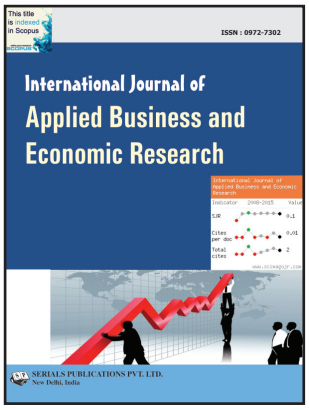

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On the Impact of Psychophysiological Factors on Potential Productivity of a Human During Labour Activities

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ABSTRACT

The paper explores a number of aspects of labour activities affecting the functioning of a human factor. In modern conditions the human factor has become a very specific production factor, possessing not only production, but also social, psychological, and physiological capabilities and needs. The increased role of the human factor and, thus, of a person as a labour resource is linked with structural changes in modern production. It is worth noting that the importance of utilizing human resources is concluded not only in their quantitative growth and measurement, but, first and foremost, in qualitative characteristics of human potential productivity. In addition, preparation and training of professionals is facing a challenge of extending requirements to various aspects of work, what clearly implies promoting a person's competence. Hence, it is obviously necessary to carry out an in-depth analysis of such aspects, particularly, to look at psychophysiological particularities of human activity influencing a person's potential productivity, which are studied within the present paper. The paper identifies main factors characterizing total and current potential productivity, its psychophysiological specifics and the impact of work and rest schedule on the final performance as well as the interrelations between the factors of total potential productivity during work.

Keywords: Potential productivity, working process, work and rest schedule.

1. INTRODUCTION

In the scientific literature an increasing attention is being paid to the concept "human resources", which has a deeper meaning than the concepts "workforce" and "labour resources". These two derive from a broader concept "human capital", whereas the concept "human resources" is one of the manifestations of the latter. The principal element characterizing the realization of a human factor in the course of working activities is a person's potential productivity.

2. THEORETICAL ANALYSIS

The human factor and, consequently, "human resources" are understood mainly as a set of workers of enterprises, organizations, institutions, who are united by their joint activities.

The specifics of human resources under current economic conditions, in our view, include the following:

- they are a complex object of socioeconomic management;
- they are determined not by quantitative, but by qualitative characteristics of working-age population;
- professionalization of all types of working activities results in greater capital investments needed to bring up professionals.

The resources of a human encompass all the qualitative characteristics, particularly, mental, physical, intellectual, psychological, moral, personal, etc. Some characteristics of a human resource are determined not by education and a set of professional knowledge and skills alone, but also by personal traits, which depend equally on heredity and upbringing of a person in a family, social group, society.

A number of personal qualities (along with such as enterprise, intelligence, prudence, risk tolerance) describe professional and personal potential both of an employee and employer (Lomov, 1981). It is possible to point to such factors affecting resources of a human and determining his/her qualities as honesty, integrity, responsibility, discipline, initiative, respect for law, ambition, desire for a career, etc.

Other important components of human resources, in our view, include such as potential of labour mobility, level of requirements, motivational characteristics of labour activities and such essential characteristic as a potential of physical and mental health (Selye, 1975).

Of specific significance are some psychophysiological factors of labour activities exerting impact on person's health and, consequently, on the duration of working age of a person and his/her potential productivity.

3. RESULTS

Labour activities or just labour is the major type of human activities. At this, labour activity is manifested in the unity of three aspects: first, an object-effective aspect, perceived as a process, where a person causes a predetermined change in an object of labour using work equipment; second, a physiological aspect as a function of a human organism (Rozenblat, 1983); third, a psychological aspect as a realization of a conscious objective, manifestation of will, attention, intellectual abilities of an employee, etc. Two last aspects play the leading role in the research of human potential productivity.

Here it is necessary to point to the fact that the physiological part of work takes the form of material processes occurring in a human organism when a person performs different tasks.

Psychological part of work can be regarded in the context of psychological (ideal) phenomena accompanying the process of work and the principal goal here is to reveal "how in the process of this activity the reality is reflected subjectively and what the mechanism of psychological regulation of the activity is.

Another goal is to study the influence of the activity on development of psychological functions, processes, states, and abilities of a human".

In the most general sense, an individual working process may be seen as a transformation of mass, energy and information by a human at a workplace. The group of parameters forming psychophysiological conditions of work include rhythm, pace and monotony of work. The rhythm and pace of work may be assigned from outside and in this case they are referred to as forced (for instance, a rhythm of a conveyor belt at an enterprise sets the corresponding rhythm for a working human), but they also can be chosen by a performer and if such is the case, they are called free. There is one common regularity that the dependence "labour productivity – rhythm of work" for a human suggests that for every person there is an optimal rhythm of work, when s/he delivers the best performance.

As for the state of monotony, it appears when a human carries out a lot of uniform repetitive actions of short duration. It is believed that in this case functional state of human deteriorates, the speed of reaction and coordination of movements gets worse, what leads to a decrease in both labour productivity and potential productivity, causes stress and adversely affects an employee health.

At the same time, significant factors behind human activity at work are stress factors, which cause nervous and emotional tension of a human organism. As it was established by a Canadian psychophysiologist H. Selye, the development of stress has three phases: alarm stage, resistance stage (when energy resources are allocated to repair damage) and exhaustion stage. He also pointed to that the impact of stress factors varies among people: some can just have a slight increase in their organism's tone, whereas others display a stormy reaction, which may manifest in the three abovementioned stages (Orefkov, 1996). Various groups of parameters of a working process can be referred to as stress factors, particularly, they can include the state of uncertainty due to information delay, time deficit for decision-making, conflicts between colleagues, etc. Continuing influence of stress factors may result in numerous diseases and disorders as well as decrease potential productivity.

It should be noted that all functional systems of human organism take part in a working process, although their role differs. This role and, to be more specific, the mechanisms of human organism functioning as well as its sets – functional systems – are the subject of study of psychophysiological content of work. Within it, meticulous attention is paid to a central nervous system and a locomotor system responsible for working actions and movements, which characterize a person's potential productivity.

Speaking about working conditions at workplaces, we should specify parameters of workload, i.e. physical load, which can be of two types: dynamic (working movements) and static (fixed means and objects of labour). Other things being equal, the static tension is considered to be more wearisome compared to dynamic work, thus, when it is possible, it is better to avoid static loads or make attempts to convert them into dynamic ones.

All necessary information in the process of work is transformed by a human using sense organs and a central nervous system. The study of mechanisms of information perception, processing, and keeping as well as its use for decision-making constitutes an essential aspect of research in the field of psychophysiological peculiarities of labour activities.

The psychophysiological approach focuses on the concept of potential productivity of a human organism. In our view, the most acceptable treatment of this concept was offered by professor V.V.

Rozenblat, who defined it as a measure of functional possibilities of an organism (a physiological system, an organ) characterized by quantity and quality of work during maximum tension or duration. Its components include: (a) maximally possible physiological input; (b) efficiency of this input, i.e. coefficient of energy conversion efficiency of a physiological object. The decrease in potential productivity in the state of fatigue is a cumulative effect of change in every mentioned parameter". This definition can be considered objective, but with a number of amendments. First and foremost, mental and physical input during work should be understood as maximum psychophysiological costs of an organism, which can be defined as "total potential productivity".

Then, a component of total potential productivity is efficiency of maximum psychophysiological costs R^{e}_{max}, i.e. the ratio of the amount of product of labour generated at maximum workload ΣQ_{max} to maximum psychophysiological costs F_{max}:

$$R^{e}_{max} = \frac{\Sigma Q_{max}}{F_{max}}$$

This indicator (at maximum workload), in our opinion, may represent the efficiency of labour. In other words, the concept "total potential productivity", expressed as a ratio between maximum workload to maximum psychophysiological costs, is close to the concept "efficiency of labour" in socio-labour sphere. We also should highlight that total potential productivity is of discreet nature.

Total potential productivity is manifested in the following concepts: current (actual) potential productivity; psychophysiological reserve of potential productivity; heaviness of labour; complexity of labour; physical tension of an organism; intellectual tension of an organism; load; organism's reaction to load (Figure 1).

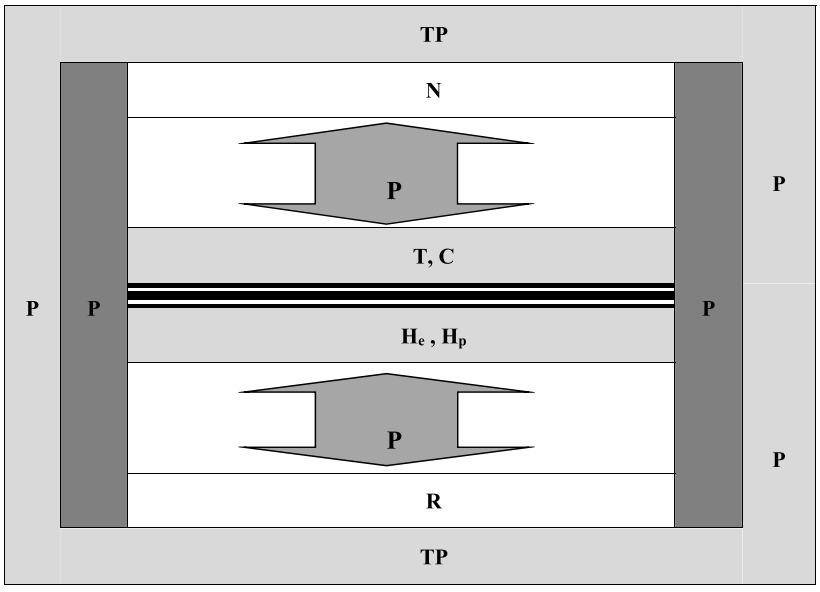

Figure 1: Interrelation between the factors of potential productivity during labour activities

For instance, let us take the concept "current potential productivity", which, on the one hand, is a psychophysiological reaction of an organism to a set level of load (psychophysiological costs), and,

on the other hand, represents total potential productivity. In this sense, the concept "current potential productivity" can be identified with such concept as "labour productivity". Therefore, it seems reasonable to take psychophysiological aspects of labour activities of a human into account in this indicator.

Heaviness of labour characterizes energy component of a working process and is directly linked with the size of physical load; complexity of labour is determined by the mechanism of information processing by a central nervous system and the size of information load, thus, using other words, by workload and an organism's reaction to it.

TP is total potential productivity; CP is current potential productivity; ΔP is psychophysiological reserve of potential productivity; T is heaviness of labour; C is complexity of labour; H_p is physical tension of an organism; H_e is intellectual tension of an organism; N is load; R is organism's reaction to load.

The dynamic of potential productivity in various periods is another essential issue studied within the psychophysiological approach. Its impact on a working process is closely linked with the task of designing optimal schedules of work and rest. The main idea of this schedule is to identify correctly the moment when an organism starts feeling fatigue and employ one or more measures to increase potential productivity (Kibanov, 2015). To build a rational schedule of work and rest it is reasonable to follow the next sequence of actions:

First, in fixed periods of time (for example, every half hour or hour) two groups of parameters are measured: technical-economic (output per hour/half hour, scrap rate, operative time, etc.) and psychophysiological (parameters of mental processes: memory, attention, perception, thinking; functional state parameters). Then for every measurement ratios of these parameters are calculated. The values of these ratios are accounted during the whole work shift.

Second, a regression equation is designed, and a mathematical model of potential productivity dynamic in the form of potential productivity curve is developed.

Third, the regression equation is transformed into graphical form of the potential productivity curve.

Finally, on the potential productivity curve there should be identified the point, at which the level of potential productivity starts to fall (the beginning of the fatigue). At this moment either irregular break or measures on promoting potential productivity should be introduced (Aksenova & Bazarov, 2013).

In different time periods fluctuations of potential productivity may vary. In case of an eight-hour shift, there are typically transitional three-phase changes in potential productivity: initial phase of a working process transforms into the phase of sustainable potential productivity, and finally is replaced by the phase of fatigue. There are some differences in duration of phases in the first and second halves of the work shift: during the first half the initial phase is longer that during the second half of the shift; the duration of the phase of sustainable potential productivity in the period before lunch break is longer than during the second half of the shift; in the second half of the work shift fatigue starts earlier and is stronger compared to the first half. In some cases, at the end of the work shift upsurges in potential productivity may be observed, also called "final impulses" connected with emotional stimulation of an organism.

Fluctuations of potential productivity during 24 hours have four clear extremes: two minimums and two maximums (Medvedev & Leonova, 1993). The greatest minimum is observed around 2-3 a.m. and a less significant one – approximately at 3 p.m.; the first maximum occurs at 8-9 a.m., the second one – around

6 p.m. Considering weekly dynamic of potential productivity, it increases before Wednesday and gradually falls during Thursday and Friday (given a workday lasts 8 hours). Recently, a common trend has been detected that there are some changes in various types of potential productivity throughout a year.

Potential productivity has an integral character and is expressed by a multi-variable function. In our opinion, the optimal potential productivity depends on a number of factors, which include, primarily, the state of production environment, energy component of a human, motivational factor, informational subsystem affecting the nature of potential productivity, and development of rational schedule of work and rest (Sarabskiy & Panchenko, 2012).

We should point to some peculiarities of information transformation by an employee during work. It is known that in a working process an employee interacts with objects, means of labour, environment and other participants of the working process, but what is more important s/he effects this interaction through informational component of production.

Regulation of information flows of a worker goes through a number stages, i.e. a consistent information transformation by an employee takes place. The following stages in the activities of a worker are identified:

1. Receiving information. The information is transformed by an employee under the influence of the elements of the system "a human – equipment – production environment – product".
2. Evaluating and processing information. At this stage a performer takes such actions as memorizing, analyzing information, generalizing about it, and identifies problems of prime importance according to the degree of possibility and speed of reaction. S/he juxtaposes standard regimes of operation of the system "a human – equipment – production environment – product" with real ones, emerging during the process of production.
3. Making a decision. The essence of this stage is that a sequence of reasonable actions to achieve a goal is formed on the basis of transformation of incoming information. At this stage, a performer searches for, extracts, classifies and generalizes about information on existing situation; a kind of a conceptual model of a working process and conditions of its occurrence is built. Then, the conceptual model is adjusted from the perspective of a working process optimization.
4. Implementing a decision taken. This stage consists of all sorts of managerial actions of a worker in relation to surrounding objects through physical impact on control systems of machines, mechanisms, apparatus and emotional interaction with other participants of a working process during implementation of the decisions taken (personal contacts).

Vital importance in reproduction of a human resource as a capital is increasingly gained by such factors as health, improvement of employability, potential productivity, and longevity in general, which largely depend on the quality of life. The quality of life in turn is highly dependent on working conditions and potential productivity of a person. The research proves a direct connection between the quality, efficiency, results of labour and a person's health and potential productivity during his/her labour activities.

4. CONCLUSION

The conducted analysis gives grounds to conclude that psychophysiological factors of potential productivity may be identified with efficiency of labour activities. These aspects of labour activities are directly linked

with such socio-labour concepts as workforce, labour productivity, efficiency of labour, intensity of labour and shape social and individual consumer value as an ultimate objective of social production.

Therefore, the aforementioned factors represent an essential assessment component that largely determines the value of a human resource, thus influencing the value of both total and individual human capitals.

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