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Human Factors in Industry ..... *Leonard Ring* 3

Safety Is People, People— ..... *William A. Cole* 5

Hey, Buddy—Watch Out for Me! ..... *J. P. Sagester* 10

Officers of the Automotive, Tooling, Metalworking and Associated Industries Section, 1977-78 12

Officers of the Power Press & Forging Section, 1977-78 14

Other Volumes/Order Blank for 1977 NSC Transactions ..... Back Cover

also in vol. 4. 78 1928

HUMAN FACTORS IN INDUSTRY

By LEONARD RING
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Auckland, New Zealand

As technology advances it has tended to outstrip our appreciation of human needs in working situations, and lack of such knowledge has led to the design of machinery ill-fitted to human operation. Unsuitable working conditions hamper production and are a cause of dissatisfaction among those who have to work in them.

Poor work conditions in terms of stress and classification lead to costly errors of judgment, which in turn can lead to accidents (or, more correctly, injuries) to themselves or to others, damage to plant, and spoiled material, all of which will affect production. Another direct consequence is absenteeism and increased labor turnover, which are an added unnecessary waste of human resources.

Human factors, or ergonomics, is the study of the relationship between man and his occupation, his equipment, and his environment and applying the knowledge of anatomy-physiology and psychology to the problems that arise from these areas. Its aim is the minimizing of unsafe, unnecessary, and unproductive effort so that a more efficient and worthy use can be made of the human capacities.

Enough historical evidence exists that man's limitations have typically received little attention during the design of equipment for his use. Managers have commonly adapted the man to fit the machine by instructions or training or motivating him to avoid its hazard. What is far more effective is to design the hazard out of the machine in the first place. Numerous studies have shown how minor changes in equipment design produce significant improvements in performance.

Anyone wishing to buy a machine will automatically turn to the engineering sciences for information on function, structure, tolerances, etc., but for the men and women who will work these machines, it is the normal practice to rely on common sense, but human beings have equal limitations and capacities.

There is nothing new about human factors or ergonomics; ever since man began using tools he has attempted to modify his environment to meet his needs—the development of protective clothing arose from man's own functional necessity in the workplace. The design of craftsman's tools like the scythe is another example. However, what is new is the research that has given us definitive data on man's capacities and limitations.

Most of the impetus for ergonomics occurred during the war, when speed and sophistication of equipment reached proportions that severely limited the functional capacity of its operations. For instance, in the early years of the Second World War, more pilots were killed in training than in combat, and in the U.S., while casualty figures in the combat zones ran at 25,000 per month, casualties in the factories rose to 106,000 per month. Thus, it became essential to bring together groups of specialists, those who knew about human capacities and those who knew about machines. Anatomists, physiologists, and psychologists worked together with engineers to make man plus machine an efficient fighting weapon.

The success of this led to its application after the war to industry; but its influence on job satisfaction, accidents, absenteeism, and labor turnover has only recently been appreciated. Its potential for reducing the stress and wasted effort that invariably leads to downgrading incidents and physical injury makes it a very important tool of loss control which

everybody interested in accident prevention should be aware of.

Its elements are:

Anatomy—The relationship of muscles and joints to the task.

Anthropometry—The measurement and proportions of the body applied to the workplace: chairs, workbenches, space, etc.

Physiology—The response of work to body function, space, rest pauses, heart rate, etc.

Psychology—Vigilance, inspection, aging memory, training. Selection.

The visual environment—visual acuity, glare, good lighting, etc.

The thermal environment—optimum comfort temperatures. Measurement of environment. Air temperature. Air movement. Humidity, etc.

The auditory environment—noise and its measurement. The effects of noise and its control. Vibration.

What is attempted in this address is to break away from the simplistic "unsafe acts" or "unsafe conditions" causology of accidents and to show that there is a complex act of inherent, interwoven conditions related not only to a worker's physical or mental make-up but also to the environment in which he works.

78 1829

SAFETY IS PEOPLE, PEOPLE, PEOPLE, PEOPLE

By WILLIAM A. COLE
General Sup't.-Manufacturing, Delco Moraine Div.,
General Motors Corp., Dayton, OH

We at Delco Moraine are the brake systems people, and our division dates back to 1923. Located in Dayton, Ohio, Delco Moraine has two real estate locations approximately seven miles apart. One is located on the south side of the city on Wisconsin Boulevard and the other is located on the north side of the city on Needmore Road. Each houses three individual plants. Between them, they cover almost 2¼ million square feet. We are a division of the mechanical components group of General Motors and currently employ 5,625 people.

At Delco Moraine we have total brake system responsibility for the entire corporation. In addition, we produce engine bearings, friction materials for automatic transmissions, and powdered metal parts for the automotive and appliance industries.

Some of the major processes employed at Delco Moraine to produce these components include machining of gray and nodular iron castings; metal stamping presses up to 4600 ton capacity; continuous casting and cladding of babbitt and aluminum overlays on steel strip; painting, plating, and phosphating for corrosion protection; blending, curing, and bonding of friction materials for brake linings, transmission plates and bands; blending, briquetting and sintering of metal powders; and manual and automatic assembly of components into brake wheel cylinders, master cylinders, brake power boosters, rear drum brakes, and front disc brakes.

Now that you know "who" we are, let's get down to safety. I am not trying to sell a total program which has reached its ultimate at Delco Moraine. We're not there yet, by a long way. I would also point out that the exact program which we have employed at Delco Moraine may very well be ineffective in your own environment.

The program I will be discussing originated in Plant 3. Plant 3 is one of six manufacturing plants at Delco Moraine, and it was directed by myself for 5½ years. Many of the Plant 3 program basics have been incorporated into a division-wide accident program called "Action Against Accidents." Obviously, we feel that we have effective, enthusiastic programs at Delco Moraine committed to the *people*. In fact, the most important key in our program is people, people, people, people.

In this presentation I am going to discuss the background and the history of the divisional program and its beginning in Plant 3, what we did several years ago in its establishment, and what we are doing now so that you can get an idea of the base lines.

In 1969 we had no program, in fact no safety, in Plant 3. Our performance was not poor; however, we were doing next to nothing and riding on luck. When I attended the central safety meetings at staff level, I received a flat zero to help me in any dedication toward safety.

In 1970 we began to review the program, or the possibility of establishing a program, for Plant 3. Late in 1970 the corporation safety director visited Delco Moraine, and I suppose this was the spark that ignited my commitment to safety. He gave me a coin which said, "If it's to be, it's up to me," and that surely dumped the load of responsibility on my shoulders. I reviewed the seven principles of safety as outlined by the corporation. We established some guidelines for our

program:

1. It is to create an atmosphere surrounding the hourly rate man that makes him become aware of safety. The atmosphere I'm speaking of is a thorough, genuine feeling. The intangible feeling that exists in a stadium where great sports have been played, or a museum where great art is displayed, or a monument where great statues of great people are displayed. I want that "kind" of intangible feeling to radiate in our plant. 'We aim at the employee's mind, while most accidents involve hands.'

2. To have no one in our plant experience an accident. Why should anyone need to go through the pain of an accident? Elemental guidelines included, the superintendent must attend monthly inspections; we must prove to people we care, we must prove to ourselves that the foremen really give five minute safety talks. We must get to people a message. The foremen must be convinced that accident prevention is desirable and attainable and that there are benefits from safe operations and an orderly house.

We established a sub-committee because we felt plant superintendent meetings were large enough to be effective, but a sub-committee would be small enough to be active. This sub-committee consisted of the superintendent, safety engineer, manufacturing general foremen, and inspection general foremen. Inspection is a key in our operation, always a part of our team. Like a past issue of the *Ohio Monitor* says, "Organize, develop a plan, establish control measures, sell your product."

We took a poll of ideas from foremen, reviewed 37 good ideas, reduced these to 12 possible ideas (practical enough to be used). We polled the foremen again for reaction to the 12, and adopted 6.

Out of this committee came our unsafe acts cards, refurbishing of eye glass stations, and the beginning of our handouts. Unfortunately, I sometimes felt this was the only thing that got visibility to the other managers. When newcomer managers came into our plant the only thing they saw at first was the evidence of gimmicks, prizes, hats, horns, streamers—like a three ring circus. After they got into the guts of our program they saw the seriousness and professionalism. I suggest you ask any of them what they think of our objectives and program today.

We went to the floor and reviewed all equipment and conditions with all jobsetters and hourly rates. We involved supervision and employees; we solicited ideas, itemized over 150, and corrected every one. We got hourly rates assembled into small meetings with myself and the general foremen, showed them a film, and let them rap with us about their suggestions concerning safety. These suggestions were followed through, and we did begin to do our homework.

The positive results from this program resulted in an extension of the original concept of soliciting safety problems from our people. Today we periodically hand out these safety problem report cards to our people soliciting any safety problems which they can offer to us for consideration. The cards are available in the department and are dropped in the employees' safety problem box. They are then collected by supervision, posted publicly in the department, and remain there until corrected. This involvement of the people has given us positive results. Of course, we encourage our employees to utilize the suggestion program for their safety ideas. They have done a good job pointing out legitimate safety problems, which is reflected by an adoption rate of over 50 per cent.

The detailed program is outlined as follows:

1. *Five Minute Safety Talks.* Gimmicks were used in handouts and pamphlets (this is explicitly covered in item 6 of Seven Principles of G.M. Safety). Eleventh fingers, barbecue mitts, road flares, etc., for thought starters to insure we definitely contact each man every month. This is targeted to the people; the handout item is to be safety oriented, with an appropriate safety slogan.

2. *The Home.* We send pamphlets into the homes of our employees; these are special pamphlets selected by the foremen. This targets to the people in the homes.

3. *Occupational Injuries.* We set up a "close the loop" system. We make sure that every visit made by the hourly rate to the medical department is reviewed by the foremen with the hourly rate. Information is generated and followed up through the ranks, including the superintendent's office. This lets the people know we care.

In a recent superintendent's meeting review of occupational injuries, the foremen noted three incidents involving worn out Allen wrenches. We discussed it, and one of our newcomers said, "We just don't have time to review Allen wrenches and/or hex heads." Would we find time to assist the man to medical when he slipped and ran his hand into a cutter and cut off his entire hand? We left that meeting and the general foreman and foremen immediately reviewed all jobsetter tool boxes. It made me feel good to see them actually doing this on the floor. They were pretty dirty when they finished, but we felt safer.

4. *Personal Contact Follow-up.* Three times a year we review all equipment. We solicit ideas for improvement from the people (supervisors and employees.) The mechanics of completing this require the supervisors to do a lot of homework because this really convinces the hourly rate that we do care. All suggested unsafe conditions must have been corrected before we start a showing of a film or have a general rap session with the people. All shifts are involved. All shifts are contacted. This is total people involvement.

5. *Bulletin Boards.* Bulletin boards were established and the foremen were given the responsibility to give messages every month. Some of these were unique, and we again aim at the people to consistently create the atmosphere for freshness in approach. The bulletin boards are changed from year to year. They are radically changed in structure, design, and color. This adds variety to the program. Posted statistics include eye glass audits, noted accidents, action against accidents results.

One of the keys to the success of our bulletin boards and safety displays is the involvement of our hourly rates in them.

6. *Eye Glass Program.* We audit our plant on a monthly basis for compliance with wearing safety glasses by hourly rates. In the beginning of our program we displayed a beautiful plaque in each department that showed 100 per cent compliance on all three shifts. We have since replaced this with posting statistics on the bulletin board. Variety again: Avoid a stereotyped program.

7. *Safety Inspection Tours.* Safety inspections are absolutely necessary, and I have never missed a tour in my history as superintendent. I believe it is imperative that the superintendent attend this tour and that the employees see this management support. The total psychological visibility is an absolute must. We have formal and informal inspections; both are effective.

8. *Safety Committee.* The subcommittee was established with the idea in mind that the meeting be small enough to be active. The superintendent's meetings are large enough to be effective, but a sub-committee must be extremely active. It generates freshness, ideas, and assigns for foremen the total involvement in the program. A program must be timely and pertinent and have a planned theme.

We review monthly all open work orders. Safety inspection tour completions involving work orders, environmental inquires, new equipment tag procedures and status, and general outlining of our program consistently 6 to 12 months in advance. We keep updating and improving our program to eliminate ineffective measures, adopt new methods, make our best better.

9. *Superintendent Safety Meetings.* This meeting is the superintendent's meeting. He uses the information from a divisional safety meeting for all the use he can get out of it. I feel it's his respon-

sibility to chair this meeting. The foremen, however, have specific assignments, and a definite foreman each month gets up during the meeting and presents information concerning audits of safety glasses, five minute safety talks, action against accidents results, unplanned safety contacts, occupational injuries. He also reviews pamphlet synopses and upcoming handouts including gimmicks, eleventh fingers, and job instruction sheets to be used as tools for the foremen. Out of this meeting we have recently assigned separate quarterly foremen groups with specific assignments surrounding housekeeping and refurbishing of all signs, eye glass stations, and safety oriented items.

10. *Job Instructions and Transfers.* On a quarterly basis we reinstruct each employee and validate the fact that he has been reinstructed. This is accomplished by having the employee and the foreman sign one copy to be returned to the superintendent's office, while the other copy belongs to the employee. This is a perpetual program and an absolute must. All new hires are instructed, and transfers into our departments are automatically instructed. So what does this all do? Does it get any results? I say, yes.

At Delco Moraine we measure our safety program results in many ways. The most comprehensive and results-oriented measurement is our "total injury index." This is determined by dividing the number of man hours worked by the number of occupational injuries/illnesses reported to medical. An individual safety index is determined for each foreman and for each manager at the levels above him.

When we introduced our Action Against Accidents program in 1973, our divisional injury index was 1940. Simply stated, we were having an occupational injury or illness for every 1940 hours worked. We have obtained positive results from our Action Against Accidents program: in the 1977 model year just concluded the divisional safety index was 3356—a dramatic 73 per cent improvement since 1973.

The safety index has become important to every line organization manager at Delco Moraine because it quantitatively reflects his own accident prevention results. Beyond the value for use in personal appraisals and evaluation of higher accident areas, the safety index has become a positive motivator for our supervision. This is probably best exemplified by the Green Jacket awards. Foremen and general foremen receive special recognition in the general manager's staff meeting for their outstanding safety performance.

The foreman is awarded a green blazer with the "Safety is People" emblem; his general foreman receives a very nice green windbreaker on behalf of his foreman's performance. Positive reinforcement is every bit as important as negative reinforcement if you hope to sustain a good safety program.

Obviously, results are the most important objective, and measurable systems surely provide incentive. We're not perfect. That's our goal, but we're not perfect.

Our first accident, after a perfect record of 11½ months, happened just a few days after our general manager gave praise to the safety program. We almost rushed down to cut off a finger! It wasn't fate; we cut it off. We didn't react soon enough to a previously observed unsafe act. After thorough investigation, we did not redesign or change our program through overreacting. A recently retired works manager for Delco Products said their program's objective is "to keep our employees free of serious injury." A recent issue of the *Ohio Monitor* says the objective should be a human factor—conservation of human life. My objective is "to have no one in our plant experience an accident." All three of these objectives say the same, identical thing. They say the program must eliminate the need for people to experience an accident.

The aforementioned works manager from Delco products used words such as: show employees that "we care," "real concern," "people," providing "tools" for our managers, "involvement," "cause it." "Make it happen." "Wanted something bad enough to get it."

And finally, it's work! Believe me, it's work! I wanted this bad enough to get it. After several years of solid hard work, I now see this entire program adopted throughout all of Delco Moraine and the accompanying results to show its effectiveness.

It's a habit; it happens; it's self-generating. Do we desire safety enough to put forth the extra effort that makes the difference between success and failure? Is the desire of management strong enough to convert the thought into positive action?

The managers are committed to a safety environment and atmosphere through the entire plant, and we feel this makes the hourly rate subconciously concerned about safety at all times. The penetration of this safety style is in Delco Moraine's "action against accidents" profile. Constantly, we work on the head of the employee (input) to protect his hands (output).

78 1930

HEY, BUDDY — WATCH OUT FOR ME!

By J. P. SAGESTER
Safety Mgr., Ohio Bell Telephone Co., Columbus, OH

Ohio Bell, with some 25,000 personnel, is one of the 21 associated companies of the Bell System. Most of you can probably relate a telephone company to an operator, or maybe an installer. However, within Ohio Bell we have linemen, repairmen, engineers, motor vehicle mechanics, dock workers, secretaries, executives, and on and on.

These personnel work in the skyscrapers of large cities to the coal mines of southeastern Ohio. They operate vehicles on major expressways to the right-of-ways in farmer's fields. They may be supervised directly, or then again they may go several days before they see their supervisor.

In addition to the personnel, we have more than 6,600 motor vehicles, which is the largest commercial fleet in the State of Ohio. These vehicles are passenger cars, line trucks, semis, and many special types.

Therefore, it is imperative that a company such as ours have an effective and continuing accident prevention program. During the past four years we have seen a regular 20 per cent annual decrease in on-the-job personal injuries and a like percentage of decrease in preventable motor vehicle accidents.

As you can well imagine, though, we have all types of accidents—a gal changing stalls in a restroom with her pants down, tripping and breaking her elbow; a lineman defecating in the words contacting poison ivy on the buttocks; employees being bit by large and small dogs; and we even had an employee attacked by a cock rooster. Of course, those are some of the more unusual cases which are sometimes very unexpected and hard to control. But the majority can be controlled through a continuing awareness program where the employee controls his behavior or habits.

The Ohio Bell Safety program has three basic ingredients: a corporate commitment, an accident prevention plan, and a buddy system.

First, let me speak of the importance of a corporate commitment. Each November, Ohio Bell establishes a commitment for the coming year: a certain percentage of reduction of personal injuries and preventable motor vehicle accidents. This commitment is then carried down through the lines of organization, with each department establishing their own commitment for accident reduction. Naturally, the commitment is different for a clerical department than for a construction or installation department. The latter has much more exposure to hazards.

There are a few important things about commitments. They must be realistic. They will reflect improvement. And with a little extra effort, they are attainable. The importance of safety commitments is not overlooked when it comes time for management's salary increases. Equal importance is placed on safety as it is for production, quality, sales, service, etc. With this type of higher level management view, there is little doubt of the importance placed on safety at Ohio Bell.

Next comes the Bell System accident prevention plan. The plan is designed for use in all departments. It has four objectives: (1) to provide a simple but effective approach for decreasing accident causes and their resultant injuries in the Bell System; (2) to provide a means for every employee, both management and non-management, to become personally involved in accident prevention; (3) to provide a means for ensuring that Bell System employees perform their work in accordance with prescribed safe work procedures, so as to fully comply with OSHA; (4) to provide a means for documenting on-the-job safety training given to each employee.

There are five basic parts to the plan:

1. The Safety Knowledge Review. This is an on-the-job safety training session between the supervisor and the employee covering those safety practices that pertain to the tasks or work procedures which the employee may be called upon to perform.

2. The Work Observation. This is an evaluation of an employee's on-the-job safety performance. For the evaluation to truly reflect the employee's actual day-to-day performance, the work observation must be performed in such a manner that the evaluated employee does not alter his or her normal performance merely for the sake of the evaluation.

3. The Environmental Inspection. This is a detailed checking for hazardous defects or conditions at any given location that could cause or contribute to an accident.

4. The Tool Inspection. A tool inspection is a detailed checking of one or more tools for hazardous defects or conditions that could cause or contribute to an accident.

5. The Motor Vehicle Inspection. Like the tool inspection, it is a thorough review of a vehicle for anything that could cause or contribute to an accident.

We have reviewed the first two ingredients which have proven effective in accident reduction at Ohio Bell. The third, and one of our most important, is our "buddy system." I mentioned in the beginning that Ohio Bell was comprised of some 25,00 personnel, and what company of that size would not be happy to have 25,000 safety personnel? This is what "Hey, Buddy—watch out for me!" is all about.

That makes up the basic Ohio Bell Safety Program tied to our 40-year-old Bell System creed which states that: "No job is so important, and no service is so urgent, that we cannot take the time to perform our work safely."

The injury, suffering, and heartache connected with accidents is decreasing at Ohio Bell.

78 1931
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National Safety Council

A Membership Organization Dedicated to Protecting Life and Promoting Health

March 21, 2001

Baron & Budd, P.C.
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To Whom It May Concern:

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Respectfully,

Robert J. Marecek

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