ERGO-DESIGN, AN USER CENTERED CONTEXT BASED APPROPRIATE TECHNOLOGY TO BE ADOPTED IN INDIA FOR BETTER TOOL DEVELOPMENT

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Abstract

Out of total labor force of 516.4 million (51,64,00,000) which is about 45% of total Indian population (1,147,995,904 July 2008 est.), agricultural workers are constituting about 60% (30,98,40,000). Most of them are still in use of primitive tools causing less productivity and immense drudgery while working in the field. Several reasons are observed behind this situation. The major factors are 1)Non availability of ergonomics based user centered designed tools or implements, 2) Lack of Ergo-design awareness among the manufacturers and designers, 3) Appropriateness of the tool according to the work environment, 4) Lack of awareness among the users on demanding better quality tools and their usage, 5) Economic limitations. It was further observed that while the use of modern machineries has been brought in to the cultivation system, the less return from the field has forced the male agricultural workers to look for alternative jobs in the cities. This leaves the young females in the villages for cultivation. Sooner or later this phenomenon is going to demand sex related changes in the agricultural machinery or tools especially in case of tractors. Although officially there are eight major products, rice, wheat, oilseed, cotton, jute, tea, sugarcane, potatoes, cattle, water buffalo, sheep, goats, poultry, and fish, as listed in the official website of the Govt. of India, there are drastic regional variations in the agricultural crops. For example rubber plantation is one of the major crops in Kerala which requires a special skill and tools to extract the sap from the tree. Similarly coconut cultivation also requires a special skill for removing coconuts from the tree and further processing of the coconut and the shell. Contribution by the scientists from the agriculture related engineering institutes at different parts of the country, especially under the Indian Council of Agricultural Research program, is commendable. The new generation researchers have brought in a new way of thinking in problem solving. It has been observed that while these new generation tools are of engineering excellence, there is a severe shortfall in the ergo-design component especially in development of user centered appropriate design. This paper deals with examples on how an integrated approach between the ergonomists, product designers and agricultural engineers will complement each other to develop a user centered product for maximum safety and productivity with less human cost. The paper also recommends introduction of user centered appropriate design approach at different level of academic curriculum along with conduction of workshops/seminars on “Ergo-design” to bring awareness among the common mass whether at home, in industry or in agriculture.

Keywords: ergo-design, users, tool development

DESIGNING PRODUCTS AND WORK-STATIONS FOR INDIAN ARMED FORCES: ERGONOMIC ISSUES

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In this digitalized era, any successful work-station or product design not only concentrates on aesthetics, but also emphasizes on various human factors issues. To enhance product life cycle and market value, designers generally consider usability of the product (domestic/ household/ industry/ military), targeted user population, and anthropometric and strength capability for the perfect fit. Various technical aspects like - shape and size, texture, colour, material, cost etc. are also taken into account.

In case of design for defence purposes, the basic criteria remain the same but few additional ergonomic issues are needed to be considered. Defence system design is influenced by strategy and operational requirement, budget, the user group (army/ navy/ air force) etc. Design which is durable, usable by all and in all climate conditions, movable to all terrains and use less no. of adjustable feature is mostly preferred by defence.

In a multiethnic country like India, designing of military product/ work-station is much more complex. Indian soldiers vary widely in their body shape and sizes, and other anthropometric characteristics. For instance, the difference in height between shortest and tallest army soldier is about 27.0 cm. In case of Indian Air Force this difference in height for the specific pilot population is more than 17.5 cm. This difference makes the task of a designer more difficult to design a universal cockpit for comfortable use of entire pilot population. Variations in physiological criteria of different ethnic groups such as muscular strength, physical capacity etc. further increases the difficulties in standardizing the design criteria for any product and work station need to be designed for entire Indian army personnel. Role of environmental extremes further influences the design principles.

Due to advancement of more knowledge in man- machine interface, use of sophisticated arms, ammunition and workstations manufactured in western countries and the nature of user-friendliness of these systems, the users of Indian army has become more concerned about the man-machine fit of the design of indigenously built military products.Moreover global competition, sophisticated combat technology, increased terrorism and insurgency, stringent military strategy and safety standard, prompted Indian defence to incorporate ergonomic issues in their design. Due to large variation in anthropometric and physiological criteria of Indian armed forces personnel multi-user trial is necessary for designing and evaluating a product. This is time consuming, proves costly, error and accident prone, hence not possible in all practical situations. Alternatively, this problem can be overcome by the application of virtual verification process of computer aided designing and simulation. This leads to reduction in cost and time for evaluation, improved quality, easy multiple trials, enhanced safety, and ultimately optimized man-machine compatibility. Ergonomic issues in the designing for Indian armed forces can be better addressed with digital human modelling and simulation approach.

Keywords: Ergonomics, design, products, work station, Indian armed forces

MULTIDISCIPLINARY APPROACHES TO REDUCE FALLS ON THE SAME LEVEL

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Abstract

The direct cost of occupational injuries due to slips, trips and falls in the USA was estimated to exceed 6 billion US dollars annually. In total direct workers' compensation for occupational injuries due to slips and falls, falls on the same level accounted for 53% of claim costs and 65% of claim cases.

In this talk, an overview of critical issues involved in falls on the same level will be discussed. Multidisciplinary approaches undertaken at Liberty Mutual Research Institute for Safety over the years will be discussed. These approaches covered the disciplines of biomechanics, tribology, statistics, psychology and epidemiology. Major findings of these projects and their implications on incident reduction will be discussed. Future directions for research will be outlined.

Keywords: occupational injuries, incident, direct cost, workers' compensation

FARM MACHINERY ACCIDENTS IN INDIAN AGRICULTURE

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Abstract

To meet the growing demand of food for our country's 1.1 billion population, it is necessary to produce more from the same area of land i.e. 142 million hectares. The workforce engaged in agriculture is reducing as a large number of people are migrating from villages to towns and cities for jobs in industry/service sector.

Therefore, for carrying out various farm operations, more and more tractors and farm machines are being used. Many times, due to poor design for machines or faulty procedure or operation or lack of safety awareness, a number of accidents happen causing injuries to workers which may be non-fatal or fatal in nature. For planning out any farm safety programme, it is necessary to have reliable data on farm machinery accidents and therefore a survey was carried out during the period 2004-07 in seven states namely Tamil Nadu, Orissa, Madhya Pradesh, Punjab, Rajasthan, Arunachal Pradesh and West Bengal. These data indicated that of the total accident in agriculture about 30.5 % of the accidents were due to farm machines, 34.0 % are due to hand tools and 35.5 % are due to other sources like snakebites, fall in well, environmental causes, etc. In the farm machinery category the highest number of accidents were due to tractors and tractor operated implement (30.9 %) followed by animal drawn equipment (22.4 %), threshers (14.4 %), electric motor/pump set (11.9 %), chaff cutters (7.9 %), power tillers (5.5 %) and sprayers (4.3 %). Of the total farm machinery accidents, 5.6 % accidents were fatal in nature whereas the remaining 94.4 % were non-fatal. These data are being used to prepare package of farm safety measures to be recommended for large scale adoption in various states.

The package of farm safety measures includes engineering interventions, enforcement measures and educational aspects. It is expected that wider promotion of these measures through State Departments of Agriculture can help a lot to minimize these farm machinery accidents.

Keywords: Agriculture accidents, Farm machinery accidents, Agricultural injuries, Farm ijuries, Agricultural accident survey.

DEVELOPING MORE EFFECTIVE WORKPLACE STRATEGIES FOR MANAGING MUSCULOSKELETAL INJURY RISK

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Abstract

Throughout the world, work-related musculoskeletal injuries and disorders present a major problem. In countries with well developed occupational health and safety legislation and regulatory systems, where such injuries are more likely to be documented, they usually constitute the largest single OSH problem. In less regulated regions their *recorded* incidence is not high, but their *actual* incidence is likely to be at least as high – probably higher.

Strategies to control this risk typically focus on workstation and workplace design, since these are key determinants of the biomechanical loads that people experience during the performance of specific work tasks. For both government regulatory authorities and workplace managers, it is relatively easy to identify such hazards since they are often observable during walk-through inspections. The training of workers in “safe” manual handling techniques to minimise biomechanical loads is another very popular strategy, despite strong evidence that it is ineffective.

Of course, such hazards are potentially important and it is essential that they be controlled. However, there is now increasing evidence that workplace risk management strategies which focus mainly or entirely on how people perform specific tasks may be ineffective. This evidence is uncomfortable for ergonomists, because we are typically seen as ‘the experts’ in workstation design and manual handling, and many ergonomics analysis methods focus very specifically on documenting and evaluating the physically hazardous aspects of performing specified tasks. Is the application of such methods as part of a workplace risk management procedure likely to be a waste of time? To answer this question, some results from ergonomics task analyses in four large workplaces representing two industry sectors with a high risk of musculoskeletal injuries will be presented in relation to data about other workplace hazards in these workplaces. The data were analysed to identify the most important predictors of (a) workers’ physical discomfort or pain, and (b) the probability of them taking time off work due to their pain.

Finally, current work to develop one or more ‘toolkits’ for use in managing workplace MSI risk will be outlined. This work takes account of the evidence presented above and represents a broad, ‘macro-ergonomics’ approach to risk management. It is being conducted under the auspices of the International Ergonomics Association Musculoskeletal Disorders Technical Committee, in collaboration with the World Health Organisation network of Collaborating Centres in Occupational Health.

Keywords: workplace strategies, management, musculoskeletal injury risk

FUTURE OF ERGONOMICS IN INDIA

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Abstract

After defining ergonomics and the benefits of its application or intervention in industry and business, the development of ergonomics in India is traced in the context of the present status of ergonomics in India. The future of ergonomics is discussed under: education and certification, research, and application or intervention.

Ergonomics education should give special focus on physical ergonomics, work physiology, work science and engineering and industrial/occupational applications. A due process of certification in ergonomics is necessary in the future to give recognition to qualified and experienced personnel and to protect the profession from unqualified personnel practicing ergonomics. Both basic and applied ergonomics research should be pursued. Due emphasis should be given to ergonomic design of products, equipment and tools, manual materials handling, workplace design and work environment.

Ergonomics intervention ought to give focus on quantitative/measurement based rather than on qualitative/questionnaire based solution with strong and meaningful ergonomics content. With the emerging economy, the future of ergonomics in India is indeed promising and bright.

Keywords: ergonomic, work physiology, intervention

THE DESIGN AND USE OF ERGONOMIC CHECKPOINTS FOR EVERYONE

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Abstract

Aim: Ergonomic checkpoints are increasingly used by local people in improving various work settings. It is important to know effective types of ergonomic checkpoints applicable by everyone in each situation.

Methods: The design process and use of various ergonomic checkpoints are reviewed. Examples included the IEA/ILO Ergonomic Checkpoints (1996), ISO/TS 20646 about muscle load and manuals for participatory training in small enterprises and agriculture. Emphasis is placed on locally adjusted process of designing and using these checkpoints.

Results: The reviewed checkpoints commonly present how to improve materials handling, work postures and operations at workstations, physical environment and work organization. A clear focus is placed on low-cost options reflecting basic principles of ergonomics and occupational hygiene. The design process always includes (a) collecting local good practices, (b) compiling low-cost options having real impact and (c) presenting practicable options in the action form. The checkpoints are used in combination with an action checklist listing typical options. Interestingly, this design process corresponds to the participatory steps for using the checkpoints-cum-checklist toolkit. Its use can lead to many improvements when the steps comprise (a) learning local good practices, (b) focusing on low-cost options and (c) consensus building on feasible improvements. Numerous workplace improvements have been achieved by participatory steps using a toolkit adjusted to each local situation.

Conclusions: For facilitating participatory training in improving working and living conditions, the action-oriented design and use of ergonomic checkpoints combined with an action checklist is recommended. Training using locally adjusted checkpoints is useful in varied work settings.

Keywords: Ergonomic checkpoints, workplace improvements, action checklist, small enterprises, agriculture

DESIGN ERGONOMICS REFERENCE TO PLEASURE AND TRUSTWORTHINESS

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Abstract

Perception of design is gradually crossing the boundary of achieving functional utility to meet the needs. And it also demands total trustworthiness and pleasure value. It should satisfy a set of human factors, and many of them are utility oriented and pleasure. Functionality and reliability are the aspects of useable whereas pleasure is the aesthetic perception, attractiveness, feel good to possess and joy in use; when both are applied in a design it creates trust.

Design acceptance greatly depends on its compatibility with cultural value and aesthetic perception of the user. Both physical and cognitive aspects of users are the prime ingredients that make design specifications. Pleasure is related with creativity link and functional trust goes with understanding of pleasure factors and context specific applications; these have become an integral component of design ergonomics. Indian relevance is now being cited to imbibe these aspects into the mind of design students, who inturn are going to take lead in the creation of products of desire.

This deliberation presents the IIT Guwahati way of dealing the subject matter that not only the students are getting structured input, but also is equally relevant to create general awareness to the people. It cites some common examples from daily life that expresses the basic insights of design ergonomics. This presentation stresses the scope of application of ergonomics principles along with aesthetics perception factors that leads development of user-centred design to see functional beauty in interaction.

Keywords: Design ergonomics, trustworthiness, academic input

ACTION : A TOTAL MEASURE FOR HUMAN ACTIVITIES IN ERGONOMIC PARLANCE

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Abstract

By the common man's notion, 'action' conveys different meanings and perceptions, chiefly to bring a change of state or status that effects some desired result or otherwise to the system in generic sense. Human body engaged in some physical / cognitive activities is concerned here in the ergonomic parlance.

Present facts about 'actions' are as follow:

1. Every action is time bound, from sub-nuclear to astronomical scales. Time is an indispensable dimension of any action.
2. Only action changes the states of any system, its status being ultimately described by the total energy content at that state, and it is the quantum of energy, or quantum of action, that differentiates the levels of the states.
3. Action is a path dependent function, like work done (δw) at the cost of expenditure of heat (δq) in thermodynamic systems. Their difference is the state of change of the internal energy (du) of the system. It is a characteristic property not os a single point, but of the entire path, or trajectory.
4. Principle of minimal action : this is the principle of physics from which the equations of motion of a classical system can be deduced. Introduced by Lagrange in the 19th Century and extended by Hamilton, it states that motion minimizes the value of a certain integral, known as ACTION, which can be calculated from the knowledge of both kinetic and potential energy.

Load lifting and shifting tasks are very common in every spheres of human activities. These performed under difficult postures add to MSDs, particularly with ageing. Path depended lifting tasks were analysed over a considerable period and have been reported time to time. Such studies revealed forces in muscle groups and moments at different joints of different magnitudes that corroborate with other published reports. In addition however, the total cumulative work done in lifting tasks to different heights and by different paths of lift were plotted with time duration of those tasks, indicating clear difference in the work done by different paths corresponding to each height of lift. The areas ubder these curve serve as a measure of 'Actions' in different paths. The path which gives the minimum action is therefore the optimal path. Action can therefore be taken as one of the parameters of investigation in human activities for ergonomic evaluation of the task.

Keywords: human activities in ergonomic, load lifting and shifting tasks

ERGONOMICS IN INDIA – FOCUS AND CHANGE

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Abstract

This paper looks at the different thrust areas of ergonomics in India and how these have evolved and changed over the past five decades, by charting the development of ergonomics research, practice and teaching in these thrust areas across institutions. Analysis of the growth of the Indian Society of Ergonomics and its diversified membership pattern is seen as a reflection of the increased inclusiveness of ergonomics and the resultant surge in interest in ergonomics among a varied group of specialists. One of the major problems in making ergonomics “for everyone” is that of communicating our profession to influencers and the public, which is partly due to variability in knowledge and standards, thus stressing the need for certification of professionals and products. Finally, some future drivers of ergonomics and programmes to expand our horizons are discussed.

Keywords: growth, development, ergonomics, certification, programmes

A STUDY OF THE EFFECT OF EXTENDED WORKING HOURS ON FATIGUE, HEALTH AND WELL BEING

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Abstract

Working time regulations has a long history, starting from 1784. Till 1868, average working hours per week was between sixty to seventy hours. In 1868, U.S Congress passed a law limiting daily working time to eight hours. Subsequently, in 1919 ILO in its Convention 1 mentioned that working hours should not exceed forty eight hours in a week for industrial workers. This was subsequently introduced for commerce and office in ILO convention 30, 1930. In 1935 ILO had proposed to bring down the working hours to forty hours per week through the convention no 47.France in 2000 had further reduced this to thirty five hours a week. India conforms to forty eight hours a week. Studies have been reported that estimated 22.0 percent of global work force work more than forty eight hours a week and there are cases where workers spend more than seventy hours a week (ILO, 2007). Question arises what are the basis for eight hours per day. Initially, it was fixed on the basis of 1/3rd of the total time of the day that can be attributed to working hours. Ergonomists in last two decades and a half tried to find out the effect of longer working hours on health and well being especially after the reports of Karosi in Japan. Studies have been reported that working for extended working hours have direct impact on fatigue, health and well – being. Extended working hours increases risk of cardiovascular disease, hypertension, diabetes and work disability. In India, in recent years, duration of working hours especially for new technology jobs and manufacturing jobs in unorganized sector have gone up substantially. In order to understand the impact of working hours on fatigue, health and well – being a study was taken up in jewellery manufacturing in India. The purpose of selecting this occupation was a) it is in unorganized sector b) workers spend more than seventy hours a week c) work involves six and a half day in a week. Study was carried out in Mumbai on 45 jewellery manufacturing workers. The subjective fatigue level, reaction time, level of body discomforts, back, leg and hand strengths were measured both before and after the work exposure. Results showed that level of fatigue, level of body discomfort and reaction time increased while the strength of back, leg and hand had decreased significantly after the work exposure. The results were compared with age match control group who are exposed to thirty five to forty hours a week. The results showed that there were significant differences between the groups. It can be therefore concluded that longer working hours have an impact on fatigue, health and well being.

Keywords: Working time regulations, extended working hours, fatigue, health and wellbeing,

AN ERGONOMIC APPROACH FOR DESIGNING INDIAN TRADITIONAL VEGETABLE CUTTER ('BONTI')

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Abstract

An Ergonomic Approach for Designing Indian Traditional Vegetable Cutter ('Bonti') Prakash C. Dhara Ergonomics and Sports Physiology Division Department of Human Physiology with Community Health Vidyasagar University, Midnapore – 721 102 West Bengal, India Abstract: In the present investigation efforts have been made to modify the design of traditional vegetable cutter ('Bonti'), which is commonly used in the Indian kitchen, with consideration of human factors.

The study has been conducted on 150 women selected from the municipal areas of West Midnapore District in West Bengal. The problems of traditional vegetable cutter were evaluated by developing a suitable questionnaire. Usually two types of sitting postures, e.g., squatting and sitting on the floor with folded knees, were adopted during using the vegetable cutter. From the comparative assessment of musculoskeletal disorders (MSD) it was noted that the occurrence of pain/ discomfort in different parts of the body was lower when the subjects worked by sitting on the floor with folded knees than that of squatting. The design of the vegetable cutter was modified by considering the postural preference of the users and by changing the blade angle, length, breadth and width of the sitting area according to their anthropometric dimension. The blade angle was optimized by assessing the changes of body joint angles of the users with the change of blade angle as well as by considering the preference scores of the psychophysical analysis. The psychophysical analysis was also made to finalize the other physical dimensions of the vegetable cutter. A broad platform was included in the design to provide comfortable sitting on it. In the final design, the blade angle of 1200 and a broad folded base (platform) were suggested. The modified vegetable cutter was also assessed by joint angle study and subjective evaluation. It has been revealed that the body joint angles (Knee, hip, Shoulder, elbow and wrist joint) remained in more suitable position during cutting in the modified vegetable cutter than that of the existing one.

It has been concluded that the modified vegetable cutter may reduce the discomfort of the users as well as productivity may also be increased.

Keywords: Vegetable cutter, ergonomic design, MSD, Joint angle