

**BIOLOGICAL ANTHROPOLOGY AND APPLIED
ANTHROPOMETRY- ERGONOMICS AND ERGONOMIC
ANTHROPOMETRY- WORK STUDY**

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ABSTRACT

Ergonomics is a multidisciplinary area, in which the most suitable relations between elements of the inner system "man-work place (machine)- space" MWP(M)S are established. In the aforementioned system, it is necessary, for searching of the morphological characteristics of the human body and its variability, to get to know the biological anthropology, and to use the applied anthropometry in searching of quantitative relations of human body dimensions. Ergonomic anthropometry researches and establishes the needed anthropometric measures of some operator, while work study applies them in the rationalization process and the aimed systems, processes and work places (machines) projecting.

Keywords: biological anthropology, ergonomics, ergonomic anthropometry

1. INTRODUCTION

Biological anthropology is a multidisciplinary expert area and science, subject of which is the research of the human biological characteristics and the problems related to the growth and the development of human populations.

Applied Anthropometry has a goal and a task to quantify morphological characteristics of the human body by measuring, but on the basis of the proved act, that all morphological characteristics of human body are a result of genetic factors and experience/ environment factors interaction, most often in three modes: linear dimensions, of measured mass and of measured body volume.

Ergonomics is a multidisciplinary area, in which the aspiration is to reach the most suitable relations between the elements of the inner system "man-work place (machine)- space" MWP(M)S, and this also requests for the establishing of the amounts for all elements of the aforementioned system, or rather the introduction of the biological anthropology and of the applied anthropometry.

Ergonomic anthropometric research, for the Homo sapiens sapiens and for the static condition, in a procedure usually uses previously made backgrounds: a list of 33 basic anthropometric measures and a list of 20 additionally calculated anthropometric measures on the basis of the measured variables.

Work Study is an expert area and a science in industrial engineering and productive mechanical engineering, with established elements of the researched subject: a purpose, the composed parts and aims, along with the tasks of mentioned parts.

2. BIOLOGICAL ANTHROPOLOGY

Biological anthropology is a multidisciplinary expert area and a science, which has the most valuable object in nature, the human genus with its differences and variations of characteristics, and researches the "human factor", or rather, the biological human characteristics and problems connected to the growth and the development of human population and of the belonging structures in space and time. The previous one is used and supplemented with the contents of the other expert areas and sciences, such as human genetics, physiology, anatomy, ecology, demography, etc. The fact that all

morphological characteristics of the human body are a result of genetic factors and environment/experience factor, the interaction is proved on dual-kinds studies: of twins and genetically identical or similar populations, which are, considering the characterized stress, in different conditions. Many studies also demand the establishing of all elements of some system and that is possible by necessary introduction of the biological anthropology, [1].

3. ANTHROPOMETRY AND APPLIED ANTHROPOMETRY

The approaches to **the classical biological anthropology** are always going back to the researches of characteristics of one population, especially its variability regarding the evolution. Applied **choice method** is, for the most part, **the anthropometry**, which has for a goal and a task to quantify the morphological characteristics of a human body by measuring in the three kinds or modes:

- 1) linear dimensions,
- 2) a measured mass and
- 3) a measured body volume.

Anthropometric researches inevitably consist of two main kinds, the static and the dynamic one, along with belonging characteristics. The data obtained from a mode of **static anthropometry** has an aim and a task to be used for determining the space in which man exists, but only in addition to the condition, that in this space a man rests in standing position or only slightly moves. Such approach is simple and easy for applying, but unadequate realization doesn't secure the obtaining of the correct measures, nor a functional design of space and machine. Opposite of that one, the data obtained from the **dynamic anthropometry** has an aim and a task to measure human body at performing defined acts. It seems on basis of a central hypothesis, that at realization of the defined acts, single parts of human body don't function independently, but act as a "mosaically functional whole".

Applied anthropometry represents an area of application for some biologically-anthropological studies, especially for industrial, military and medical purpose. It can be concluded that the applied anthropometric measures of morphological characteristics of human body are needed for:

- a) the correctly industrial production of objects (making of plans, drawings and sketches of employees clothes samples),
- b) the projecting of the space where people stay,
- c) the production of the defined quantity of equipment from **(1)**, where the results of the anthropometric measures of "human factor" relates to researches: **(1) shape and size of the space** in which the man stays (works, rests and spends time, protect himself, and etc.); **(2) suitability of machines and the other equipment**; **(3) clothes production** (working, protecting/ securing, etc.) and **protecting/ securing the equipment** (masks, helmets, glasses, gloves, parachutes, etc.), which he permanently/ continually and temporarily applies.

Some of the possibilities for practical application in anthropometric researches, based on established, analyzed and interpreted anthropometric measures for population, have for a consequences correct:

- (a) projecting for **extreme/ marginal individuals**,
- (b) projecting for **group of chosen individuals** with chosen common characteristics;
- (c) projecting for **average individuals**.

Within direct possibilities of anthropometric researches, the need is especially expressed for establishing appropriate space dimensions, surfaces, seats, etc., exact dimensions of the following entities, on which one of authors is especially directed, [2]:

- (1) dimensions of work space:** work spaces for men are unlimited, but generally they're divided, at first according to criteria (un)mobility, on work space with fixed and mobile work place and on limited work space;
- (2) work surfaces:** usual division is on horizontal and vertical surfaces and the ones under an angle in relation to a background, where anthropometry creates bases and allows for correct conclusion about the dimensions or characteristics of researched surfaces to be made;
- (3) seats:** problem of sitting and of seats is interesting from many, at least three, views: because of possible consequences of incorrect detain of people in defined position at work operating or resting, also because of medical needs at constructing equipment, space and the other entities, and because of the sole importance of applied anthropometry at searching the most appropriate modes of the aforementioned entities, according to morphological characteristics of some population.

In many countries, there are realized anthropometric researches and the results are applied on establishing the suitability of the objects (machines, tools, cars, firearms i dr.), where the principle

which anthropologists usually know well has to be applied, the continuous updating of the study.

4. ERGONOMICS

There are more than one ergonomics definition, for example [3], a majority defines ergonomics as a work adjustment according to the man/operator in the system “man-work place-work methods-environment”. Somewhat different one defines ergonomics as an area, that contains multidisciplinary research, along with the interdisciplinary shaping of ergonomic principles with the purpose in the system “man-work place-work methods-environment”, and all that with the purpose of work humanization, [4]. Special definitions are determined and coordinated with the most important kinds of ergonomics, and those are: conceptual, systemic, correctional, hardware and software ergonomics.

Ergonomics uses systemic innovation principles in the multidisciplinary approach to more different areas of research, along with the interdisciplinary application of research results. In the same research [4], 73 ergonomic principles have been shaped, that are divided in five groups.

5. ERGONOMIC ANTHROPOMETRY

Every ergonomic anthropometric research demands the application of some specific measurements, most often in dependence with two parameters: about the sort of work activity, along with the requirements of the tested product, both in the “state of active work“ at the most. Basic anthropometric list is continuously adapted with the measures, which can point to:

- possibility of the appropriate performing of the system **MWP(M)S**,
- possibility of achieving a certain amount of force, needed for the fixed goal and for the tested man’s task performing, at first, by ascertaining more than one possibility of taking a certain position, and with the movement inside a certain space and then the ranking of the suitable position for acting and from them, finally, at the most appropriate position choice for the man’s working,
- the need, along with the taking into consideration the dimensions of that space, depending on the size and the shape of the work place, of the machine and of the equipment, to determine the possibilities, that relate to the most suitable and most appropriate clothes and footwear for the man,
- additional parameter, to which the psychologists and psychiatrists mostly point, the determined duration of staying in some space, that’s needed for the execution of some act,
- the necessity of satisfying some basic biomedical criterias in the solution.

The studies with the previous characteristics demand a systemic and organized following of the growth and development of the populations, filling out a “basic anthropometric list”, for instance, along with the details of the shape and of the built of human face, hands, feet, etc., along with transforming it into a “basic ergonomic anthropometric list”. The choice of “ergonomic anthropometric measures” varies, depending on the shape of the subject (work place or machine, product, etc.), along with the goals and tasks and is submitted to special demands, which move inside the anthropometric points, determined previously inside the classical anthropology textbooks and manuals.

While object projecting, it’s necessary to determine a planned schedule of activities, necessarily taking into consideration the relationship between human body parts and the object, while using already known rules. With the purpose of unification of the “basic ergonomic anthropometric list”, 33 basic anthropometric measurements have been chosen, with a division into two categories and with the measuring characteristics:

(1) in a standing position – p.e., (2) in a sitting position – p.a., and with a characteristic that ergonomic anthropometric measurement, contradictory to classic anthropology, are being done on the man’s right side of the body, [5].

The mentioned “list” contains the list of anthropometric measures, by simple adding and subtracting, 20 more anthropometric measurements can be calculated and which can be found on the separate list. The two mentioned measurement lists make possible for the 33 basic anthropometric measurements to be made in a relatively short time of about 30 minutes, and then, for additional 20 measurements to be calculated, or rather, for the whole 53 measurements of one man to be determined. For the majority of general ergonomic researches, the previously mentioned measurement lists are both satisfying in the

economy and in industry. Examples of “ergonomic anthropometric researches” of Homo sapiens are many and have been done in many countries, mostly on the examinees in resting and less on examinees in movement, along with the examinees who performed certain acts and movements. The conclusion can be made, that the measurements of the morphological qualities of the human body are needed for: the correct industrial object production (plans making, along with the pictures and sketches of the clothes samples of employees); space designing for the people to stay in; the production of the specific amounts of the equipment, where the results of the anthropometric measurements of the “human factor” are related to the research of the shape and size of the space, in which the man spends his time (works, rests, moves around, protects, etc.), suitability of the machine and of other equipment, along with the clothes production (work, protective, etc.), and protective equipment (masks, helmets, glasses, gloves, parachutes, etc.), which a man continuously/ permanently and temporary/ occasionally uses.

6. WORK STUDY

Chronological development encompasses the following degrees or development periods: work study (F.W. Taylor, 1881-83.); motion study (F.B.Gilbreth and dr.sc.L.M.Gilbreth, 1911.); work simplification (A.Mogensen, 1930.); motion and work study (R.M.Barnes, 1937.); work designing/operation analysis (H.B.Maynard, 1939.); Work Study, germ. Arbeitwissenschaft; franc., L'étude du Travail (from 1940. till today's form, it's been specifically improved by the european firms like REFA Reichausschuss fur Arbeitstudien, Darmstadt, Germany, then BTE from Paris, France, along with the US ones like MEC Methods Engineering Council, from Pittsburgh, Pennsylvania and of course a whole line of others, first and foremost, from the industrially more developed world countries).

The elements of the Work Study purpose are: work humanization, tiredness reduction and security increase of the operator, along with the production cost decrease and production growth. The goal of one of the two basic parts, Work rationalization, is the search and the establishing of the most economical way of work, along with the stated belonging assignments. In realization of the elements of both parts, the purpose, the and the assignments, helps the ergonomics. The interaction of the work rationalization, time determining/ measuring and of ergonomics are implied in the following special, prioritized areas of research or their combinations: the determination/measuring of the real work and losses time; teaching and studying/practicing of the working operators; work time structure; work humanization; mastering/ managing time.

7. CONCLUSION

The application of anthropometric studies on populations samples is necessary. Ergonomic anthropometric data of the studied population is necessary for learning about any part of the MWP(M)S system, where those need to be applied in practice. Taking into consideration the constant changes of the human morphological status of all populations and the need of the continuous follow up on their structures and the updating of the anthropometric data at least every five years, a continual and organized researching and upgrading of the growth and development data of our populations is needed. Those studies would make the integration of bio-anthropology and of applied anthropometry, along with the ergonomics on the joint element "human factor", possible, as well as on the need to apply the obtained results in the economy and industry.

8. REFERENCES

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