



Fundamental Principles of Productivity Theory for Industrial Engineering

Ryspek Usubamatov*

Kyrgyz State Technical University After I. Razzakov, Bishkek, Kyrgyzstan

***Corresponding Author:** Ryspek Usubamatov, Kyrgyz State Technical University After I. Razzakov, Bishkek, Kyrgyzstan.

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More than 300 years scientist, researchers, and engineers are solving the problems how to increase the labor productivity, productivity of economic system, and quality of the products fabricated. Analysis of known publications demonstrate the partial and simplified solutions of industrial problems. It can be explained by the complexity of the problem that based on principles of different physical nature of production process that should be formulated by the complex and holistic mathematical expressions. Contemporary production processes are based on technology, production machine design and system that present the conglomerate of mechanical, electrical, and electronic units, reliability of them, system of maintaining, management, ergonomics, etc. Each of them today is defined and computed by own theories which combining in one holistic theory was problematic for the long time [1,2]. All these diversities of machines and systems with different designs are solving the pivoted problems of economics to increase the productivity rate of manufacturing processes with high-quality products and to increase labor productivity of economic system [3,4].

Labor productivity is a multifaceted indicator of labor efficiency. Its role for one enterprise or separate industry can highlight the role of labor productivity at the macroeconomic level. Labor productivity contributes to the solution of the following issues: reducing labor costs in the production and increasing sale of products; contributes to the saving of raw materials; promotes an increase in the level of wages of employees; increases the economic sustainability of the enterprise. Along with technical aspects depend on the acceleration of the application of the latest achievements of science and technology, technological developments in production

and in improving the forms and methods of management and production planning. That is why all the leading countries of the world are adopting appropriate programs to further increase productivity and search for reserves for this.

Economics considers the macro and microeconomics that related to the labor productivity of state industries and the production system of companies respectively [5,6]. Economic relations in their totality provide a certain, unique action of factors that affect labor productivity. Macroeconomics operates with the term of productivity that is the ratio of output to input, which is the efficiency of the economic system according to the fundamental science. Economists describe analytically labor productivity that depends on the value of its components and their influence on the economic system. Each component of the mathematical model for labor productivity has its own weight and presents the following percentage: the machine productivity gives 60-70% of economic efficiency; the fixed capital and the service capital give 15 - 20% of economic efficiency as the quality of products, and the number of employee's gives 10 - 15% of economic efficiency. Therefore, physical or machine productivity is the main and weighed component of efficiency of the economic system. Growth potentials in labor productivity vary greatly by industries, and as a whole, they are directly proportionate to the engineering development in the branch. Microeconomics considers the physical productivity rate of machines and systems that is the number of products fabricated per observation time. Microeconomics is the fundamental component of macroeconomics and each of them has its own indices that reflect their level of perfectness.

Labor productivity is variable with the time of the service of the economic system. It grows intensively at the first years of functioning of the economic system, then the growth is decelerating and monotonically comes to its limit. The change in the labor productivity clearly demonstrates that any economic system with permanent technology and service has a limit and with the years becomes obsolete and does not respond to the marketing environment. It means the economic system should find ways for constant growth and not to be bankrupt. To have a high value of the labor productivity is necessary first of all to develop the new technology with a high productivity rate, then decreases the expenses on the fixed and variable capitals. These are obvious ways to increase the value of labor productivity but the economic system should spend capital to realize them [8].

Microeconomics the index is the physical productivity rate of machines and complex production systems. The physical productivity rate is multifactor index that depends on the technology of processes, the reliability of mechanisms, machines, and units, and indices of managerial and organizational activities, which definitely affect the output of production systems. All these components are represented in mathematical models for the productivity of machines and systems. Such mathematical models are based on the causal links between all parameters of different physical nature that play important role in the development and evaluation of the production systems. The full holistic productivity theory for industrial engineering that combines all indices of different nature is presented in the manuscript [9]. The grow of productivity rate has represented the progress in developing industrial machines that are manifested in the application of innovative technological processes. The perspective designs of manufacturing systems request from engineers and technologists the wide knowledge and prospects and understanding the essence and regularities in developing industrial engineering. Hence, the fundamental principles of productivity theory for industrial engineering can be expressed by the following basic postulates:

- Any work performed requires time and labor.
- The time is spent productively if it is spent on the main work processes.
- The auxiliary time for preparation and restoration of the main work process is wasted time.
- The performance limit of machines depends on the physical limitations of the technical and technological processes.

- The machine is perfect if there is no auxiliary time, has high efficiency, and produces a high-quality product.

These fundamental principles of productivity theory for industrial engineering are the components of the theory of labor productivity which is defined by the theory of marketing with its own economic indices. The combination of these several theories and their application enables predicting the evolution process of the social system [10].

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