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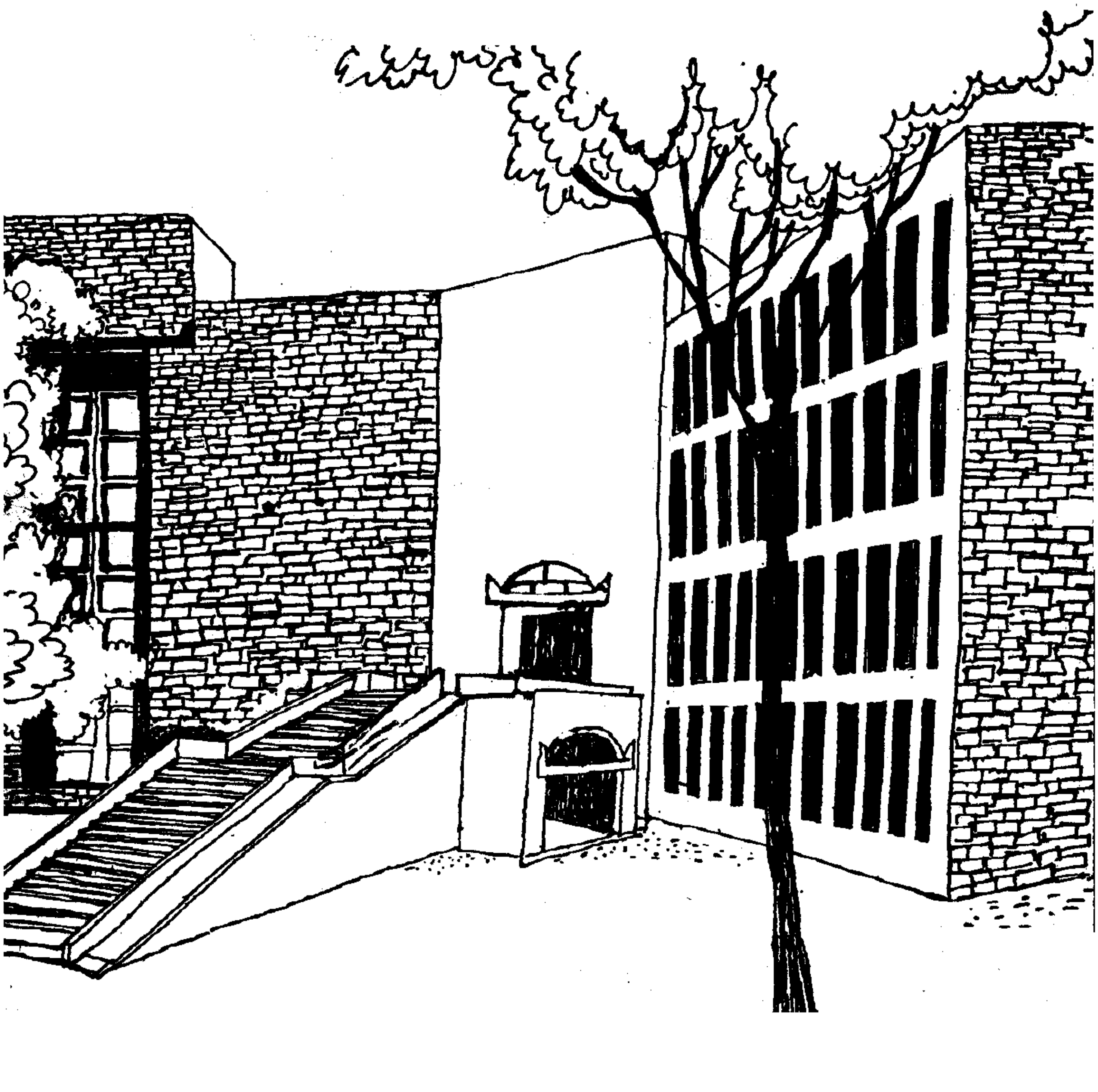

SAFETY AT THE WORK PLACE: A BEHAVIOURAL APPROACH

By

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Introduction

Occupational safety continues to be a major area of social concern despite the attention which it has received over the years and regardless of the stage of industrial and economic development in a country. This is evident from the fact that there were approximately 2,100,000 disabling work injuries in the United States in 1981, out of which 12,300 were fatal and 70,000 resulted in some permanent impairment. The time lost due to work injuries was estimated to be 80,000,000 days and the total cost as $32.5 billion. The figures in terms of rates appear even more disconcerting. There was a work related death every 42 minutes and a work related injury every 15 seconds.[1] The situation in the developing countries is even more alarming in view of the assessment, made in 1975, that "accident frequency rates had a stagnated in most of the industrialised countries and had risen in the developing countries."[2] Three factors combine to compound the problem in the developing countries: rapid growth in industrialisation and economic activity, high rates of unemployment and availability of large labour forces, and inadequate implementation or a total lack of safety related laws. While accurate and reliable figures are not available because many countries do not maintain and/or publish them, a recent conservative assesement is of over 15 million occupational accidents per year worldwide.[3] The implications of this in terms of consequent loss of and damage to human life and limb, property, and wastage of productive capacity, are truly staggering.

Early Developments in Safety

The large number of accidents accompanying the Industrial Revolution was, probably, the first impetus towards making safety a public issue. The earliest legislative developments were, predictably, in England, the country where the Industrial Revolution began. Series of regulations governing working conditions were introduced through the 18th century. Most of these "statutes of labourers", as they came to be called, seemed to be designed more for the benefit of the community under the "greatest good for the greatest number" idea than for protection of workers. Perhaps the first governmental action for safety resulted from a serious outbreak of fever in the cotton mills in Manchester in 1784. The Manchester Board of Health was formed in 1795 and in 1802, the Health and Morals of Apprentices Act was passed which effectively, was the first step toward government regulated prevention of injuries in English factories. Beginning with the Mines Act of 1842 which provided for punitive compensation for preventable injuries caused by unguarded machinery and governmental mine safety inspection programme in 1850, a number of laws and regulations were passed covering almost all types of factories. The nineteenth century saw the enactment of various safety related laws in many European countries and also in the United States.

The workmen's compensation concept of requiring the employer to compensate employees injured in work related accidents, made employers realise that preventing accidents from happening might be financially sounder than paying compensation for them. This, coupled with workmen's compensation or casuaty insurance carriers' use of "schedule rating" plan under which factories with lower rates of accidents were charged lower or reduced premiums for similar coverage, gave a further boost to the organized safety movement. In a way, the workmen's compensation legislation made industrial safety a financially viable proposition.[4]

Parallel to the legislation and government agencies, a number of voluntary and private organizations have been concerned with and involved in safety. The earliest known voluntary safety organization, the Mulhouse Accident Prevention Association, was founded in 1867. The Illinois Steel Company of the U.S.A. set up a safety department at its Joliet Works around 1892 and the United States Steel Corporation set up a committee for safety inspections and accident prevention in 1906. There are many other private voluntary and industrial organizations such as the National Safety Council (U.S.A.), the Royal Society for the Prevention of Accidents (U.K.), the American Insurance Association, which have contributed to the development of safety.

Human Aspect of Safety

Early safety efforts tended to concentrate almost entirely on making the working conditions and environment safe and hazard-free through good housekeeping, putting guards over and around moving parts, and other similar actions.[5] In a way, even the comprehensive Occupational Safety and Health Act (OSHA) of the United States passed in 1970, has been considered to be the culmniation of such a work-environment oriented approach to safety.[6] The publication of Heinrich's Industrial Accident Prevention in 1931 with the "domino" model of accident causation, perhaps, was the first time that the human aspect was formally brought into safety.[7] The second of Heinrich's ten axioms of safety was that "the unsafe acts of persons are responsible for a majority of accidents." While Heinrich's assessment that as many as 88 percent of accidents are attributable to unsafe acts may be debatable, the view that unsafe acts are, at least, a contributory factor in a large proportion of accidents seems reasonable. It is this recognition of the human element in safety which resulted in the development of the interactive view of accident causation. It is held that accidents happen basically due to an interaction between workers and their work environments.[8] It seems clear that if the contribution of human behaviour to accidents can be reduced it will help in progress towards the overall goal of reduction/elimination of accidents.

Most of the early work on the human aspect of safety concentrated generally in three broad areas: identification of individual employee traits under the "accident proneness" theory; effectiveness of informational or communication safety campaigns on employees; and comparing organizations with different accident rates. The results concerning effectiveness in all three area have, at best, been mixed.[9] While this research has made a useful contribution in furthering the work on safety, there are some limitations to the conclusions which can be drawn. A number of studies have been anecdotal and descriptive without any specific attempts at establishing cause-effect relationships. It is, perhaps, this paucity of rigourous and well controlled studies which has contributed to the widespread reliance on the technical and engineering approaches to safety and a lack of attention to the behavioural approach. A recent review of the safety and health systems in Switzerland, the United Kingdom, and the United States concluded that "the alternative of solutions to influence behaviour or performance is not regarded as equally viable because behavioural and social sciences are less developed and less certain in their predictions and application."[10]

However, there has been considerable progress in the behavioural and social sciences knowledge in recent years, resulting in enhanced confidence in cause-effect relationships, predictions, and application. One of the results of the progress is the development and refining of applied behaviour analysis as a means of studying and, if considered necessary and desirable, modifying behaviour. Beginning with the early works of Watson[11] and Thorndike[12] and with a major contribution from Skinner[13], principles of operant conditioning and reinforcement were first applied in hospitals and schools with mentally ill patients and young children respectively. Subsequently, their area of application was extended, with considerable success, to adult working behaviour in complex organizations.[14] The essence of applied behaviour analysis is the observation, analysis, and measurement of behaviour and its change. It is particularly useful for evaluation of the effects of a given programme or method on any socially important behaviour. With its focus on the establishment of specific cause-effect relationships, it has also been described as "a self-examining, self-evaluating, discovery-oriented research procedure for studying behaviour."[15] Combining the widespread efficacy of applied behaviour analysis in improving performance and influencing behaviour in a variety of organizational settings with the importance of human behaviour in occupational accidents and injuries, the use of behavioural techniques to improve safety was suggested.[16] Subsequently, some studies have been reported which have attempted to use this general approach towards reduction of accidents and enhancement of safety.[17] The studies have been conducted in diverse organizational settings and have had consistently positive results. A few studies carried out in organizations engaged in different types of activity, will be described briefly in the following section. Subsequently, the prominent and common features of a generalized behavioural approach to safety will be summarised.

Study 1[18]

This study was conducted in a wholesale backery engaged in making-up, wrapping, and transporting pastry products to retail outlets throughout the United States. Although the entire plant had a total of 162 employees, 142 of which were directly involved in preparation of baked goods, only 38 employees comprising the make-up and wrapping departments were selected for the study. While the plant worked two shifts, the study was confined to only one shift. The rationale for the selections was that these two departments and the particular shift accounted for a majority of the accidents in previous years. The prevailing accident rates were substantially higher than (almost twice) the average rates for similar industries nationwide.

The 25-week programme used a multiple baseline (within subjects) design consisting of a baseline, an intervention, and a reversal phase.

Worker behaviour was observed by trained raters periodically on the basis of an observational code consisting of specific behaviours. The intervention consisted of two components: training and motivation. Training was conducted by showing the workers pairs of slides depicting unsafe and safe behaviour corresponding to items on the observational code. The motivational component consisted of providing periodic feedback on the basis of observed performance and reinforcement of desired safe behaviour in the form of praise by supervisors. Feedback was provided visually by posting it on a chart displayed at a conspicuous place in the employees' working area. The outcome variable of interest was operationalised as "percent of incidents performed safely" and a departmental goal of 90 percent was suggested and agreed to by the employees. The desired safety performance level of 90 percent was also demarcated on the chart used for providing feedback.

The <u>average</u> "percent of incidents performed safely" during the baseline phase was 70 percent and 77.6 for the make-up and wrapping departments respectively. This <u>average</u> safety performance increased to 95.8 percent and 99.3 percent respectively for the two departments following the intervention. During the reversal phase when posting of observed performance to provide feedback was discontinued, the mean safety performance of the two departments went down to 70.8 percent and 72.3 percent respectively. Subsequently the observation and posting of data were resumed for both the shifts and within one year, the injury frequency rate had stablized at a level which was substantially less than the national average and much lower than the rates prevailing in the previous years.

Study 2[19]

The study was conducted in a sugar cane machinery manufacturing company and covered 105 full-time employees of eleven departments of the plant. The departments were selected for the study because 95 percent of all the recorded injuries in the plant during three previous years took place in these departments. Three distinctive features of the safety programme were: an observational check list for observing the behaviour of employees at work and recording it as safe or unsafe, specific inclusion of goal setting and feedback, and a multiple baseline design across groups with four phases. Accident reports of the company for three previous years were analysed to identify unsafe acts which had caused or contributed to accidents. An observational code was, then, prepared consisting of a written rule specifying the correct and safe way of performing each unsafe act identified. The code contained 37 behaviour-specific rules. The observational check-list was an abbreviated and summarized version of the code such that it could be carried by an observer conveniently and unobtrusively.

The inclusion of goal setting and feedback in the programme was based on previous work in the area of motivation and performance.[20] A specific, difficult but realistic and attainable goal was set for safe performance based on the average performance observed during the baseline phase. Feedback was provided in a manner similar to study 1, by posting the actual observed safety performance of a department on a graph displayed in each department. There were three groups and four phases in the multiple baseline design. Three groups were formed by combining the eleven departments on the basis of physical proximity and operational similarity. The interventions, at the start of various phases, were introduced across the three groups in a staggered sequence of time, as is commonly done in multiple baseline designs.[21] The four phases were: baseline; training only; training and goal setting; and training, goal setting, and feedback (knowledge of results).

Safety performance in this study was operationalised as "the percentage of employees working in a completely safe manner." It was computed for each department on the basis of observing the behaviour of all the employees at work in the department during an observation session, in accordance with the observational code and checklist. An employee was considered to be working safely <u>only</u> when he/she was scored safe on <u>all</u> of the checklist items applicable to his/her activity at the time of the observation. An employee might have been working in accordance with most of the behavioural rules applicable to his/her activity, but even if one of the items was violated, the employee was considered to be behaving unsafely.

The <u>average</u> behavioural performance of various departments improved progressively across the four phases and showed marked improvement by the end of the 56-week period of the study. The average for the three groups (consisting of eleven departments) during the baseline phase was 61.57 percent which increases to 95.40 percent during the last phase—an overall <u>percentage</u> increase of 54.95 (on a base of 61.57). The overall figures for the three groups taken together also showed steady improvement in the average safety performance across the four phases. The averages for the second and third phases were 71.09 percent and 77.27 percent respectively. Appropriate statistical techniques (time series analysis[22] and analysis of variance) were used to analyse the data and it was found that the differences in the average values of the behavioural safety performance across various phases were statistically significant.

The increase in behavioural safety performance was accompanied by the expected and, possibly, consequential decrease in accidents and injuries in the plant in terms of the overall injury incidence rate and the lost-time injury incidence rate.[23] The overall injury incidence rate came down from 84.77 to 55.14 and the lost-time injury rate from 21.40 to 9.88. There was, thus, a reduction of 35 percent in the former and 53.83 percent in latter on the basis of the average of the three previous years. Another significant outcome of the programme was substantial financial saving. Two major sources of saving were through the reduction in productive time lost due to accidents and the reduction in accident insurance premium. A saving of $80,000 per year was estimated due to the reduction in lost time accidents, based on the average annual costs of accidents before and after the programme was instituted. The reduction in accident insurance premium was estimated to be $40,000 per year which was due to the reduced rates of accidents during the period of the programme. Based on the expenditure incurred on the programme, the study reported a cost/benefit ratio ranging from 1:8 to 1:11 depending on the level of savings.

Discussion

The two studies described above tend to confirm the applicability of a behavioural approach to safety. The studies have a number of similarities and two major differences. Some of the similarities are that both were conducted in selected departments or portions of a plant and did not cover the entire unit; both used multiple baseline designs; both were conducted in plants which had quite high rates of accidents; and both used similar intervention packages consisting of training, goal setting, and feedback. The major differences are that they were carried out in organizations engaged in different types of activity: bakery and machinery manufacture, and that Study 2 used statistical techniques to analyse the data and confirm its results.

The fact that both the studies were conducted in plants with high rates of accidents and even within those plants, were confined to selected departments with the highest prevailing accidents rates can have various implications. One interpretation can be that accidents rates in these plants and departments would have gone down even if a conventional--technological and engineering based--safety programme had been started, just because the existing rates were high. Such an interpretation is valid and it may well have been the case. However, it does not reduce the importance of the fact that behavioural approach <u>was</u> applied in these cases and was found to be effective in reducing accidents and enhancing safety. In addition, similar results, confirming the efficacy of the behavioural approach to enhance safety, have also been reported in a study conducted in an organization which had a fairly standard and conventional safety programme in operation.[24] This study had some other important differences when compared to the two studies described earlier. This study was not confined to selected departments with high accident rates but covered all the employees of a metal fabrication plant. In addition, it used a withdrawal type of design which is considered superior to the multiple baseline design.[25] In the results of this study, the dependent variable, safe behaviour (percent) defined as "the percentage of employees performing their job in a completely safe manner", increased from an average of 64.93 percent during baseline to 96.63 percent after the introduction of the interventions package. This study also makes two additional points, one concerning compliance with safety rules and the other concerning safety measurement and evaluation. The behavioural approach appears to be useful in encouraging compliance with safety rules as an alternative to punitive measures. It does so by focussing on the positive by measuring how frequently are safe behaviours performed. It can, thus, be used to enhance safety actively because safe behaviours are more frequent than unsafe behaviours. The conventional approaches focus on accidents and unsafe behaviours which, usually, are infrequent occurrences. In the area of measurement and evaluation, a "behaviourally based, positive measure of safety" is recommended which is "useful for measuring and enhancing the presence of safety while other, after-the-fact measures based on accident/incident rates measure only the absence of safety."[26] Another advantage is that the designs used permit an assessment whether a safety programme is having its desired effects or not. It is, thus, possible to establish reasonably reliable cause-effect relationships thereby overcoming one of the major limitations of social and behavioural sciences.

It follows from the results described above that training and encouraging workers to behave safely would be useful in enhancing safety even when conventional, technological and engineering oriented safety programmes are in effect and accident rates are not very high. The logical explanation for this is that safe and unsafe behaviours can be considered to be mutually exclusive. It, therefore, follows that an increase in safe behaviour, however it is achieved, will result in a consequential and corresponding decrease in unsafe behaviour. This would, in turn, lead to a decrease in or prevention of accidents and enhancement of safety.

However, it needs to be stressed that the purpose of highlighting the efficacy of the behavioural approach is <u>not</u> to undermine the importance of the technological and engineering approaches to safety. While it may be said that however safe the environment may be, so long as a worker behaves in an unsafe manner, accidents will continue to occur; it also holds, perhaps equally, that however safely one may behave, it may be impossible to avoid accidents in an unsafe and hazardous working environment. It has already been suggested that "the behavioural approach should be considered complementary to the conventional approach."[27] Practically, the most useful course of action would, obviously, be a combination of the two approaches.

Summary and Conclusions

The most common and popular approaches to safety have generally been technologically and engineering oriented. The viability of social and behavioural sciences based approaches has been doubted on the basis that these sciences are not developed enough to provide reliable predictions and hence have restricted applicability. Recent research indicates that it is possible to develop an effective approach to occupational safety based on the behavioural sciences. The practical applicability of such a behavioural approach to safety is demonstrated by some rigourous and well controlled studies which have used this approach to reduce accidents and enhance safety in existing organizations. The approach essentially consists of three basis elements: identification and pinpointing of specific behaviours which represent the safe way of performing various tasks in a given work situation; training workers in these specific behaviours leading to their being able to do their jobs in a safe manner; and motivating and reinforcing workers to continue to behave safely by providing them feedback based on periodic observation and monitoring of their actual behaviour at work. There are also a number of other advantage in using the behavioural approach such as compliance with safety rules and reliable evaluation of the efficacy of safety programmes. The behavioural approach is, however, not a substitute for the engineering and technologically based approaches. An appropriate combination of various approaches would be the most effective strategy to achieve the best results by way of reduction of accidents and enhancement of safety.

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Notes

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[3] Ibid.

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[23] The incidence rates are calculated according to the following formula standardised and adopted by the National Safety Council, U.S.A.

$$\text{Incidence Rate} = \frac{\text{Number of cases} \times 200{,}000}{\text{Employee Hours}}$$

200,000 = base for 100 full-time equivalent workers (working 40 hours per week, 50 weeks per year).

[24] Chhokar and Wallin, op. cit.

[25] Hersen and Barlow, op. cit.

[26] Chhokar and Wallin, op. cit., p. 150

[27] Chhokar and Wallin, op. cit., p. 149.