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The Role of Physiology in Ergonomics - Empowerment Human Resources for Nations Competitiveness

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Keywords: Ergonomic Intervention, Physiology, Total Ergonomic Approach Model.

Abstract: Competitiveness is being important issue for Indonesia to face globalization. Human resources is one factors that must be developed physically and mentally. The goal is to produce human resources who has competence and can compete in the change and complexity world and finally have competitiveness. Ergonomic approach can be used to develop human resources to think and act comprehensively. Total ergonomic approach and total ergonomic approach model provide some approach to empower the human through several steps of action in implementation of ergonomic intervention. The most important of this process is the human as a subject of ergonomic intervention, because they will use any product from industry and any environment changes during activities. Homestasis of the human must be considered and must be maintain while do ergonomic intervention, monitoring and evaluation. The human systems are references and as parameter for evaluation of any changes in ergonomic intervention that affect to the human. The parameters developed from the systems for objective assessment and prevent the human from injury or disesases. Some parameters that can be used to monitor human body during activities such as heart rate, oxygen uptake, musculoskeletal disorders, energy expenditure, balance of body liquid and others. The use of body systems as parameter showed that physiology is important role in ergonomic intervention because the effect of it is the human who use and interact to working condition such as tools, machines, work stations and environment.

1 INTRODUCTION

Competitiveness is an important issue for Indonesian because being market target for the other countries. Bordeless country as an impact of globalization will permit everyone to go to the other country for job and gain more money. Indonesia people is a big human resources that must have competitiveness to compete other country's workers in Indonesia and win the competition for job. By this condition, everyone in Indonesia should work hard to increase nations competitiveness. On the other hand one factor that have high impact in competitiveness is human resources.

Human resources can be developed physically and mentally to increase productivity and finally to achieve good quality of life. This is the national target of Indonesia that are programmed by Indonesia goverment and must be supported by all Indonesian people. Empowerment of human resources should be done to motivate and to drive them to increase competence in any aspects of job, because without competence the industry would not accept them. There are manys way can be used in order to increase competitiveness of human resources among other is ergonomics.

Ergonomics is focus on human or human-centered. In this case, the workers or human resources is put as an subject. Working condition that has some problem for the human, should be improved. All matter of improvement do for the productivity. But if there is no consideration about human as a standar of improvement and implementation, the new technology in working condition will not solve comprehensively. So, when implemen new technology must consider the human to avoid the emerge of another problem.

The human resources is a human who have many human systems and react together in harmony to any changes of environment as an adaptation process. The adaptation has optimum and maximum capasity and if the stimulus is more than its capacity to adaptation, it will make injury or diseses. Physioloy as normal

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range of human system changes is used as references to monitor maximum capacity of the human otherwise to prevent them from injury. Every system has several parameter as references for the ergonomnist when design and improve or implemen new technology.

2 NATIONS COMPETITIVENESS

Nations competitiveness is the most important and must be increased by all Indonesian. To support this effort, human resources must ready to change toward competitiveness era. That mean, each people should maintain and increasing their competence to think and act comprehensively. This can be achieved if the physical and mental abilities are developed optimally. One factor that will be faced in the future is the expatriate human resources. They will compete and commonly more ready to win the competition in order to get a good job position. For the reason, everyone must prepare their selves with competence.

Indonesian competitiveness based on World Economic Forum, as revealed in *Global Competitiveness Report*2015-2016, that Indonesia level was 37 among 140 countries. In South East Asia, Indonesian position was under Singapore, Malaysia and Thailand.Regarding World Bank analysis on 2014, South East Asia should develop productivity higher accompany with infestation in education and training for the young generation. In this condition, human resources development is needed and a must to increase nations competitiveness. Focus of competitiveness is productivity, that drive everyone must have it and finally can increase quality of life.

Regarding various data presented by various stakeholders, shows that the Indonesian competitiveness still needs to be improved in various areas of life. The role of human resources is affected by several factors such as level of health, education, training and competence. This affects the productivity or people in general which in turn will also improve the quality of life.

3 ERGONOMICS AS A TOOL OF HUMAN RESOURCES EMPOWERMENT

The strength of nations is based on characterized human resources. The must have self-identity and personal being and should be supported by healthy of mental and physic, social and economy. The goal is to increase productivity and quality of life.

Building characteristic of human resources requires integrated approaches. Development is not only done to the physical condition in order to be healthy and fit, but also the mental condition in order to have human values, leadership value and humanities. Manuaba states that the role of HR in various sectors such as product design, marketing, manufacturing, quality management, and organizational change.

Awareness of community to the role of human resources in productivity should be completed with an action such as empowerment of the human resources. The goal of action is to maintain balance between task and human ability in regard to achieve productivity and quality of life. In this case, everyone should understand the ability, weakness and limitation of human resources.

Ergonomics focus on human as a subject not an object. Capacity of human must be considered when were given a task. Working condition and work station must be designed based on human characteristics. This condition showed that human as a center of any application of ergonomics while in the other hand human will get the effect of any acitivities using tools, working station and working condition.

Ergonomics approach is one method to assess working condition based on 3 parts or 8 aspects. The 3 parts are task, organization and environment, while the 8 aspect are including nutrition, work posture, energy expenditure, environment condition, time condition, information condition, socio-culture condition and man-machine interface. Based on the assessment using 8 aspects, working condition were assessed related to human as a subject and any intervention should consider the human who will use any intervention.

Intervention must be design holisticlically and comprehensively to get the improvement that are humane, competitive and sustain. One approach that can be use is total ergonomic approach model (TEAM). TEAM is consist of awareness program and total ergonomic approach. Implementation of TEAM can be done through several steps such as : 1) health and safety work promotion, 2) identification of ergonomic problem, 3) priority of problem solving, 4) change of conceps to postive thinking, 5) strategic planning, 6) action plan and 7) monitoring and evaluation

All the steps should be done to get optimum effect in ergonomic intervention. During awareness program, the workers or people were introduced ergonomic aspect in their life and its effect to he quality of life in the future, if the unergonomcs working condition were done continuously. While analysis the ergonomic problem and its impact should be done using 4 aspect of approach thats are systemically, holistically, interdisciplinary and participatory or SHIP Approach. When choose the best way of intervention, everyone should consider 6 aspect of Appropriate Technology such as technologically sound, holistically sound, economically sound, socio-culture, save energy, preserve the environment. One things that be considered is user friendly. SHIP Approach and Appropriate Technology as a whole ia called Total Ergonomic Approach.

TEAM is introduced to the community based on local contents and local genius of working condition while implemen TEA. The worker were encourage to know, to indentify, to choose and to evaluate the ergonomic aspect using their own knowledge and applied in a simple way. This is the core of empowerment process for the human in order to make the ergonomic intervention were sustain.

TEAM were encaurage all stakeolders to contribute together to find out the best way of solving problem in working condition. Everyone should concern and commitment since identification until implementation. The most important is everyone should work as a team and minimize arogance and individual ego, while collaboration and communication should increasingly implemented.

4 ERGONOMICS BASED ON PHYSIOLOGY

In the field of medicine, physiology is one field of science that explains the normal functioning of various systems in the human body. In a broader study that normal conditions became a reference in assessing any changes facing humans in various interactions with internal and external environment. Physiology develope to be the basis data while analyzing physiological processes associated with changes in body activity. These activity changes related to human activities such as work, exercise, recreation, and other activities. Therefore, one development of human physiology is becomes ergonomics or work physiology.

The importance of physiology in ergonomics related to the human as a subject of ergonomics. Human-centered means that everything in ergonomics application must consider the human who will use the technology, interact with technology, exposure by technology. Working condition of human during activities are affected by several factor including environment and technology. The human can adapt to the intervention. If they can not adapt well, they will fall into high risk to injury and diseases.

Ergonomics has known focus on human as an object. That means human must be look after in well condition. The goal of ergonomics is to make working condition safe, healthy, comfort, effective and efficient. This goal should be applied to human while they were work and maintain the human condition in a normal condition. In term of physiology, normal condition is homeostasis.

Homeostasis of human during activities in order to prevent the human from injury or work related diseases. Any activities such as exercise, pleisure, work or hobbies can act as an external stress for the body that make a reaction from the body as an adaptation process. The working condition also give another stress to the body such as environment. Factor form the environment that give more stress are temperature and humidity, vibration, noise, and lighting. However, adaptation process within the body can act as internal stress, too. All of stress to the body will make the system within the body make some changes to maintain homestasis.

A healthy body is necessary, fitness body is more important to ensure a human being can perform its function properly without experiencing significant fatigue. Various approaches are required to improve a person's physical fitness, especially in ensuring optimal cardio respiratory function. In this case, it is necessary to apply the concept of exercise physiology.

Implementation of ergonomics for working conditions is in various fields of life, such as household, small scale industries, large and multi-national industries. The goal is provide working condition safe, comfort, healthy, effective and efficient. Various studies show the benefits of ergonomics - work physiology in solving human resource problems so that its performance increases. Increased performance may occur due to decreased fatigue and musculoskeletal complaints, decreased mental stress, changes in work postures, nutrition, improved conditions of information and the environment. All the studies showed that physiology is used in ergonomics and have important role.

5 PHYSIOLOGY IMPLEMENTATION IN ERGONOMICS

In ergonomics, human-centered for any intervention in order to make the human safe and healthy. Assesment of the human body can be used as parameter of any changes within the body to make homeostasis still continue.Any changes in the body can be measured subjective or objective using spesial tool. The assessment can be done based on system such as (Table 1) :

1. Cardiovascular system as parameter of work load and heart function. Heart rate and pulse rate were used to monitor level of work load by measure rest pulse rate, work pulse rate and recovery pulse rate. Electrocardiography and echocardiography can be done, if the pulse rate and heart rate were abnormal for further investigation. Blood pressure is another parameter to monitor body condition during work.
2. Respiratory system as parameter of oxygen uptake and disturbance of airway cause by any diseases. Spirometri is one method to measure oxygen uptake, restriction or abstruction of the respiratory system.
3. Muskuloskeletal system as parameter of work force and energy expenditure. All activities are using musculascletal and need energy for muscle contraction and heat production. Musculosceletal disorders, energy expenditure and body temperature can be measured as representative of fatigue.
4. Endocrine system can be used to monitor any activities related to endocrine changing. Blood glucose man be used to monitor the using of glucose before, during and after activities. Level of stress during work can be measured from cortisol level an others.

Uropoetika system to monitor dehydration and over hydration of workers during work hard, in hot temperature or other extreme temperature. Monitor of body weight, urine production, frequency of pee can be used to monitor balance of fluid.

Table 1: Human system implementation for ergonomics aspects and some parameters.

Aspects of ergonomics	Human system	Parameters
Nutrition	Alimentary, cardiovascular, Metabolism	Body weight, blood pressure, pulse rate, energy
Work posture	Musculoskeletal, Metabolism Body size	Muscle strength, endurance, Body mass Index, energy
Musculoskeletal	Musculoskeletal, metabolism	Work related disorder
Environment condition	Sense, Integument, vascular, respiratory, musculoskeletal	Visus, Temperature, Respiratory rate,
Time condition	Brain, sense, endocrine	Visus, brain function, endocrine level
Information condition	Brain, sense	Coordination, reaction time, visus, ear, touch
Socio-culture condition	Nutrition, vascular, metabolism, sense	Body mass index, eye, ear,
Man-machine interface	Body size, musculoskeletal, alimentary	Hand size, height, strength, energy

Another assessment can be done base on function of body, such as :

1. Physical fitness as parameter of cardio respiratory system while do some activities. Physical fitness can be measured by 2.4 km running, treadmill, Harvard Step-up test, Multistage Fitness Test, VO2 max. Another test were done related to specific age such as elementary school fitness, employee fitness, senior citizen fitness and others.
2. Fatigue and musculoskeletal disorders, as parameter of musculoskeletal system, cardio respiratory system and metabolism in order to supply optimum nutrition, oxygen to the active muscle and release
3. Reaction timeand coordination study as parameter of brain function related to task and stimulus.
4. Biomechanics is used to analysis movement of human using several tools. Assessment can be done whole body or segmental for limb and others
5. Anthropometry as parameter of functional body size related to designing work station, tools, and man-machine interaction. Body size, body mass index can be used to monitor the using of energy or nutrition state that is important during activities.

Parameters that are used in ergonomic even subjective or objective were supported from physiology aspect. For the reason, understanding of the human anatomically and physiologically is a

must, because human as a center of any process in ergonomic.

6 CONCLUSION

Ergonomic approach is applied to achieve working condition in humane, competitive and sustain through designing any aspect of working condition that are healthy, safety, comfort, effective and efficient. Human-centered is the core of ergonomic implementation. The must fit to work in good condition to prevent from injury and diseases or the human body in a good and normal condition. Physiology was applied to meet that goal that is to maintain homeostasis. Assessment of the human systems is a way to monitor any changing within the body to maintain homeostasis condition. Data from human body assessment are important to change working condition in order to provide proper environment for the human during activities.

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