered strong support to the need for implementing interventions for workers later. These needs had been consolidated into the other three hypotheses accordingly to predict improvements in safety behaviours as well as the related attitudes after the interventions.

The significant differences in attitudes between the two types of workers mentioned above were limited to certain dimensions of the safety attitude scale only. It is crucial to remember that the results with attitude investigation must be inspected with caution because the results implied that the techniques are limited in their effectiveness when being employed in moderating the attitudes of the workers in the three departments where the interventions were implemented. Further research is necessary to locate factors that affect the effectiveness of attitudinal techniques in a Chinese setting.

As the data collected from both the behavioural and attitudinal techniques in Hypothesis V belonged to two sets of data (nominal and interval) collected differently, they could not be directly compared to test the hypothesis. In the former, the behaviours were recorded on sometimes twice weekly basis in terms of 'safe acts' observed and these were collected as percentages. In the latter, the attitudes were collected as a pre and post treatment questionnaire measured on a Likert scale. These latter data were collected from individuals in the sample whereas the behaviours were observed across the sample as a whole. To deal with this discrepancy, the author had to resort to the other alternative. That was to examine each group of data separately to see their improvement. The results collected by of both techniques exhibited significant improvements in safety performance as well as safety attitudes. As both techniques were measuring the same common elements in work safety, it was possible to indirectly infer that the combined behavioural and attitudinal techniques in safety research was effective.

However, it is fair to state that the effect of the techniques in the interventions seemed to be more appropriate with certain attitudinal dimensions than they would be with others.

9.2.0 **Conclusions**

The present study was original and significant in the sense that it was a combined model of a behavioural study evolved from contemporary studies accompanied by attitudinal investigation to be applied to a new context other than the American and European communities. The major measuring instrument was direct observations to collect first hand data. Though behavioural analyses have been used in quite a number of researches (multiple base-line) in the West but to be used in a metal works was very rare. The culture in China is different from the West in that it values collective work instead of individual emphasis. The individual interests should be subordinate to the collective benefits. Sacrifice for the course of the country is merited. Regardless of personal risk, heroic deeds are openly praised. Thus accidents and injuries are not given due attention. Rather, they are sometimes considered glories to set models for the public.

When more and more enterprises are moved to China (Intel, Motorola, Nokia, IBM, Samsung, etc.) targeting at the potential market of over 1.3 billion people, about one fourth of the world's population, the problem of occupational safety becomes more acute. Compared with other big enterprises, the metal works tends to be neglected. Though being a minority, the metal houses experience a heavy accident rate because of the high risk incurred. The cost of improving occupational safety is a big concern for the employers, because of the relatively small capital involved compared to the gigantic investment in the electronic assembly factories.

This dissertation does not seek to refute the noticeable importance of the western concept of developing occupational safety that has achieved substantial success in various fields of occupations in the West. Neither does it seek to give unreserved support to the application of western safety theories to the Chinese context without taking into account the underlying values and assumptions within the local culture that might give tremendous influence on the behaviours of the respondents. While it is important to identify innovative approaches in health and safety worldwide, the author has discerned the constraints and specificity in the occupational behaviours in the Chinese society. In this respect, the social and cultural elements which affect the effectiveness of the behavioural and attitudinal approach as highlighted by the author in the current research seem to expand the horizon in the field of occupational safety and health. It is hoped that the generic factor of the local culture that can render partial explanation of the formulation of a particular behaviour in the developing countries should not be overlooked. A final significant comment on the present study at the conclusion of this dissertation from the author is that in a

Chinese metalwork an intervention in the form of posted feedback with goal setting does work in improving safety performance and to a certain extent, attitudes.

9.3.0 **Limitations**

9.3.1 Sample Size

The limitations of the sample size need to be noted when generalizations about the research in the worksite are made. In a large organization with several thousands of people as in the example of Video Technologies (a tele-communicative assembly company with around 30000 people) and SAE (a company engaged in manufacturing magnetic heads for VCD and DVD with over 20000 people) in Dongguan, random sampling is possible for the survey. However, for small and medium size companies such as AMX in Shenzhen, with only several hundred people, all employees in the particular focus groups of the organization have to be included in the survey, because random selection is not realistic.

Meanwhile, if a similar research is being done simultaneously in a number of plants where a large number of respondents are involved, statistical outcomes may prove to be more reliable.

9.3.2 An Assumption

In fact, in the light of the present experience, if given another chance to do a similar study all over again, the author would still favour the multiple baseline design but with more than one intervention in the form of goal-setting and feed-backs coupled by reversals to see the repeatability of the changes, as a result of the interventions. That means a much longer period of time, probably 52 weeks would be needed for the whole study. In the meantime, the night shift had to be included to have a more comprehensive investigation of the workers' safety performance at both shifts. Of course, more demanding cooperation had to be sought from a willing employer who could be rewarded with a quality program linked to the study to improve his product quality. Furthermore, if more resource was allowed and if workers' privacy was not violated, CCD cameras instead of observers would be used for more effectively monitoring of the safety behaviours in terms of the accuracy of observation, as the video tapes obtained could be reviewed.

9.3.3 Frustrations and inadequacies

The author had to admit that there were times that he felt he was a nuisance to the factory. When the factory was rushing to meet the delivery, it was embarrassing for the author to stand in the way of the production line to monitor the observers doing the observation. Besides, owing to the limited resource and disagreement from the employer, the author was unable to have the observers work in the night shift, the safety status of which thus remained unknown. In addition, the workers' 'days-off due to accidents or minor injuries' were not specified on the factory's official record which only documented general 'days-off' taken by workers. The intentionally leaving out the above part was out of the fear for being labeled an unsafe work-site by the Labour Bureau. The present investigation could only rely indirectly on the 'self report' from the workers.

9.3.4 The Western Basis of Safety Concepts

There were difficulties in interpreting the results in the current research owing to the Western basis of the frame of reference established in this dissertation. The author tried to deal with the difficulties by referring to the influence of Chinese culture on the Chinese society and on occupational safety from time to time.

Researchers must be reminded not to overlook the existence of the dualistic conflicting forces arising from the need to maintain the Chinese culture while trying to assimilate the others when western theories in occupational safety were transplanted in China alongside the importation of technologies. Li (1997 pp-69-92) had made this point very clear:

> "Two opposing forces have historically existed within China: first, the conversion and integration of foreign expertise into Chinese practices by maintaining a strong 'Chineseness' despite foreign conquest (Wang 1991, pp; 1-10), and second, the import of technologies, expertise, and ideologies while maintaining the Chinese identity."

It is important, thus, to note the balance needed for successful integration when introducing occupational safety into Chinese industries. Overlooking the fundamental values and assumptions in the local culture is a danger, since what has been proved to be successful in work safety in the West may not necessarily be workable in China.

The present research thus attempted to provide a basis on which to stimulate further studies to apply the adapted western concepts in work safety to Chinese society where the main stream of cultural influence is from Confucianism. The Chinese culture is so profound that its tremendous influence on the Chinese will continue.

9.4.0 Implications and Suggestions for Future Research

9.4.1 Implications

i) Consideration should be given to the integration of permanent staff to conduct and monitor the safety observation and the application of posted feed-backs on a regular basis to ensure an ongoing safety performance.

ii) It is suggested that an across department safety intervention involving the whole factory would be likely to be more effective. This practice can avoid the inclination of self-serving of the supervisors in the department under treatment (Santamaria, 1978), because the supervisors of the department receiving the treatment might care only for their department, while the occurrence in the peer departments is not their concern.

9.4.2 Suggestions for Future Research

The following suggestions may be aspirations for continuous research in occupational safety:

i) In case studies, implementing occupational safety by contrasting a successful factory with an unsuccessful one can be considered, with a view to having more longitudinal investigations of safety behaviours.

ii) A comparative study on occupational safety in industries of high risk between the Chinese context and an Asian one to explore the cultural impact on safety behaviours can be a choice.

iii) Research could be designed with the patronage of the Chinese government for metal houses in a nation-wide scale to identify the various patterns of safety behaviour in relation to Chinese culture.

9.5.0 **Summary of this Chapter**

As the concluding part of the dissertation, this chapter tried to remind the readers of the purpose of the study, the measuring instruments used and the research design, data analysis as well as the results of the hypotheses tested in the outline of the study. The conclusion then delineated the major contributions of the author in the development of a safety culture in the developing countries. The part that followed covered the limitations experienced in the study. In the implications, the author intended to stimulate more constructive potential research by listing a number of research alternatives.

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GLOSSARY

Accident Proneness
"Constitutional tendency within the organism to engage in unsafe behaviour within some stated field of vocational activity (Kerr, 1957, pp-3)"

Baseline.
An extended period of time in which a pattern of behaviour is to be observed.

Central Committee.
The 210 full and 133 alternate (non-voting) members of the Central Committee of the CCP consist of senior party officials, military and state officials, provincial and some country party secretaries, trade union and youth league officials and intellectuals. Its primary task is to elect the politburo and ratify policy decisions. (Leung, 1988)

Collective Enterprise.
A factory, or service industry controlled locally by the municipality. At lest until the reforms, these factories offered lower wages and security than state enterprises, and consequently less status. (Leung, 1988)

Engineering
"Engineering" refers to the design of the machinery and equipment, taking into consideration the protection of the workers by guarding the moving parts to keep the operators from direct contact with hazards.

Facet

A facet is a distinct conceptual category describing a component, or dimension, of a particular object or area of research. Examples of facets could be age, sex, and colour. (HSE Contract Research Report No, 81, 1996, pp-203)

Foreign-Funded Enterprise.
A factory or service venture involving some form of foreign economic investment. These can take the form of a wholly-owned foreign enterprise, an equity joint venture, or a contractual joint venture. In addition to foreign-funded enterprises, a variety of trade, service and other business arrangements involving foreign firms exist in China and result in the employment of Chinese workers. (Leung, 1988)

Four Modernizations.
China's paramount programme, first mentioned in 1975 but properly launched in 1978, with the intention of rapidly developing China economically, through the modernization of industry, agriculture, defense, and science and technology. (Leung, 1988)

Gang of Four.
Four senior party members (Mao's wife Jiang Qing. Zhang Chunqiao, Wang Hungwen and Yao Wenyuan) who rose to power during the cultural revolution, and who continued to advocate political struggle after Mao's death. They were arrested by the reformists in 1976, and charged with plotting to overthrow party and state, and of persecuting hundreds of thousands of officials in the cultural revolution, but they claimed to be the true inheritors of Mao's revolutionary political line. Opposed to autonomous trade union power, they waged the first purge against ACFTU (All-China Federation of Trade Unions) from their base in Shanghai, and promptly disbanded the ACFTU and suspended the Labour Ministry. (Leung, 1988)

Goal-setting.
The setting up of object or aim of an action (Locke et al, 1981) to be accomplished.

HSE.
Health & Safety Executive --- Safety Research Unit, Department of Psychology, University of Liverpool, U.K.

Lost-time Accidents
Lost-time accidents refer to "death, permanent total disabilities, permanent partial disabilities (Komaki et al, 1978, pp-435)".

National Party Congress.
The highest organ or the CCP, whose 1,500 to 2,000 delegates are elected through a series of indirect delegate conferences within the party. Theoretically, this is the most powerful party organ with power to elect the Central Committee of the CCP which in turn elects the politburo. In practice, they are strongly guided from above, with most decisions already approved and recommended by the politburo, the State Council or the Secretariat, although recent reforms have given them more real voting power. The NPC has recently met about once every five years. (Leung, 1988)

National People's Congress (NPC).
A 3,000-member assembly which forms the legislature of China, representing the state rather than party structure. It has the power to amend the constitution, enact laws, and appoint and remove members of the State Council. Its indirectly elected delegates meet only once a year for about two weeks. The NPC contains representatives from various constituencies such as minorities, women, intellectuals, the PLA, different geographical areas, religious groups and overseas Chinese. Although dominated by the CCP, the NPC also contains token delegates from other parties. (Leung, 1988)

Near-hit/Near-miss
Dangerous behaviours or situation leading to accidents (Carter and Menchel, 1985; Sulzer-Azaroff, 1987).

OECD.
Organization for Economic Co-operation and Development --- OECD International Scientific Expert Group

OSHA.
Occupational Safety and Health Association

Posted-Feedback.
"The information provided to individuals concerning some aspects of their performance on a task (Young & Klina, 1996)".

Private Enterprise.
A factory, farm or service industry owned and controlled by one or more individuals. (Leung, 1988)

Standing Committee of the NPC.
A permanent body 133 members of the National People's Congress, which is roughly equivalent to a parliament, meeting fortnightly to interpret laws, oversee the work of the State Council, appoint judicial officers, enact certain legislation between NPC sessions, and deal with the ceremonial aspects of diplomacy. (Leung, 1988)

State Council.
A 60-member administrative cabinet of the NPC, including 33 departmental ministers, and other officials. The leading executive body in the state government. The council draws up detailed national economic plans and budgets in accordance with priorities dictated by the CCP. (leung, 1988)

State Economic Commission.
A 'super-ministry' set up in 1978 to streamline the economic planning and decision-making process and cut out middle layers of state bureaucracy through the merging of a number of ministries. (Leung, 1988)

State Enterprise.
A factory centrally controlled by the state. Workers in these enterprises generally enjoy better wages and conditions and higher status than those in collective enterprises (at least until the reforms) and due to the fact that ownership and

accounting were central they were considered to be at a higher level of socialism. (Leung, 1988)

Structuple
A structuple is an element of a cartesian set; it is a profile composed by selecting an element from each facet. (Sheye, 1978, pp-9-10)

Work Unit.
An economic and administrative body to which all employees in China are assigned. Each factory, restaurant, railway station, school or government office etc. is usually one work unit. Work units are not only responsible for the employment of its workers, but also their housing, insurance and pensions, and many other aspects of the workers' and their families' welfare. Until the recent reforms, almost everybody's assignments to work units were lifelong. (Leung, 1988)

APPENDIX

APPENDIX 1

Question Set At Pilot I (34 version)

SECTION ONE: YOURSELF AND SAFETY

very strongly disagree strongly disagree disagree neither agree nor disagree agree strongly agree very strongly agree

1. (HSE 1) Whenever there are safety meetings to do with my job I go to them
   1 2 3 4 5 6 7

2. (HSE 3) Before I start work I check the safety equipment I might need
   1 2 3 4 5 6 7

3. (HSE 4) I know the written safe working procedures for my job
   1 2 3 4 5 6 7

4. (HSE 5) Generally, I keep the area I work in tidy
   1 2 3 4 5 6 7

5. (HSE 8) If changes are made to the procedures for my job I know about them
   1 2 3 4 5 6 7

6. (HSE 9) I know the results of safety inspections to do with my job
   1 2 3 4 5 6 7

7. (HSE 10) I'm satisfied with the safety equipment specified for my job
   1 2 3 4 5 6 7

8. (HSE 11) I'm happy with the existing safety precautions for especially dangerous parts of the plant
   1 2 3 4 5 6 7

9. (HSE 12) I feel satisfied with the safety information I get
   1 2 3 4 5 6 7

10. (HSE 13) I feel satisfied with the attention given to safety in any training I have had
    1 2 3 4 5 6 7

11. (HSE 14) I am satisfied with the safety meetings we have
    1 2 3 4 5 6 7

12. (HSE 16) Overall, I think that I work safely

1 2 3 4 5 6 7

13. (HSE 17) In terms of safety, I'm happy with the way I usually work

1 2 3 4 5 6 7

SECTION TWO: YOUR WORKMATES

very strongly disagree strongly disagree disagree neither agree nor disagree agree strongly agree very strongly agree

14. (HSE 18) The people I work with go to safety meetings about their jobs
1 2 3 4 5 6 7

....

15. (HSE 19) My workmates keep the area they work in tidy
1 2 3 4 5 6 7

....

16. (HSE 20) The people I work with check any safety equipment they might use before starting work
1 2 3 4 5 6 7

....

17. (HSE 21) My workmates are satisfied with the safety procedures in general
1 2 3 4 5 6 7

....

18. (HSE 22) The people I work with are satisfied with the attention given to safety in any traini ng they have had
1 2 3 4 5 6 7

....

19. (HSE 23) The people I work with are satisfied with the information they get about safe working
1 2 3 4 5 6 7

....

20. (HSE 25) The people I work with understand the reasons for the safe working procedures the y are supposed to follow
1 2 3 4 5 6 7

....

21. (HSE 29) The people I work with are satisfied with the input they have at safety meetings
1 2 3 4 5 6 7

....

22. (HSE 30) The people I work with know what safety training is needed for their jobs
1 2 3 4 5 6 7

....

23. (HSE 31) My workmates are satisfied with the attention paid to safety in any training they have
1 2 3 4 5 6 7

....

very strongly disagree strongly disagree disagree neither agree nor disagree agree strongly agree very strongly agree

24. (HSE 32) The people I work with encourage me to work safely
1 2 3 4 5 6 7

25. (HSE 33) If I had a complaint about safety my workmates would support me
1 2 3 4 5 6 7

26. (HSE 34) I encourage the people in my plant to work safely
1 2 3 4 5 6 7

27. (HSE 35) My workmates would expect me to support them if they had a complaint about safety
1 2 3 4 5 6 7

SECTION THREE: YOUR SUPERVISORS

very strongly disagree strongly disagree disagree neither agree nor disagree agree strongly agree very strongly agree

28. (HSE 50) My supervisors encourage me to report any safety problems I might notice
1 2 3 4 5 6 7

29. (HSE 51) I'm encouraged by my supervisors to go to meetings about job safety
1 2 3 4 5 6 7

30. (HSE 52) My supervisors are satisfied with the safety training given to their workgroup
1 2 3 4 5 6 7

31. (HSE 53) My supervisors are generally satisfied with safety in my plant
1 2 3 4 5 6 7

32. (HSE 54) My supervisors know what safety equipment people in my plant should use
1 2 3 4 5 6 7

33. (HSE 56) My supervisors know what is discussed in plant safety meetings
1 2 3 4 5 6 7

34. (HSE 57) My supervisors know what safe working procedures people should be following
1 2 3 4 5 6 7

BACKGROUND QUESTIONS

In this section there are a number of questions about you and your job. Please answer them by circling the appropriate answer or by filling in the space provided.
All answers are in the STRICTEST CONFIDENCE No one outside the research team at the Unive rsity of Surrey will see the completed questionnaires. No attempt will be made to identify you fr om the responses you make. Our interest is in understanding accidents and safety, and in making where you work a safer place to be.

1. Which plant do you work in? ....

2. In the last six months how many days have you been off work? ....

3. Of those days you were off work, how many were due to illness NOT related to any accident at work? ....

4. Did you serve an apprenticeship? YES NO

5. Do you have a particular craft or trade for which you are qualified? YES NO

6. If you have a trade, what is it? ....

7. Were you formally trained for your job? YES NO

8. How much time was spent in training (if any) for your job? ....

9. Are you a member of any safety committees? YES NO

10. What is your main job at the moment? ....

11. How long have you worked for this company? ....

12. How long have you been in your present job with this company?
....

13. How many different jobs INCLUDING your present one have you had since you have been with the company?

....

14. Below is a list of words.
Please circle ALL of those which you feel apply to your job.

PRODUCTION ENGINEERING SKILLED SEMISKILLED

UNSKILLED MAINTENANCE TRANSPORT MANAGERIAL

SUPERVISORY MANUFACTURING SAFETY REPRESENTATIVE

DAY WORKER SHIFT WORKER SERVICES FOREMAN

OPERATOR ACCIDENTS

ACCIDENTS

1.	Have you been involved in an accident of any kind AT WORK in the last six months?	YES	NO
2.	Were you injured?	YES	NO
3.	Did you receive any treatment or attention at work?	YES	NO
4.	Did you lose days off work?	YES	NO
5.	If you lost time, how many days were you off work?		
6.	Was damage done to the plant?	YES	NO
7.	Was anyone else injured?	YES	NO
8.	How many days, if any, were they off work?		
9.	Could the accident have been prevented?	YES	NO

10. In your opinion who was mainly to blame for the accident?

MANAGEMENT WORKMATE SUPERVISOR YOURSELF

11. Please briefly describe the accident and if possible say how it could have been prevented.

APPENDIX 2

Draft of the Critical Behaviour Checklist

i) General Operation and Equipment:

1. Before starting the punching press, the operator must check to make sure that the rotation of the wheel, brake, 'start' and 'stop' button are in good working order.

2. Machines installed with a protective arms should not be operated if found defective with the protective arms.

3. No one is allowed to change the design of the machine to single-handed button or foot-brake from a two-handed buttons.

4. When foot-brake is used for starting the machine, the operator must note that the foot should be put back to its original position before attempting the next action.

5. Both hands must be away from the working platform when pressing the foot release.

6. With small hand-press machines, the operator must make sure that his/her hand is away from the lever after each pulling to start the motion and laying the hand on the lever all the time is strictly forbidden.

7. In case it is necessary for the operator to take the semi-product out from the dies, it is strictly prohibited to us the hand except with a clipper, when the power press is still in motion.

8. During working time, the operator must be concentrating on the operation and should not leave the position without notifying the supervisor.

9. During operation, the operator should not chat with the neighbouring colleagues.

10. Before leaving the machine with the permission of the supervisor, the operator must turn off the machine.

11. It is strictly forbidden for the operator to regulate the machine or change the speed data on the machine.

12. The operator should stay away from the machine, during maintenance, loading or unloading of the dies by the technicians.

13. The use of chairs, fork-lifts or other makeshift devices for work platform is prohibited. Always stand on a ladder when working more than 1 ft. off the ground.

ii) Material Handling

1. Care must be taken not to place the next piece of material into the dies, when the previous one is still inside.

2. The semi-product must be placed securely inside the chuck of the dies before punching. It is strictly prohibited to operate the machine without any semi-product in the chunk.

3. Before attempting to drill, grind, or ream small objects, clamp or secure the item first. Avoid holding the object with one hand while performing the operation with the other.

iii) Personal Protective Equipment

1. Within the vicinity of the plant, no personnel are allowed to wear slippers or sandals.

2. Within the vicinity of the plant, the hair of the operator should be regulated in a way that it does not block the sight of the eyes.

3. The operators should take care that the sleeves of their clothes be rolled up and tightly buttoned.

4. No personal decorative substances such as necklace should be left dangling at the outside of the clothes.

5. Approved safety glasses or goggles should be worn when working beneath or with equipment where the danger of falling or flying particles exists.

iv) <u>Housekeeping</u>

1. During working hour, personnel inside the plant are advised not to wander to interrupt the operation.

2. Workers when using the hand cart for transporting material or semi-products should take care not to bump against things in the passages.

3. The passages between the lines should be kept clean and tidy. No scrap or waste chips should be left on the passage.

4. Products, carton boards, carton boxes, plastic boxes, wooden pallet or raw material should be stored in the proper places as specified.

5. No spilled oil should be left unclean on the passage or in the vicinity of the machines.

6. Machines must be clean and free of unnecessary material or hanging.

7. Machines must be free of unnecessary dripping of oil or grease.

8. Machines must have proper guards provided and in good condition.

9. Stock and material must be properly piled and arranged.

10. Tools must be properly stored.

(From the International Safety Academy, Houston, 1980 and Company Regulations of AMX Metalwork)

APPENDIX 3

OBSERVATION FORM

Date: ______________ Name of Observer: ______________

Time: ______________ Department Observed: ____________

Section I

General Operation and Equipment

		Safe	Unsafe	Not Seen
1.	Before starting the punching press, the operator must check to make sur that the rotation of the wheel, brake, 'start' and 'stop' button are in norma condition. 1.			
2.	Machines installed with protective arms should not be operated if found defective. 2.			
3.	No one is allowed to change the design of the machine to single-handed button or foot-brake from two-handed buttons. 3.			
4.	When foot-brake is used for starting the machine, the operator must note that his/her foot should be put back to its original position before attempting the next action. 4.			
5.	Workers should not put things under their feet as platforms for the sake of comfort. 5.			
6.	Hands must be off the area where the press buttons are located when loading the semi-finished product onto the die. 6.			
7.	Both hands must be away from the working platform when pressing the foot release. 7.			
8.	With small hand-press machines, the operator must make sure that his/her hand is away from the lever after each pulling to start the motion and laying the arm on the lever all the time is strictly forbidden. 8.			

9.	In case it is necessary for the operator to take the semi-product out of th dies, it is strictly prohibited to use the hand. Instead, a clipper should b used, when the power press is still in motion.	9.			
10.	During working time, the operator must be concentrating on the operation and should not leave the post without notifying the supervisor.	10.			
11.	During operation, the operator should not chat with the neighbouring colleagues.	11.			
12.	The machine operators must maintain their appropriate sitting postures for safety concern.				
13.	Before leaving the machine, the operator must obtain the permission of the supervisor and turn the machine off.	13.			
14.	It is strictly forbidden for the operator to regulate the machine or change the parameter.	14.			
15.	During operation, the operator should watch for any mechanical abnormality, for example, on the protective arms, ultra-red system, the two-handed buttons (starters) or abnormal sound on the machine. The operator should report the mal-function, if there is any.	15.			
16.	The operator should stay away from the machine, during maintenance, loading or unloading of the dies by the technicians.	16.			
17.	The use of chairs, fork-lifts or other makeshift devices as work platform is prohibited. Always stand on a ladder when working more than 1 ft off the ground.	17.			
18	Machines must be properly guarded and be in good condition.	18.			

Section II
Material Handling

No.	Item		Safe	Unsafe	Not Seen
1.	Care must be taken not to place a second piece of material into the dies, when the previous one is still inside.	1.			
2.	The semi-product must be placed securely inside the chuck of the dies before punching. It is strictly prohibited to operate the machine with an empty chunk.	2.			
3.	Small particles should be tightly clamped, when being drilled and tapped. Holding the particles single-handed should be avoided.	3.			
4.	Small particles should be placed in a small container and put in an appropriate place nearby before and after punching or drilling.	4.			
5.	The work platform should be clear of any particles after tool adjustment.	5.			
6.	The material should be piled or placed neatly beside the operator before and after being processed.	6.			
7.	Stock and material must be properly stacked and arranged within the specified areas marked with yellow lines.	7.			
8.	Products, carton boards, carton boxes, plastic boxes, wooden pallet or raw material should be stored in the proper places as specified.	8.			

Section III

Personal Protective Equipment

	Item		Safe	Unsafe	Not Seen
1.	Within the vicinity of the plant, no personnel is allowed to wear slipper or sandals.	1.			
2.	Within the vicinity of the plant, the hair of the operator should be regulated in such a way that it does not block the sight of the eyes.	2.			
3.	The operators should take care that the sleeves of their clothes be rolled up and tightly buttoned.	3.			
4.	No personal decorative substances such as necklace should be left dangling outside the clothes.	4.			
5.	Approved safety glasses or goggles should be worn when working with dangerous equipment or at places where the danger of falling or flying particles exists.	5.			
6.	During working hours, personnel inside the plant are advised not to wander to interrupt the operation. During working hours, staffs are forbidden to loiter in the production areas for the sake of safety.	6.			

Section IV
Housekeeping

		Safe	Unsafe	Not Seen
1.	Machines must be clean and free of unnecessary material or hanging.			
2.	Machines must be free of dripping of oil or grease.			
3.	Tools must be properly stored.			
4.	Workers when using the forklift for transporting material or semi-products should take care not to bump against things in the passages.			
5.	No scrap, small particles, stain of oil or junk be left underneath or in the vicinity of a machine.			
6.	The worker who was responsible for transporting material should avoid standing on the empty forklift.			
7.	The passages between the production lines should be kept clean and tidy. No scrap, waste chips or spilled oil should be left on the passage.			
8.	Forklifts should be placed in the zone as specified by the yellow lines.			
9.	Workers if found to be in a bad mood or in a poor physical condition (lack of sleep or drunk) should not be allowed to work.			
	Total			

Safe Colume

1 – All people work safely
0 – Some or all people work safely

Unsafe Colume

1 or infinite - Number of unsafe acts

Not Seen Colume

0 – absence of a particular activity

APPENDIX 4 Observation Form (in Chinese)

觀察表

日期: ____________　　　　觀察員姓名: ____________________

時間: ____________　　　　被觀察部門: ____________________

甲) 一般操作及設備

		安全	不安全	不適用
1. 啓動啤機前，首先觀察啤機的轉動離合器，操縱器，是否正常。	1.			
2. 凡須裝撥手的啤機，定要裝上撥手方可進行生產。	2.			
3. 凡要用雙手製動的，任何人不准改爲單手製或腳踏製。	3.			
4. 在使用腳踏製開關時，每腳踏一次後，腳應挪回原地，然後再進行第二次動作。	4.			
5. 不可私自放腳墊將腳墊高。	5.			
6. 放半成品進模中時，雙手要離開手掣。	6.			
7. 用腳踏開動啤機時，雙手要離開工作台。	7.			
8. 在使用手拉製開關時，每拉一次，手必須離開拉桿，嚴禁將手壓在拉捍上面。	8.			
9. 將產品從模具中取出來時，一定要使用夾具，嚴禁將手伸入正在運沖床的模具內。	9.			
10. 工作時間內必須集中精神，未知會組長前，不可離開座位。	10.			
11. 生產操作中，操作員不應與鄰座工友閒談。	11.			
12. 工人坐姿要正確。	12.			
13. 啤工離開工作崗位必須得到組長同意，同時把機器關掉。	13.			
14. 啤工嚴禁私自調較控制箱上任何按鈕或私自更改任何數據。	14.			
15. 啤工作業時，須注意機器運作情況，當發現異樣時，須馬上通知組長啤機上之安全設施是指：撥手、紅外線，雙手按動開關等。	15.			
16. 較啤及上下模時，工人必須離開沖床，待完畢後方可進行操作。	16.			
17. 禁止使用椅子，劏車等暫時代用品作爲工作台，當離地一呎以上工作時，應站在梯上。	17.			
18. 機器要有適當保護蓋及性能良好。	18.			

乙 物料處理

		安全	不安全	不適用
1.	啤札時，當一件產品仍在模裏，不可放第二件入內(即啤兩件或連續啤)	1.			
2.	產品必須放在模具固定的管位內，不可放歪，放斜，更不能在沒有產品在模具內的情況下空啤。	2.			
3.	當要在小五金件上鑽﹑絞孔時，要把物品鉗牢，避免一手拿物品，一手操作。	3.			
4.	啤札或鑽孔前，細少物應放在小盒子內，並把盒子放於附近適當地方	4.			
5.	機台上不可放有產品、雜物或廢料。	5.			
6.	物料經處理前後，應整齊放在操作員旁邊。	6.			
7.	存貨及物料要在黃線內妥善疊放和整理。	7.			
8.	產品，紙板，紙箱，塑料箱，卡板及原材料須存於適當的指定地點。	8.			

丙 個人安全保護措施

			安全	不安全	不適用
1.	在工場範圍內，不可穿著拖鞋或涼鞋。	1.			
2.	在工場範圍內，髮型不可過長阻礙視線。	2.			
3.	工人衣袖要捲起或扣好。	3.			
4.	項鏈等飾物不可掉出衣服外。	4.			
5.	在有飛屑等危險機械操作時，必須戴上認許的安全眼罩或目鏡。	5.			
6.	上班時間，廠內人員不可閒蕩，以免騷擾生產操作。	6.			

丁 工場管理

			安全	不安全	不適用
1.	機器要清潔，不可留有或懸掛不必要物件。	1.			
2.	機器須清除漏油及潤滑劑。	2.			
3.	工具須妥善存放。	3.			
4.	拉劏車要有正確方法，避免碰角灣之物件。	4.			
5.	機台下或四周不可有廢料、碎屑、油漬、雜物。	5.			
6.	運輸工人不可站在空劏車上。	6.			
7.	車間通道不可留有碎屑、鐵絲、雜物。	7.			
8.	叉車不可亂擺放，要按劃線規定。	8.			
9.	工人情緒或身體狀況不佳不可工作。	9.			
		合共			

APPENDIX 5

Interview Questions

The researcher thus tries to identify the existence of dangerous behaviours in the plant

The ensuing questions will ask about the time when accidents are likely to happen:

The research then attempts to know the general opinion of the respondents about the safety consciousness in his /her department and about other departments:

The last question in the elementary interview intends to collect recommendations on improving safety performance:

Interview Questions

Q1 What do you understand about the words "work safety"?

Q2 What do you think dangerous behaviours in work are ?

Q3 Give some examples. Are they very dangerous?

Q4 In your opinion, is there any repetition in dangerous behaviour? Is it frequent? How?

Q5 Do you notice any people occasionally work around (prefer short-cut) proper procedures when hurrying up for delivery? Can you give an example?

Q6 And do you notice any of your colleagues occasionally behave dangerously at work? Can you give an example?

Q7 When do you think dangerous behaviour is likely to take place?

O8 Is your Department safety conscious?

Q9 Why do you say that?

Q10 Are other Departments more or less safety conscious?

Q11 Why do you say that?

Q12 What recommendations can you make for combating work accidents?

APPENDIX 6

Nature of Metal-working Machines

As has been recommended by the Department of Labour, Bureau of Labour Standard since 1951, machines should be guarded where necessary to prevent the occurrence of danger (Blake, 1963, pp197), because of the extremely dangerous nature of each kind of these machines.

For example, with the milling machine, as one of the machine tools, accidents often occur when the tool is rotating and the work is in motion. The milling machine is for machining the piece of metal by bringing it into contact with a rotating cutter with multiple edges. To guard against both the tool rotating and movement and work in motion. Some guards should be installed over the periphery of the cutter to prevent accidental contact with the cutter head and act as chip guards. Besides, the 'start' and 'stop' control mechanism should be installed at an accessible normal working position for convenience.

During operation, attention must be guarded against removing the chips with the waste. The chips can only be cleared with a chip brush when the machine stops. Furthermore, the material being worked on must be clamped securely and no later adjustment be allowed, while the machine is in motion.

Other machine tools are dangerous as well. Turning is another example. Turning involves shaping a rotating piece by revolving it against a cutting tool to generate a cylindrical surface. Machine tools of this kind include all forms of metal-turning lathes. In cutting nonferrous metals, especially cast iron and brass, the only way to protect the operator against accidents caused by flying chips is to install a permanent chip guard while goggles should be worn as a rule.

In comparison, more dangerous than machine tools are the pressing or punching machines which carry out process of metal forming, shaping, cutting or assembling with tools or dies attached to punchers or moving parts. Machines performing cold metal forming, punching, and shearing include power presses, punch presses, plate punches, power-screw and hydraulic presses. The groups can be further subdivided by their special function. The most commonly known machines in a metal stamping house are blanking presses, piecing presses, forming presses and stamping presses. Though, theoretically, every operation can be guarded against danger; the time and expense necessary for such purpose seems not to be feasible, when taking the busy daily production into consideration. The more common compromise alternative is to provide guards suitable for certain points of each operation which are deemed especially hazardous.

Often, the problem of guarding is closely connected with the way of feeding the material. Of the three methods of feeding----fully automatic, semi-automatic and manual, the last is the most problematic. Mechanical feeding , both fully automatic or semi-automatic can help guarding easier. Hand feeding is by far the most dangerous. To avoid entrapment, it is necessary that the stroke of the ram be limited to 1/4 inch and each stroke triggers the gate guard that cut off the dangerous zone before the ram lowers. The other alternative is to use a two-handed tripping device for each stroke of the press. Another available guard is a device actuated by ropes connecting with the pulleys to pull the operator's hands away from the danger zone when the ram descends (Blake, 1963, pp208).

APPENDIX 7

Interview Questions (Chinese Version)

面談的發問問題

1. 你對工作安全這兩個字明白多少

2. 你認爲工作中的危險行爲是什麼？

3. 依你看法危險行爲會有重覆性嗎？

4. 你認爲當人們趕貨時，有沒有可能走捷徑(不照正常工作程序) ？

5. 你有否留意到工友在工作上有危險行爲？

6. 你認爲危險行爲何時會發生？

7. 對於防範意外，你有什麼建議呢？

Appendix 8

Questionnaire (finalized)

In this section there are a number of questions about you and people in your plant. Please answer them by circling the appropriate answer or by filling in the space. All answers are in the STRICTEST CONFIDENCE. No one except the researcher will see the completed questionnaire. No attempt will be made to identify you from the responses you make. Our interest is in understanding accidents and safety, and in making where you work a safer place to be.

SECTION ONE: YOURSELF AND SAFETY

		Very strong disagree	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree	Very strongly agree
1.	Whenever there are safety meetings to do with my job I go to them	1	2	3	4	5	6	7
2.	Before I start work I check the safety equipment I might need.	1	2	3	4	5	6	7
3.	I know the written safe working procedures for my job.	1	2	3	4	5	6	7
4.	Generally, I keep the area I work in tidy.	1	2	3	4	5	6	7
5.	If changes are made to the procedures for my job I know about them.	1	2	3	4	5	6	7
6.	I'm satisfied with the safety equipment specified for my job.	1	2	3	4	5	6	7
7.	I'm happy with the existing safety precautions for especially dangerous parts of the plant.	1	2	3	4	5	6	7
8.	I feel satisfied with the safety information I get.	1	2	3	4	5	6	7
9.	I feel satisfied with the attention given to safety in any training I have had.	1	2	3	4	5	6	7
10.	I am satisfied with the safety meetings we have.	1	2	3	4	5	6	7

SECTION TWO: YOUR WORKMATES

	Very strong disagree	Strongly disagree	Disagree	Neither agree nor	Agree	Strongly agree	Very strongly agree
11. The people I work with go to safety meetings about their jobs.	1	2	3	4	5	6	7
12. My workmates keep the area they work in tidy.	1	2	3	4	5	6	7
13. The people I work with check any safety equipment they might use before starting work.	1	2	3	4	5	6	7
14. The people I work with are satisfied with the attention given to safety in any training they have had.	1	2	3	4	5	6	7
15. The people I work with understand the reasons for the safe working procedures they are supposed to follow.	1	2	3	4	5	6	7
16. The people I work with are satisfied with the input they have at safety meetings.	1	2	3	4	5	6	7
17. The people I work with know what safety training is needed for their jobs.	1	2	3	4	5	6	7
18. My workmates are satisfied with the attention paid to safety in any training they have.	1	2	3	4	5	6	7

SECTION THREE: YOUR SUPER VISORS

	Very strong disagree	Strongly disagree	Disagree	Neither agree nor	Agree	Strongly agree	Very strongly agree
19. My supervisors encourage me to report any safety problems I might notice.	1	2	3	4	5	6	7
20. I'm encouraged by my supervisors to go to meetings about job safety.	1	2	3	4	5	6	7
21. My supervisors are satisfied with the safety training given to their work group.	1	2	3	4	5	6	7
22. My supervisors are generally satisfied with safety in my plant.	1	2	3	4	5	6	7
23. My supervisors know what safety equipment people in my plant should use.	1	2	3	4	5	6	7
24. My supervisors know what is discussed in plant safety meetings.	1	2	3	4	5	6	7
25. My supervisors know what safe working procedures people should be following.	1	2	3	4	5	6	7

BACKGROUND QUESTIONS

In this section there are a number of questions about you and your job. Please answer them by circling the appropriate answer or by filling in the space provided. All answers are in the STRICTEST CONFIDENCE. No one except the researcher will see the completed questionnaires. No attempt will be made to identify you from the responses you make. Our interest is in understanding accidents and safety, and in making where you work a safer place to be.

1. Which department do you work in? ______________________________

2. In the last six months how many days have you been off work? __________

2. Of those days you were off work, how many were due to illness NOT related to any accident at work? ______________________________

4. Did you serve an apprenticeship? YES NO

5. Did you have a particular craft or trade for which you are qualified? YES NO

6. If you have a trade, what is it? ______________________________

7. Were you formally trained for your job? YES NO

8. How much time was spent in training (if any) for your job? ____________

9. Are you a member of any safety committees YES NO

10. What is your main job at the moment? ______________________

11. How long have you worked for this company? ______________________

12. How long have you been in your present job with this company? __________

13. How many different jobs INCLUDING your present one have you had since you have been with the company? ______________________

14. Below is a list of words.
Please circle ALL of those which you feel apply to your job

PRODUCTION	ENGINEERING	SKILLED
SEMISKILLED	UNSKILLED	MAINTENANCE
TRANSPORT	MANAGERIAL	SUPERVISORY
MANUFACTURING	SHOPFLOOR	SAFETY REPRESENTATIVE
DAY WORKER	SHIFT WORKER	SERVICES
TRADE UNION OFFICIAL	OPERATOR	FOREMAN
LINE-MANAGER	ACCIDENTS	

ACCIDENTS

1.	Have you been involved in an accident of any kind at WORK in the last six months?	YES	NO
2.	Were you injured?	YES	NO
3.	Did you receive any treatment or attention at work?	YES	NO
4.	Did you lose days off work?	YES	NO
5.	If you lost time, how many days were you off work? ________________		
6.	Was damage done to the plant?	YES	NO
7.	Was anyone else injured?	YES	NO
8.	How many days, if any, were they off work? ____________________		
9	Could the accident have been prevented?	YES	NO

10. In your opinion who was mainly to blame for the accident?

MANAGEMENT WORKMATE SUPERVISOR YOURSELF

Please briefly describe the accident and if possible say how it could have been prevented.

____

Appendix 9

Questionnaire in Chinese (finalized)
問卷

下列問題與你及工友有關，請選擇適當答案並在上面劃一圓圈，所有答案絕對保密，除研究員外，無人會看到全份問卷，亦不會由答卷中認出是你所填，我們只有興趣瞭解工業意外和安全，及使你的工廠變成安全地方。

甲部 你與安全	非常強烈不同意	強烈不同意	不同意	不表示同意或不同意	同意	強烈同意	非常強烈同意
1. 每逢召開與我工作有關的安全會議，我參加。	1	2	3	4	5	6	7
2. 開工前，我檢查我要用的設備安全。	1	2	3	4	5	6	7
3. 我知道明白廠方寫出來的安全操作程序。	1	2	3	4	5	6	7
4. 我常保持工作環境的整潔。	1	2	3	4	5	6	7
5. 如我的正常工作程序有所改變，我知道。	1	2	3	4	5	6	7
6. 我對指派給我的設備安全滿意。	1	2	3	4	5	6	7
7. 我對現時針對工廠特別危險部門之安全措施感到開心。	1	2	3	4	5	6	7
8. 我對由廠方取得的安全資料(貼出的指示)滿意。	1	2	3	4	5	6	7
9. 我對廠方注意安全操作訓練方面感到滿意。	1	2	3	4	5	6	7
10. 我對我參加的安全會議滿意。	1	2	3	4	5	6	7

	非常強烈不同意	強烈不同意	不同意	不表示同意或不同意	同意	強烈同意	非常強烈同意
乙部 你的工友							
11. 本部工友參加與他們工作有關的安全會議。	1	2	3	4	5	6	7
12. 我的顆伴保持工作範圍的整齊。	1	2	3	4	5	6	7
13. 本部工友開始工作前檢查要用的安全設備。	1	2	3	4	5	6	7
14. 本部工友對廠方注意給他們的安全操作訓練感到滿意	1	2	3	4	5	6	7
15. 本部工友明白他們爲什麼應遵守安全操作程序	1	2	3	4	5	6	7
16. 本部工友對自己在安全會議上所提意見感到滿意。	1	2	3	4	5	6	7
17. 本部工友知道他們工作上需要甚麼樣的安全操作培訓。	1	2	3	4	5	6	7
18. 我的顆伴對廠方注意給予生手的安全訓練感滿意。	1	2	3	4	5	6	7

	非常強烈不同意	強烈不同意	不同意	不表示同意或不同意	同意	強烈同意	非常強烈同意
丙部 你的組長							
19. 我組組長鼓勵我舉報違反安全的事件。	1	2	3	4	5	6	7
20. 我組組長鼓勵我參加與工作有關的安全會議。	1	2	3	4	5	6	7
21. 我組組長對給予我組的生手安全訓練感滿意。	1	2	3	4	5	6	7
22. 我組組長普遍對我廠的安全滿意。	1	2	3	4	5	6	7
23. 我組組長清楚我廠工友應用什麼安全設備。	1	2	3	4	5	6	7
24. 我組組長知道在安全會議討論什麼。	1	2	3	4	5	6	7
25. 我組組長知道我廠工友應遵照什麼安全程序工作。	1	2	3	4	5	6	7

背景問題

這部份有數條有關你自己和你工作的問題，請答覆時在適當的答案上劃一圓圈或塡上答案所有答案絕對保密，除研究員外，無人可看到問卷的全部。亦不會由你的答題，把你辨認出來，我們只有興趣去暸解意外和安全，把你的工廠變成安全的地方。

APPENDIX 10

The Remuneration of Workers in the Major Departments of AMX Metal Works

Salary	Workers in the four departments (Heavy Duty, Small Press, Hand Press, Drilling) are receiving approximately the same level of salary: RMB $ 500-600. The determination of their pay is based on the length of their service with the company. The highest pay some workers are receiving has reached RMB$ 18-19/day. The daily pay for the new comer is RMB$ 12.
Normal working hours for the workers	8 hours/day
Basic working hours in a month	18 X 8 = 224 hours
Calculation of the pay for overtime	For worker working over 224 hours in a month: Daily basic hourly rate X 1.5 E.g. If a worker receiving a daily basic hour rate of RMB$ 16, his / her overtime rate will be: RMB$ (16/8) X 1.5 = RMB$ 3 / hour
Allowance for full attendance	RMB$ 30-40/month
Remark: Living quarters are provided to the workers. Each room accommodates 8-10 workers. Each person has to pay MMB$ to share the charges for water and power which will be automatically deducted from their salary.	

APPENDIX 11

PERCENTAGE OF SAFETY PERFORMANCE OF THE FOUR DEPARTMENTS BY WEEK FROM EARLY AUGUST 1999 TO JANUARY 2000

% OF SAFETY PERFORMANCE FOR DEPARTMENT OF

	Heavy-duty Press	Small Press	Hand Press	Drilling
Aug. 2-5, 1999				
Observation 1	46.00	62.50	63.75	64.00
Observation 2	47.00	65.00	74.00	61.50
Observation 3	38.00	74.00	72.50	67.50
Observation 4	49.00	61.50	67.50	69.00
Mean	45.00	65.75	69.44	65.50
Aug. 6-12, 1999				
Observation 1	49.50	60.50	71.00	68.50
Observation 2	47.50	62.00	79.00	64.00
Observation 3	50.00	58.50	70.00	76.00
Observation 4	49.50	50.50	78.00	77.50
Mean	49.13	57.88	74.50	71.38
Aug. 13-19, 1999				
Observation 1	48.00	62.75	68.00	59.50
Observation 2	56.50	72.50	76.50	66.00
Observation 3	55.50	70.25	82.00	61.00
Observation 4	54.00	68.50	72.50	63.50
Mean	53.50	68.5	74.75	62.5
Aug. 20-26, 1999				
Observation 1	41.00	68.75	71.50	83.00
Observation 2	54.75	73.50	63.00	68.50
Observation 3	49.30	65.00	71.50	72.00
Observation 4	48.00	78.50	61.00	71.50
Mean	49.01	71.44	66.75	73.75
Sep. 3-8, 1999				
Observation 1	45.25	70.00	64.00	76.50
Observation 2	49.50	57.00	66.00	82.50
Observation 3	45.00	68.00	70.00	74.00
Observation 4	52.50	63.75	66.00	69.50
Mean	48.06	64.69	66.50	75.63

Sep. 9-15, 1999				
Observation 1	51.15	79.00	67.75	59.25
Observation 2	51.25	55.56	68.50	69.40
Observation 3	53.20	63.60	69.10	-
Observation 4	56.60	70.40	66.50	-
Mean	53.05	67.14	67.96	64.33
Sep. 17-23, 1999				
Observation 1	46.00	69.85	59.30	51.95
Observation 2	44.20	54.20	67.35	59.40
Observation 3	49.40	61.45	62.20	62.75
Observation 4	51.95	59.40	71.35	61.70
Mean	47.89	61.22	65.05	61.45
Sep. 24-30, 1999				
Observation 1	47.35	55.95	74.55	71.35
Observation 2	42.30	60.00	66.75	73.70
Observation 3	48.50	67.35	64.05	67.10
Observation 4	55.15	58.65	70.85	68.00
Mean	48.33	60.49	69.05	70.04
Oct. 3-7, 1999				
Observation 1	39.20	59.35	65.25	59.70
Observation 2	51.35	64.60	57.65	61.10
Observation 3	51.00	62.75	69.60	54.15
Observation 4	51.95	63.75	64.10	56.25
Mean	48.38	62.61	64.15	57.80
Oct. 8-14, 1999				
Observation 1	45.50	71.60	61.15	64.60
Observation 2	47.30	58.35	63.45	57.00
Observation 3	46.05	58.80	59.55	75.70
Observation 4	45.06	62.30	70.20	61.90
Mean	45.98	62.76	63.59	64.80
Oct. 15-21, 1999				
Observation 1	45.50	61.65	54.50	62.35
Observation 2	44.75	63.50	62.45	63.30
Observation 3	54.50	62.45	52.85	61.55
Observation 4	62.35	63.30	63.00	64.10
Mean	51.78	62.73	58.20	62.83
Oct. 22-28, 1999				
Observation 1	59.00	63.30	62.50	55.15
Observation 2	63.30	71.40	64.20	61.25
Observation 3	63.75	62.90	65.50	56.45
Observation 4	66.70	60.10	64.25	56.25
Mean	63.19	64.43	64.11	57.28

Nov. 1-4, 1999				
Observation 1	67.75	62.40	65.50	55.15
Observation 2	62.80	60.95	62.70	62.25
Observation 3	64.10	75.40	61.50	62.00
Observation 4	67.95	62.05	60.35	58.35
Mean	65.66	65.20	62.51	59.44
Nov. 5-11, 1999				
Observation 1	67.95	70.70	59.30	63.85
Observation 2	67.75	70.00	65.40	81.48
Observation 3	66.65	66.70	61.50	61.70
Observation 4	68.25	79.65	65.45	71.05
Mean	67.65	71.76	62.91	69.52
Nov. 12-18, 1999				
Observation 1	61.50	70.20	61.25	63.95
Observation 2	67.95	68.45	58.75	54.00
Observation 3	68.75	74.20	58.85	59.00
Observation 4	69.40	76.00	64.75	60.05
Mean	66.90	72.21	60.90	59.25
Nov. 19-25, 1999				
Observation 1	67.95	77.05	60.05	58.35
Observation 2	65.35	71.45	63.45	61.25
Observation 3	68.05	75.45	60.75	66.55
Observation 4	68.75	69.55	64.70	61.40
Mean	67.53	73.38	62.24	61.89
Nov. 26-30, 1999				
Observation 1	68.75	73.10	56.40	62.75
Observation 2	65.40	81.55	56.50	58.85
Observation 3	70.05	74.60	59.80	66.75
Observation 4	71.80	76.90	55.75	68.60
Mean	69.00	76.54	57.11	64.24
Dec. 3-8, 1999				
Observation 1	67.95	78.15	69.20	70.00
Observation 2	66.65	80.85	69.35	73.00
Observation 3	69.20	70.40	66.70	64.00
Observation 4	70.00	61.10	61.70	63.10
Mean	68.45	72.63	66.74	67.53
Dec. 10-16, 1999				
Observation 1	71.80	77.40	64.75	68.55
Observation 2	66.75	71.45	70.60	64.85
Observation 3	73.05	73.75	77.95	66.25
Observation 4	70.45	80.65	74.00	63.90
Mean	70.51	75.81	71.83	65.89

Dec. 17-23, 1999				
Observation 1	75.65	72.05	76.85	56.90
Observation 2	73.05	74.65	85.00	57.65
Observation 3	71.80	77.30	84.15	62.75
Observation 4	72.50	77.75	80.10	64.70
Mean	73.25	75.44	81.53	60.50
Dec. 24-30, 1999				
Observation 1	64.50	72.40	83.65	61.50
Observation 2	65.40	81.55	77.40	60.90
Observation 3	67.95	73.75	78.45	64.00
Observation 4	66.65	75.95	77.95	66.00
Mean	66.13	75.91	79.36	63.10
Jan. 3-6, 2000				
Observation 1	66.80	59.00	64.10	61.25
Observation 2	76.65	69.70	68.75	70.45
Observation 3	73.15	67.35	73.65	76.25
Observation 4	61.10	64.20	77.00	74.90
Mean	69.43	65.06	70.88	70.71
Jan. 7-13, 2000				
Observation 1	62.10	56.25	55.20	57.00
Observation 2	73.90	65.65	58.05	62.45
Observation 3	74.95	70.00	79.65	78.20
Observation 4	80.00	64.00	74.00	68.90
Mean	72.74	63.98	66.73	66.64
Jan. 21-27, 2000				
Observation 1	65.40	74.15	88.45	64.40
Observation 2	58.75	66.10	82.60	61.50
Observation 3	57.00	68.85	89.50	56.05
Observation 4	57.70	57.70	80.30	57.30
Mean	59.71	66.70	85.21	59.81
Feb. 1-11, 2000				
Observation 1			68.58	66.85
Observation 2			68.63	56.83
Observation 3			65.11	60.30
Mean			67.44	61.33
Feb. 12-17, 2000				
Observation 1			70.20	72.25
Observation 2			69.50	71.15
Observation 3			63.45	70.30
Observation 4			71.15	53.70
Mean			68.58	66.85
Feb. 18-24, 2000				
Observation 1			66.60	62.90
Observation 2			69.10	53.80
Observation 3			65.35	56.75
Mean			67.02	57.81

APPENDIX 12

The Working Environment and Working Process in the Metal Works

i) High risk in the working environment

The daily production activities are being conducted in production lines where the stamping machines (power presses) have been installed. The power press is often considered the most dangerous industrial tool, as pointed out by Grimaldi & Simond (1975, pp-174,5). They had a detailed description of its dangerous configurations and the need for necessary precautions against hazards:

> "It is used widely in metal-shaping operations, and the variety of presses and dies (a die is the tool used to shape or impress the metal; the press provides the power for the die's action) required to produce the varied sizes and character of objects ...... rules out the possibility of finding a simple, general solution to its safety problems.
>
> A power press is essentially composed of a ram (plunger), connected to a crankshaft by a connecting rod and driven by a fly-wheel. (The fly-wheel is a heavy wheel for opposing and moderating, by its inertia, any fluctuation in the speed of the crankshaft.) The flywheel and crankshaft are coupled by a clutch mechanism. The clutch is automatically disengaged just before the ram reaches the top of its stroke, and the crankshaft is held in that position by a brake. The brake normally is set just tightly enough to hold the crankshaft and prevent it from turning under the weight of the ram. At the bottom of its stroke, the ram proximates the bolster-plate (a heavy table-like part of the press) to which is bolted the base of the die. The ram carries the top half of the die. The press is operated by a pedal or a hand control which engage the clutch mechanism and enable the driving force to be transmitted from the flywheel to the crankshaft. The aligning of the dies and the other details of setting up the operation should be the responsibility of workers who are thoroughly trained and who understand the safety requirements for their own protection, as well as for the operators who will work the press. Usually, the supervisor checks the setup before the press is approved for operation."

It is also imperative that the operators of the machines be concentrative when they are handling the material or semi-finished products. For example, special care has to be taken to place the metal sheet properly on the guide holes of the lower tool and leave both hands free from the vicinity of the tool. The press will descend soon as the operator presses either the hand button or steps on the foot press. Accidents often occur if the operator forgets to withdraw his/her fingers from the gap between the upper and lower tools when stepping on his /her foot press by accident. The accidents are due to the lack of coordination of the hand and foot, probably sometimes owing to fatigue after a long time working or being in an unfit physical condition. In addition to mechanical accidents, mishandling of the raw material with heavy and sharp edges will also be responsible for work injuries. Thus the dangerous nature of the production activities in the metal house will be likely to make the factory a valuable venue for investigating work safety.

ii) The relatively simple operation steps which are easy to be defined

In terms of job description, each working step of sheet metal stamping can be clearly defined and will thus facilitate the investigation into the safety status. The flow of metal stamping normally starts with shearing (cutting the material into panel or manageable sizes), blanking (eliminating the excess material to leave the outline of the material on a flat sheet), forming (fabricating a three dimensional semi-product) and other treatments (plating, spot-welding, painting) and final packing. The clear-cut nature of the production procedures will facilitate the research planning (i.e. observation and data collection)

APPENDIX13

Fisher Exact Test

Though the Fisher Exact test is normally recommended for processing discrete data for a 2x2 table with Ns (number of respondents) as large as 30 where neither of the row marginal total exceeds N=15, Everitt (1977, pp-221-224) presented a formula for use when Ns (number of respondents) are larger than 30. Similar example handling Ns larger than 30 can also be found in eBMJ's (2001, pp-1) example which involved a sample of 55 (N=55). Lowry (1999-2000, pp-8) also provided a programme by using a handy calculator capable of handling fairly large samples, up to about N=100.

Meanwhile, there is a version for 2x3 (Everitt, 1977, pp-152)contingency tables in addition to the

2x2 version.

The Fisher Exact Test for 2x3 tables

This calculated in very similar way as for the Fisher 2x2 test, the difference being simply the increased numbers of cells (table 6.11). The formula for the 2x3 exact probability is as follows:

$$\text{Exact probability} = \frac{W!\ \ X!\ \ K!\ \ L!\ \ M!}{N!\ \ a!\ \ b!\ \ c!\ \ d!\ \ e!\ \ f!}$$

Table 6.11 Stages in the calculation of a 2x3 Fisher Exact test

	Column 1	**Column 2**	**Column 3**	**Row Totals**
Row 1	a	b	c	W (=a + b + c)
Row 2	d	e	f	X (=d + e +f)
Column Totals	K (=a + d)	L (=b + e)	M (=c + f)	Overall Total = N

Factories and Industrial Undertakings
(Amendment) Ordinance, 1989

General duties of a proprietor

6A. (1) It shall be the duty of every proprietor of an industrial undertaking to ensure, so far as is reasonably practicable, the health and safety at work of all persons employed by him at the industrial undertaking.

(2) Without prejudice to the generality of a proprietor's duty under subsection (1), the matters to which that duty extends include in particular-

(a) the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safety and absence of risks to health;

(b)arrangements for ensuring, so far as is reasonably practicable, safety and absence of risks to health in connection with the use, handling, storage and transport of articles and substances;

(c)the provision of such information, instruction, training and supervision as is necessary to ensure, so far as reasonably practicable, the health and safety at work of all persons employed by him in the industrial undertaking;

(d) so far as reasonably practicable as regards any part of the industrial undertaking under the proprietor's control, the maintenance of it in a condition that is safe and without risks to health and the provision and maintenance of means of access to and egress from it that are safe and without such risks; and

(e) the provision and maintenance of a working environment for all persons employed by him at the industrial undertaking that is, so far as reasonably practicable, safe and without risks to health.

(3) Subject to subsection (4), a proprietor of an industrial undertaking who contravenes this section commits an offence and is liable to a fine of $200,000.

section willfully and without reasonable excuse commits an offence and is liable to a fine of $200,000 and to imprisonment for 6 months.

General duties of persons employed

6B. (1) It shall be the duty of every person employed at an industrial undertaking while at work-

(a) to take reasonable care for the health and safety of himself and of other persons who may be affected by his acts of omissions at work; and

(b) as regards any duty or requirement imposed on a proprietor of the industrial undertaking or on any other person by this ordinance for securing the health and safety of persons employed at the industrial undertaking, to co-operate with him so far as is necessary to enable that duty or requirement to be performed or compiled with.

(2) A person who contravenes subsection (1) commits an offence and is liable to a fine of $10, 000.

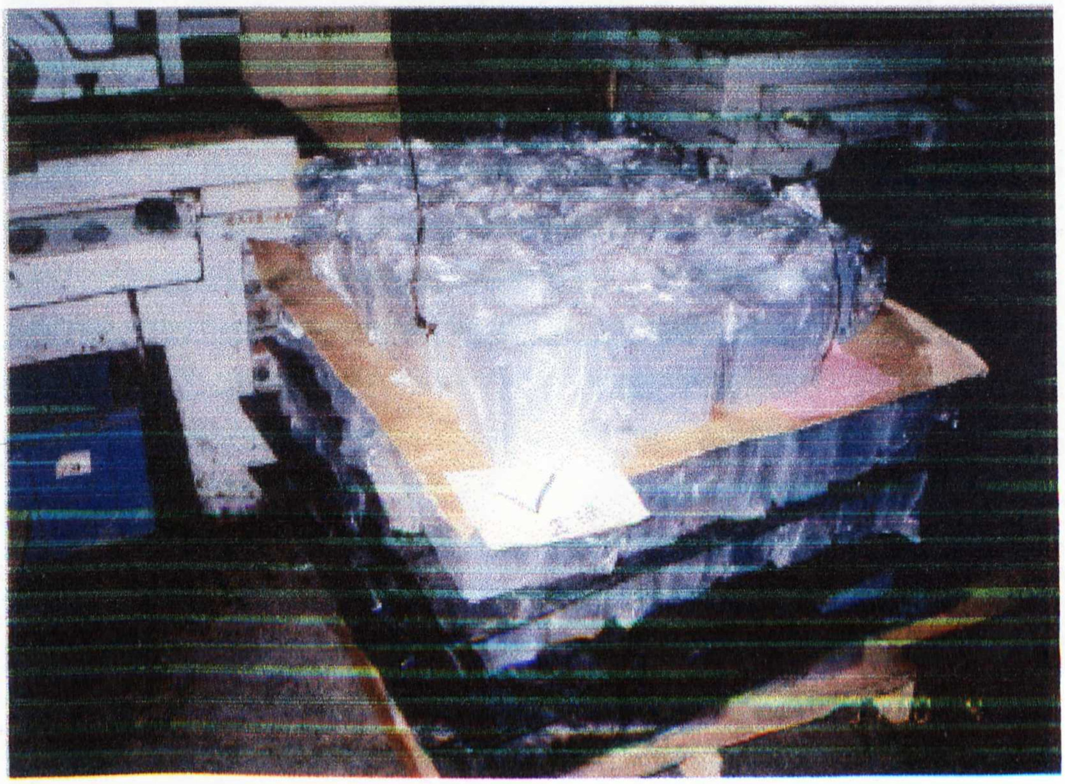
(3) A person employed at an industrial undertaking who willfully and without reasonable excuse does anything while at work likely to endanger himself or other persons commits and offence and is liable to fine of $50,000 and to imprisonment for 6 months.

Meaning of "at work"

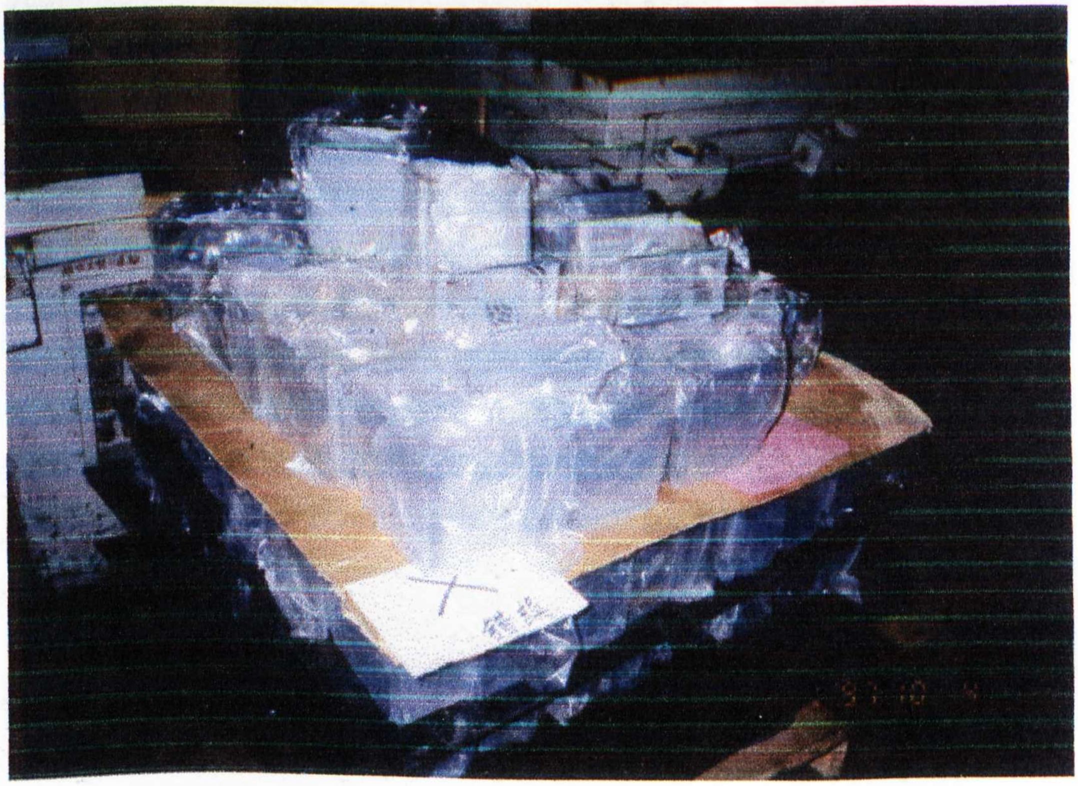
6C. For the purpose of section 6A and 6B, a person is at work throughout the time when he is in the course of employment, but not otherwise.

APPENDIX 15

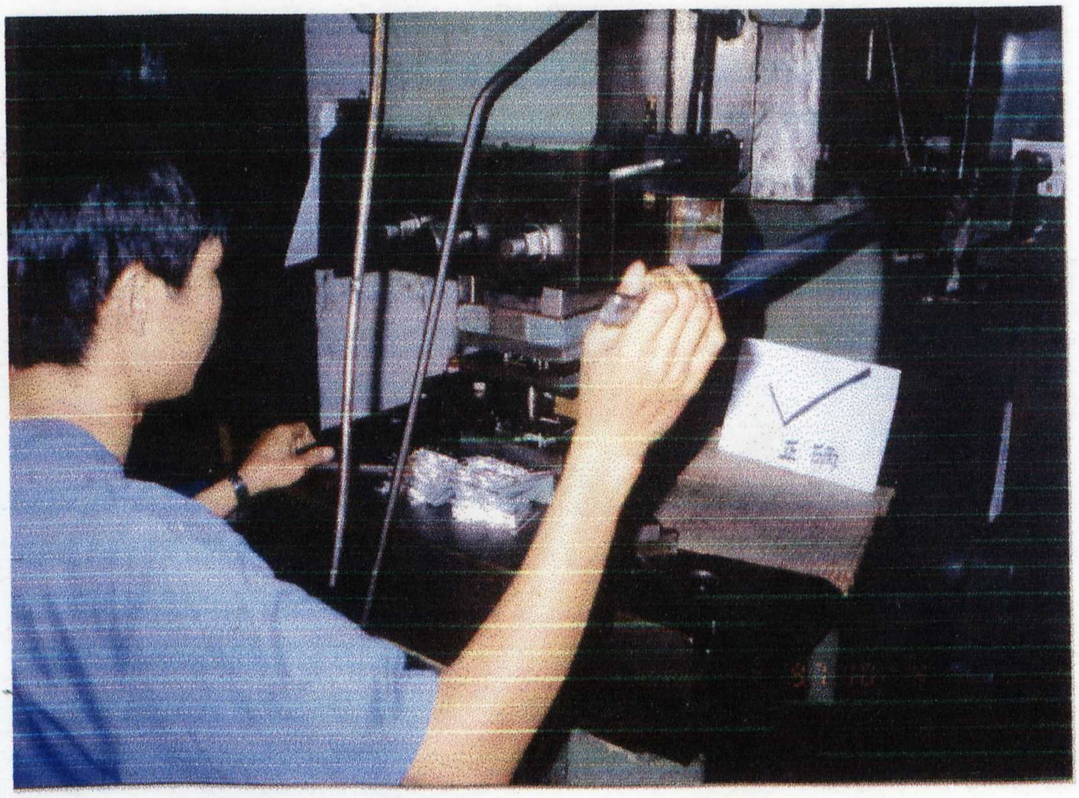
Example of the Slides for Training



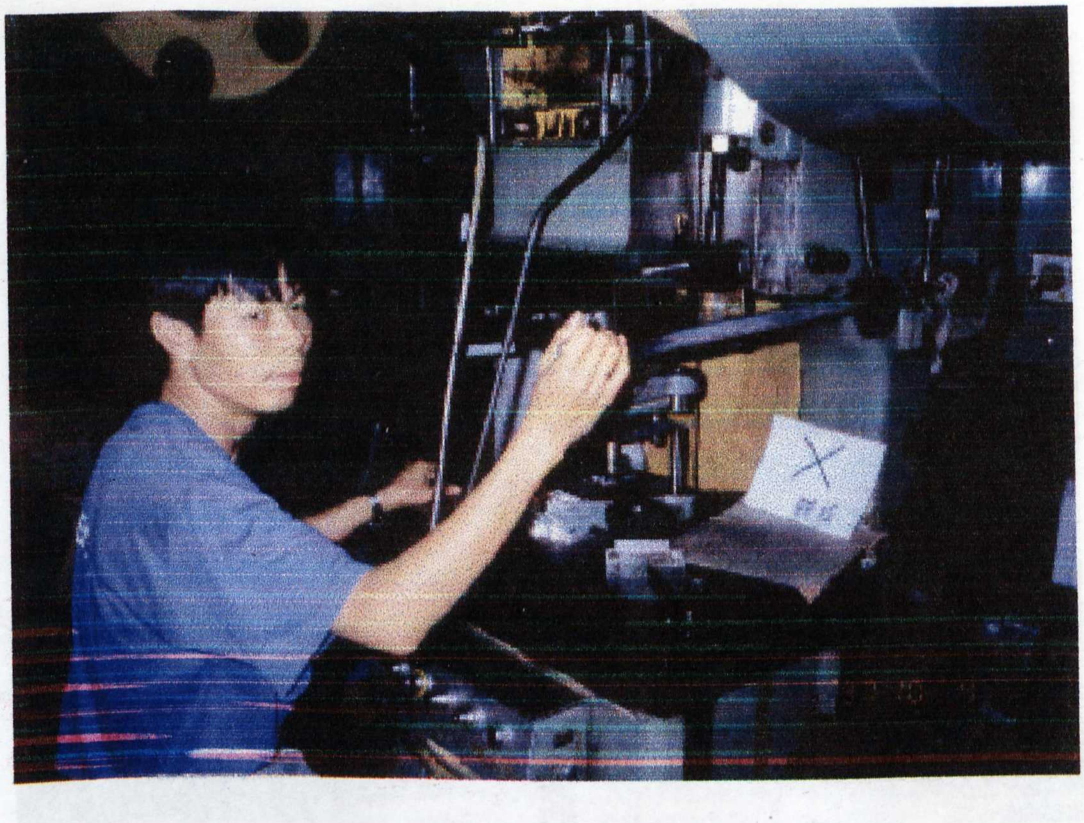
A1. CORRECT way of piling up the semi-finished products



A2. INCORRECT way of piling up the semi-finished products



B1. Concentrating on the operation – CORRECT OPERATION



B2. Not-concentrating on the operation – INCORRECT OPERATION

C1. Retreat the foot from the brake – CORRECT

C2. Leave the foot under the brake – INCORRECT

D1. Using both hands to operate the 2-botton starter – CORRECT

D2. Using one hand to operate the 2-button starter - INCORRECT