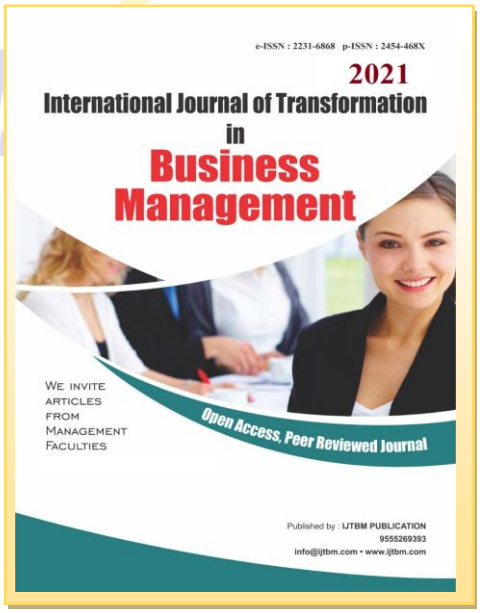
INTERNATIONAL JOURNAL OF TRANSFORMATIONS IN BUSINESS MANAGEMENT
e-ISSN: 2231-6868, p-ISSN:2454-468X

THE IMPACT OF HUMAN ENGINEERING APPLICATIONS ON THE QUALITY ENGINEERING OF DIYALA STATE COMPANY'S PRODUCTS AND PRODUCTION PROCESSES

Hayder Sh Noory Al-Brznjy, Asst. Prof. Dr Suhair Adil Hamed
Public Administration Department, College of Administration and Economics, University of Baghdad

Paper Received: 08th October, 2021; **Paper Accepted:** 18th December, 2021; **Paper Published:** 20th December, 2021

How to cite the article:
Hayder Sh Noory Al-Brznjy, Asst Prof Dr Suhair Adil Hamed, The Impact of Human Engineering Applications on The Quality Engineering of Diyala State Company's Products and Production Processes, IJTBM, October-December 2021, Vol 11, Issue 4; 173-199



ABSTRACT

The success of organizations comes from creating an ideal work environment, and human engineering performs this ambition to the fullest, because it has proven its efficiency in this field. Hence, we present a model for human engineering in Diyala State Company in order to achieve value for engineering the quality of its products and production processes. The research adopted two methods, the first represented by presenting an intellectual and philosophical framework about its variables, in which it dealt with the independent variable (human engineering) in four dimensions: human engineering: (physical, environmental, organizational, and cognitive), and the two dependent variables are: (product quality engineering, and production process engineering). As for the applied method, it adopted the descriptive analytical approach in order to verify the correlation and influence relationships between the variables by testing four main hypotheses. The data was collected from 271 individuals who were randomly selected and varied between managers of departments, units or employees of the company. The research also relied on the questionnaire as the main measurement tool, and used a number of tests to ensure its validity and stability, as well as descriptive and inferential statistical methods to answer questions and interpret the results. This is due to the necessity of paying attention to all dimensions of human engineering, as well as adopting the research model because of its impact on increasing the quality engineering of its products and production processes.

Keywords: *Human Engineering, Product Quality Engineering, Production Process Engineering.*

INTRODUCTION

In view of the growing interest on a local and global scale in human beings, with this trend, a science has developed that is concerned with adapting man to his surroundings in which he works, or with everything that surrounds man and interacts with him in terms of the vocabulary of his work environment, especially in the vicinity of production processes, which is what was agreed to be named in the literature. Specialized in the science of ergonomics, or (Ergonomic). Which has since become of interest to researchers on both the applied and academic sides. Until it has many applications in the field of harmonization between workers and their productive work environment, both physical, environmental and psychological, as these applications are positively reflected in production processes by increasing their effectiveness and efficiency, as well as simplifying them to the extent that they seek to achieve optimization, and then all of this is focused on the performance of workers. Based on the foregoing, the research deals with the concept of human engineering and its applications as an independent variable, all of which focus on the human element, production processes and the production

system alike, to increase the development of workers to adopt proactive work methodologies designed to improve the quality of products and production processes. The first chapter dealt with the study methodology, while the theoretical content was framed by the second topic, and the third topic came to review the applied aspect. We also devoted the last section to the results of the research with its conclusions and recommendations.

FIRST SUBJECT: METHODOLOGY OF THE RESEARCH AND SOME PREVIOUS STUDIES

Some Previous Studies

- **(OTOO, 2017):** "Ergonomic Risk Factors and Work -Related Musculoskeletal Al Disorders AMONG Workers in the Cement Block Manufacturing Companies in TEMA" The results showed that all participants suffered from psychological, social and muscular disorders in different areas of the body during the twelve months that followed. included in the study. Low back pain was the most common form (88.34%) among workers.
- **(Aujan, 2019):** "The impact of human engineering on organizational energy, the mediating role of the engagement strategy" and it was found that there is an effect of HE dimensions (attitude, movement, environmental factors, information and processes, and work organization) on the dimensions of organizational energy (physical, emotional, and cognitive energy). The presence of ergonomics is also present in immersion.
- **(Bogojevic, 2020):** "Ergonomic evaluation using a digital human modeling tool simulation Implementation and validation of automated ergonomic assessments in the digital human modeling tool IMMA" shows that HE needs a combination of information, time, and environmental conditions for a reliable and comprehensive assessment of the risks facing operators . Such as tools, stations, lighting conditions and production cycle times.
- **(Norling & Dávila, 2020):** "Ergonomic Case Study Of An Assembly Line And Solution Implementation In ECCO Finishing / Carlisle Fluid Technologies (CFT)" Reveals the actual need to add and change elements of the workstation to ensure a comfortable position for the user when he commits Working with HE principles.

The General Framework of the Research and Its Field Procedures

- **Research problem**: It is agreed in the literature that the human resource is the most important element of production. Because it is the planner and the product,

and therefore requires the provision of an appropriate environment for his physical, psychological and intellectual capabilities, while planning work environments. Which is reflected on the safety, performance and productivity of workers in general. Therefore, improving the work environment represents a major challenge for organizations that can be faced using HE applications because they focus on the work environment in all its aspects. We have doubts about the lack of awareness of the sample and its awareness of the importance of the research variables. Therefore, we see the company's need to employ human engineering applications in order to achieve the quality of products and production processes, and following the foregoing, the problem is determined in the following question: "Do human engineering applications affect the quality engineering of Diyala General Company's products and production processes.

- **The importance of the research**: it lies in the fact that it deals with creating an ideal work environment at all physical, physical, psychological, organizational and cognitive levels for the most important elements of production, which is the human resource, which is reflected in its harmony in the work environment and its impact on increasing work effectiveness and efficiency, as well as increasing productivity. The information that will be provided to the company will enhance its strength in addressing the shortcomings in the design of its operations and its physical, environmental, organizational and cognitive environment. as well as contributing to influencing the quality engineering of its products and processes.
- **Research objectives:** The research seeks to direct the attention of the general industrial sector to the importance of HE applications, as well as opening a future horizon to examine these variables in more depth and from different points of view, By showing the impact of human engineering and its applications on the quality of Diyala General Company's products and production processes, verifying the procedural model of the research in order to be adopted by the company as a base of reference when designing the work environment in it, as well as the design of its products and processes.
- **Procedural model for research:** The procedural model shows the nature of the relationships and influence between its variables, as shown in the following figure:

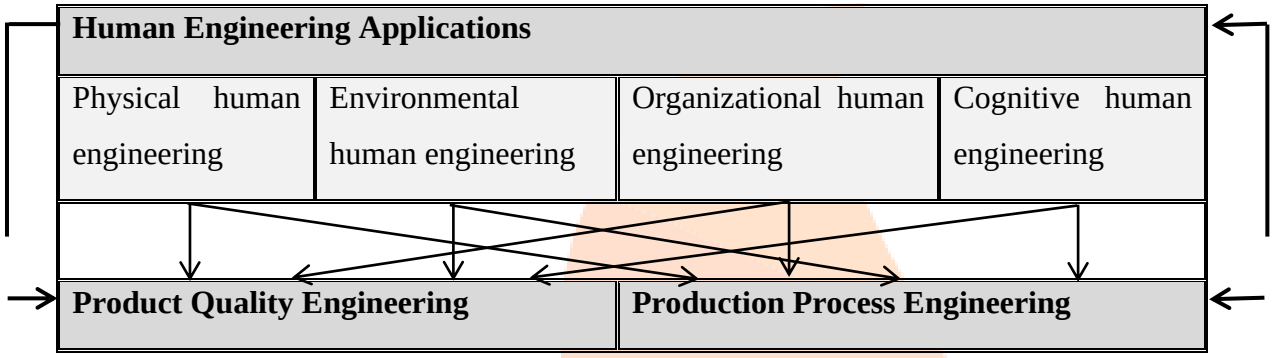


Figure (1): Action Research Form.

- **Research hypotheses:** The research seeks to prove the following: (There is a significant and positive correlation between HE applications and Diyala State Company's products quality engineering). (There is a significant and positive correlation between HE applications and Diyala State Operations Quality Engineering). (There is a significant and positive impact relationship of HE applications in the quality engineering of Diyala General Company products) (There is a significant and positive effect relationship of HE applications in the quality engineering of Diyala General Company operations).
- **Data collection and method of analysis:** Secondary research data was collected by means of available literature of all kinds, while primary data was collected by means of a questionnaire, which was designed to serve the objectives of the research and answer its questions.
- **Research community and its sample:** Diyala State Company was chosen as a location to conduct the research and test the current research model due to the clear scarcity of studies that attempt to explain the relationships between the current variables, which calls us to reduce the knowledge gap by applying it in the company. And because it has qualified employees to carry out its work and support its growth and continuity, which facilitates data collection and enriches research results. The target sample amounted to 271 people, representing 14% of the original community, which is considered a statistically acceptable proportion to represent the community. Their distinguishing characteristics were represented in five categories.

1. **Gender category**: males made up the highest percentage 65.5%, while females 35.5% of the research sample, which is an acceptable percentage due to the nature of the manufacturing

company's work and reflects the participation of women in the company's business and that they are aware of the research variables.

2. **Category of Academic Qualification:** Bachelor's constituted approximately 53%, followed by diploma by approximately 35.5%. Although it reflects the sample's ability to understand the variables, it also reflects the company's reluctance to take the importance of working staff from higher degrees.
3. **Category of specialization:** The specializations available to the company are diverse and include specializations that fall into the two categories (technical) at a rate of 67.5% (and administrative) at a rate of 32.5%, which facilitates understanding and diagnosing research variables.
4. **Years of Experience Category:** Years of service of 21 years or more constituted the largest percentage of the sample 46.5%, followed by 25.5% for the category (16-20) years, which means that the largest percentage has the ability to diagnose research variables by virtue of its experience.
5. **Job duties category**: The employees category constituted the largest percentage of 50.5% of the job tasks for the target sample, followed by 18.8% for the officials of the administrative units, and although the categories of officials and senior leaders are the least, they are somewhat normal ratios according to the organization map approved in the company, and thus they are Good at diagnosing search variables.

SECOND SUBJECT: THE THEORETICAL FRAMEWORK FOR RESEARCH

First: Human Engineering and its Applications

1. **The concept of human engineering:** The human resource is one of the most valuable resources that management needs and represents the beating heart of the organization and its living conscience. Rather, it is the real wealth and the focus of organizations' attention because its success, growth or failure depends on it, yet it is subject to a group of factors in the work environment that can weaken its performance (Österman, 2007: 11), and therefore it is incumbent on organizations to provide a work environment that suits his abilities and knowledge ideally, in order to make the production environment that surrounds him more secure, safe and appropriate. The first (oldest) term for human engineering and universally recognized (ergonomics) includes two Greek terms:

ergon: meaning work, and nomos: meaning organization, skill or rules. (Holden et al, 2020: 3) nomics is borrowed from economics, but is attributed to nomos, meaning laws or rules in Greek. There are definitions that differ in essence, some of which we list to avoid prolongation, as it is "a concept related to improving productivity, safety and design of workplaces, instructions, computers, workstations and equipment, according to the individual's physiological capabilities" (Evans & Collier, 2007: 331). or it is "a science concerned with understanding the interactions between humans and other elements of a system to improve human well-being and overall system performance." (Dul & Neumann, 2009: 745). Or it is "a business system in which people and machines carry out processes using information and resources to produce products for internal and external customers." (Zink & Fischer, 2014: 349). Finally, it is "an interdisciplinary science that aims to study the effect of work means, conditions, processes and products as results of work on humans from the psychological, physiological, mechanical, social, organizational and physical aspects through the application of quantitative and qualitative research methods, and the adaptation of the design of system elements to humans, with the aim of improving comfort, safety, efficiency and satisfaction" (Zunjic, 2017: 5). To define HE, it must be taken into account that it is a science related to different sciences. It is practiced according to scientific foundations, objective rules and quantitative and qualitative facts. To provide improved solutions for the work environment. And it falls under the responsibility of managing the operations of the organization. In light of this, we define it as: "a field of knowledge with various specializations, concerned with the study of the interaction between individuals and the material, technical and environmental elements shared with it in the productive work environment and is based on information to create compatibility between the design of jobs, equipment, tasks, activities and products with the individuals' physical abilities, technical skills, knowledge capabilities and requirements for their work To give a full understanding of their characteristics in designing systems and business in order to secure a safer and more comfortable work environment for individuals on the one hand, and more efficient and effective possible to improve the overall performance of the organization on the other hand.

2. **Human engineering applications:** "Accidents depend mainly on the negligence and inattention of workers" (Burnham, 2009: 53) stated by the Oxford University psychologist (Vernon) in the early twentieth century. The human factor was seen at that time on the basis of It is physical, mental or moral defects that make some people vulnerable to accidents.(Sharples et al, 2015: 21) asserts that this view was already prevalent in the search for the main source of risks to the safety of people in the workplace and the argument that the worker did not comply, or that he took a risk The human factor is a problem that must be controlled. Although we do not deny that humans may be an actual cause of the risks, but the concern for individuals in the post-war work environment, The diseases that workers are exposed to are caused by poor design of the workplace and its physical and physical environment, as well as the organizational environment, and it is one of the main causes of work injuries (Bogojevic, 2020: iv). Because humans have exceptional capabilities, the operations manager must build A system that connects humans with the environment and machines seeks to improve their performance (Heizer et al, 2015: 416). This led to the development of HE applications to focus on the physical, psychological and mental aspects of humans, and include the search for solutions in the technical and organizational fields (Alves et al, 2019: 245). The authors and researchers did not agree on a unified or common classification to classify its fields or practices. In any case, we see that most of them fall into four divisions that we adopt in our current research in agreement with a model (Helali, 2008: 18), and they can be stated as follows:

- **Physical ergonomics:** It is called ergonomics design for the workplace (Slack et al, 2010: 255). Which is concerned with the overall physiological aspects of job design, that is, the human body and its adaptation to its surroundings. This involves understanding how a person interacts with the physical aspect of his workplace, as the workplace includes tables, chairs, desks, machines, computers, operating equipment... (Slack et al 2010: 238), and therefore includes posture, movements, physical capabilities, workstations, surfaces, and machines... and play a role in reducing physical risk factors for workers in both workstations and offices. And ergonomics experts put two ways to avoid this, the first is indirect participation: that is, directly elected

representatives of employees participate; and the direct participation method: that is, employees themselves participate in the risk assessment (Baydur et al, 2016: 2). So the design of tools and the workplace depends on studying people to determine what they can and cannot do. By collecting master data to facilitate design. To make the workplace easier, computer modeling can also be used to analyze human movements, activities, and efforts.

- **Environmental ergonomics:** It includes all work environments related to factors such as lighting, noise, heat and humidity... and their impact on the performance of individuals. Human engineering gives the meaning of natural factors and their determinants (Christy, 2019: 106) because their impact on the worker's performance, efficiency and productivity is due to their effect on the body's organs. And his senses, too. Although its impact is in two directions: negative and positive (Trebu & Petriková, 2017: 1), because it comes into contact with all work environments and the individual's surroundings, for example the production of microchips requires a closed and very clean climate-controlled environment. Embossing or sewing work requires proper lighting; Textile processes that produce dust and dirt require proper ventilation. Other jobs require space around the work area...and so on (Russell &Taylor, 2010: 334.(Peters & D'Penna, 2020: 2 believes that the global developments of the global health situation (the COVID-19 pandemic) has increased global concern about the internal environments in organizations, and the work is focused on creating an environment that promotes mental and physical health in the place where workers or beneficiaries interact. of services, as studies have confirmed that there are health and psychological benefits for environments that include higher levels of required daylight, carefully placed windows overlooking the exterior, appropriate diversity in lighting levels, use of natural materials, and simulating green nature within the organization, as seen by (Dekker, 2015: 21) They contribute to keeping workers from accidents and problems by directly interfering in the design of a suitable environment for them.
- **Organizational human engineering:** It means designing work and organizing production processes. Job design has evolved since the Hawthorne studies by adding the characteristics of psychological components. The researchers proposed a job design group, skills: it requires the worker to use a variety of skills and

talents. Job identity: It allows the worker to fully perceive the job. The importance of the job: to give a sense that the job has an impact on the organization and society. And independence: to give full freedom to the workers to act. and feedback: to provide timely performance information. Process design is the means by which a good or service is produced, and thus seeks to improve technical and social systems in terms of organizational structures, policies and processes (Gualtieri et al, 2021: 11). As well as taking advantage of the organization's structure, policies, and operations. In order to develop an integrated system that combines the working conditions and personal skills of the worker on the one hand, with the physical and psychological constraints and the efficiency of the production system on the other hand (Santos et al, 2015: 5950. Human engineering experts and production and operations managers are of the view that job design should never limit the capabilities of the employee Or jeopardize his physical and mental health due to poor job design (Russell & Taylor, 2010: 334), so organizational ergonomics aims to increase organizational efficiency and productivity, worker safety and health, reduce risks and prevent errors and accidents, analyze situations and body movements, equipment used, tools and machines furniture, debugging of identified problems and training in the best techniques for carrying out tasks (Santos et al, 2015: 5950. It also refers to the improvement of technical and social systems in terms of organizational structures, policies and processes (Gualtieri et al, 2021: 11).

- **Cognitive ergonomics:** It is sometimes called mental ergonomics because it is related to mental functions, or cognitive ergonomics, that is, the engineering that is related to the intellectual and mental capabilities of people (Helali, 2008: 18), and (Stevenson, 2018:301) supports this approach, as he sees that Cognitive ergonomics represents the burdens of mental work and related decision-making, as well as the interaction between humans and the work environment, and work pressures... It relates to the way individuals think and their motives to design programs appropriate to their mental and mental capabilities. In this sense, it is a field that uses scientific knowledge about human behavior in the workplace, With the aim of improving system efficiency by reducing human error, as well as reducing stress or psychological discomfort that can occur to operators while sharing workspace through

cognitive ergonomics principles (Gualtieri et al, 2021: 11). Cognitive ergonomics also focuses on situational understanding, decision-making, the formation of learning skills, and cognitive aspects of mental effort (khayal, 2019:3), and researchers of human factors can contribute to making distinct analytical roles to analyze the intelligence and intelligence of individuals.It offers many possibilities for studying the development of competence, critical thinking, perceptual skills, and other cognitive processes, and cognitive anthropology assumes that all analyzes of intelligence can be called all-source analysis (McNeese et al, 2015: 130). The interaction between human and machine from the point of view of (Bridger, 2003: 329) depends on a two-way exchange of information between the operator and the system. This exchange takes place through the human's use of his sensory and mental capabilities. The senses receive information, and the mind interprets it and then stores it for retrieval in time of need. Accordingly, designers must take into account not only the physical limits of the human being used in the various design processes, but also the cognitive or mental capabilities of that user. When a person deals with any product, environment or work system, two types of performance occur: physical performance and cognitive performance or mental.

3. **Product Quality Engineering::** (Tao & Yu, 2018: 27) sees that product life cycle design requirements, also known as life cycle engineering capabilities requirements, relate to the product itself including function, performance, structure, appearance, materials, cost... which It represents its quality, some of which focus on the process and the various activities related to the product throughout its life cycle. Hence, the achievement of quality from both internal and external aspects, while the external is represented by achieving the specifications that the customer aspires to, and the internal is represented by the extent of designing the characteristics and features that work to produce this product according to specifications Required, that is, the processes that produce this product according to its specific specifications as seen (Bock & Pütz, 2016: 11). And (Ahmed & Pandey, 2016: 1231) believes that the process of simplifying the product increases the degree of its reliability, that is, the possibility of the product or its parts performing its function well within a certain period and under specific conditions (Barkhuiezen, 2002: 29, meaning the possibility of the product

working efficiently (without failure). within a specific period of time and specific working conditions.With the emergence of performance reliability engineering that measures the failure of product components, the matter was reflected in the proportionality of product quality directly with work efficiency and performance of its functions because it analyzes the causes and effects of product failure. It begins by detailing the functions of the product and its parts. Then the failure modes are determined They are arranged in order of severity.The failures are then dealt with one by one starting with the most difficult ones, and design changes are made to reduce the chance of failure (Russell & Taylor, 2010: 169). As seen by (MACIVER, 2018: 7) this depends on finding the best combination between function and cost, as product quality engineering is created either by improving functionality or reducing cost, and from here the function can be divided into measurable variables, such as flow rates, weight and volume..., and others that are not measurable, such as happiness, ease of use, and preference... Therefore, the quality of a product is linked to the functions of its parts in a comprehensive way, and then to the ability to satisfy these functions (Tassinari, 2006: 4), and despite the ongoing controversy regarding the contradiction of product quality with However, product quality engineering often balances the two issues and solves problems through the possibility of increasing quality and reducing cost, which is used by operations management in this field, so product quality value engineering is one of the best techniques available for production and operations management to achieve high quality by including the desired performance characteristics in product (Heizer et al, 2015: 170). The impact of product quality engineering extends to the environment, with what is known as design for the environment (Russell & Taylor, 2010: 169), through teams sometimes known as environmental teams because they are one of the most important techniques that measure the impact of products on society, as well as attention to the life cycle of products, starting From raw materials through production processes until it is brought to the market, with the aim of reducing the environmental impact of the product during its life cycle (Heizer et al, 2015: 194). This led to the emergence of green industrialization, which means the manufacture of environmentally integrated quality products. As it has the possibility of reducing costs on the one hand, and increasing quality on the

other, by increasing its reliability and great ability to perform the required.

4. **Production Process Engineering:** The application of effective methods to control production processes has an important role in the success of any manufacturing system. Without the application of advanced performance systems, the success of production activities will be questionable (Zohoori et al, 2018: 3), and quality engineering production processes is an approach Organized to ensure the equitable distribution of resources, and to improve the value of the elements involved in the production process because it reduces waste and adopts creativity in simplifying the complex elements in the production process and identifies the main and subsidiary areas of improvement in production systems, as it is possible to make the required modifications in designs and change in components and production elements in a way that achieves Efficiency and effectiveness, and production process quality engineering studies are conducted in three stages: pre-process, during process and post-process (DAHOOIE et al, 2020: 1320), as the process of product value engineering is closely related to the processes involved in the production of the agreed product, with the aim of Searching for opportunities to reduce production costs and increase its quality, and this is done by identifying the main and supporting production processes and related activities. Identification of cost-inducing activities and processes for the purpose of addressing them. And analyze activities and classify them into value-adding and non-value-adding activities. and finally identifying opportunities for improvement for activities and processes. (Jeyakumar, 2013: 49) believes that value engineering provides a basis for revised feasibility studies, as it ensures the most cost-effective way of operations, as well as supports good process design, improved communication, learning and teamwork... which leads to better technical solutions, with Improve performance and quality. (Christensen, 2014: 10) argues that organizations have resorted to a solution to reduce manufacturing and assembly costs because of the risks of late engineering change or poor process choices. With the aim of building a production system that incorporates best practices, minimizes risks, and selects appropriate materials.

5. **Theoretical relationship between variables:** (Limerick, 2019: 289) argues that HE is the analytical and empirical methods used to guide the development

of systems to ensure their suitability for human use, and HE experts contribute to the design and evaluation of tasks, functions, products, environments, and systems to make them compatible with people's needs, capabilities, and limitations, Therefore, we see it as one of the key factors in designing and simplifying processes, and removing complexity in the work. It thus tends to remove functions or parts that do not add value to the product or processes. Therefore, organizations implementing HE indicate a 40% reduction in costs (Stephens, 2020: 16). It uses a team of specialists that takes into account the organization as a whole, and not as independent functional units, and this undoubtedly has an impact on the work of organizations and engineering the value of their products and production processes. The literature confirms that the principles of product quality engineering and production processes depend on the approach of the multifunctional team, which designs the product, and the production processes of this product, and from here we see the need to take into account HE considerations in the early stages of the design processes that lead to removing complexity in workplaces and making them ideal (Broberg, 2007: 78). (Hill, 2012: 376) emphasizes the link between product quality engineering and production processes with ergonomics applications through the cross-functional team, and (Waterson, 2017:30) argues that HE is a unique approach to a group of approaches that go beyond just ergonomics, It is used to treat applied industrial problems. To come up with a variety of methods and tools, to solve a common problem such as improving the quality of products and processes (Shorrock & Williams, 2017: 30), Others argue that the potential for social, environmental and economic crises is still great and requires technologies to sustain the work at the same pace, without compromising the quality and functionality of the products, referring to the ergonomics team, product quality engineering and production processes to work towards common goals (MAREK et al, 2014: 456).

THIRD SUBJECT: DATA ANALYSIS AND DISCUSSION OF THE APPLIED SIDE

1. **Measuring the study variables:** We include a presentation of the research variables according to the answers of the sample in the following table:

Table (1): a general description of the sample's answer to the three search variables (n = 271).

N0	Variables	Dimensions	mean	Std. Dev.	C.V	relative importance	Application result	Type of interest	Rank
1	HE Applications	Physical Human Engineering	3.99	0.83	0.20	0.79	High	Very good-	second
		Physical Human Engineering	3.70	0.87	0.23	0.74	High	Very good-	fourth
		Organizational Human Engineering	4.02	0.80	0.19	0.80	High	Very good-	First
		Cognitive Human Engineering	3.82	0.80	0.20	0.76	High	Very good-	third
	Human engineering variable rate		**3.89**	**0.64**	**0.16**	**0.77**	**High**	**Very good-**	**third**
2	Production Quality Engineering		3.97	0.88	0.22	0.79	High	Very good-	second
3	Production Process Engineering		3.91	0.81	0.20	0.78	High	Very good-	First
Overall average for research variables			**3.93**	**0.59**	**15.00**	**78.5**	**High**	**Very good-**	-

The results of the descriptive analysis of the variables showed the following:

1. Organizational human engineering ranked first, and we attribute this result to the presence of a good level of standard specifications that the company uses when designing and organizing production processes, as well as the presence of occupational safety training programs to avoid various work risks, and this result differs from the result (Aujan, 2019). which demonstrated the moderation of the application of work organization engineering in the Jordanian Aqaba Water Company. But it is consistent with it in that it confirmed that the issue of design is fundamental to the organization and its impact is reflected in the control of work, and it can be a decisive factor in achieving the goals of the organization.

2. physical Human engineering ranked second, and we attribute this result to the fact that workers see a tangible reality that the company studies the material requirements to perform its work when designing the work environment, as it determines the tools used in the completion of operations to take into account the different physical positions. Which facilitates movement and movement between departments, machines or offices without obstacles or tangible physical risks, and this result is consistent with (Norling & Dávila, 2020) in the company CARLISLE, which is reflected on the performance of workers and raise their morale, as the weakness of material factors will inevitably reflect on the performance of Employees and then the performance of the organization as indicated (Otoo, 2017).
3. cognitive Human engineering ranked third, and we attribute this result to the fact that employees believe that the company takes their knowledge capabilities and personal experiences into account when designing work and distributing tasks. So they actually perceive the fit of their abilities and qualifications with the psychological working conditions, and as a result they are largely satisfied with their current jobs. They do not find it difficult to understand the tasks or operate the equipment and machines to complete the work assigned to them, and this result is consistent with what was stated (Bogojevic, 2020) of the need to know the time required for completion, as well as the aspects of physical strength and different working conditions in order to achieve a comprehensive assessment of the risks facing operators. As well as the availability of information and data.
4. Environmental human engineering ranked fourth, and we attribute this result to the fact that the company's current work environment is not completely free from the negative influences of physical factors affecting work, including lighting, heat and pollution, and the reason is due to frequent electrical power cuts, and this result is consistent with what Most of the literature referred to him, and from this aspect we agree that the lack of attention to the physical environment will be reflected in the weakness of the workers and the performance of the organization in general.
5. Product quality engineering has gained great importance because the company has a good knowledge of the concept of product quality engineering and its belief in the participation of workers in studies to improve the quality of its products, and if product quality

engineering is technical to reduce the total cost of the product, this is not at the expense of quality as is followed in The Chinese method, but it works to put the product in the circle of competition with competing products, which requires the availability of the appropriate ground to absorb its impact in increasing the quality of the product.

6. Production process engineering has been of great importance due to the belief of officials in improving the quality of production processes. As a result, the company's facilities and general services accompanying its production processes are easy to use. Which gave the company the advantage of simplicity in its production processes, and it not only reduces the total cost of the product and increases its quality, but it also improves the quality of production processes because it is concerned with improving production activities in the first place.

2. Hypothesis testing

- **First hypothesis:** There is a significant and positive correlation between HE applications and Diyala State Company's products quality engineering.
- **Second hypothesis:** There is a significant and positive correlation between the applications of HE and the engineering operations of Diyala State Production Company.

1. There are medium and positive significant correlations of physical human engineering with product quality engineering and production process engineering at a significance level of 0.01 to support the verification of the validity of the first and second main hypotheses.
2. There are medium and positive significant correlations of environmental human engineering with product quality engineering and production process engineering at a significance level of 0.01 to support the validation of the first and second main hypotheses.
3. There are medium and positive significant correlations of organizational human engineering with product quality engineering and production process engineering at a significance level of 0.01 to support the validation of the first and second main hypotheses.
4. There are medium and positive significant correlations of cognitive human engineering with product quality engineering and production process engineering at a significance level of 0.01 to support the validation of the first and second main hypotheses.

Table 3: The correlation of HE applications with product quality engineering and production process engineering

Variables		Product Quality Engineering	Production Process Engineering	number	%
Physical Human Engineering	Pearson	0.324**	0.339**	2	100
	Sig.	0.000	0.000		
Environmental Human Engineering	Pearson	0.348**	0.469**	2	100
	Sig.	0.000	0.000		
Organizational Human Engineering	Pearson	0.351**	0.382**	2	100
	Sig.	0.000	0.000		
Cognitive Human Engineering	Pearson	0.295**	0.414**	2	100
	Sig.	0.000	0.000		
Number of sub-links		4	4	8	100
Percentage of sub-links		100	100		

- **Third Hypothesis:** There is a significant and positive impact relationship of HE applications in the quality engineering of Diyala State Company's products.

Table (4): Testing the effect of HE applications on the first variable.

HE applications	α	β	βS	C.R.	S.E.	P.	direction	Sig.	R^2	
physical Human Engineering	1.293	.144	.143	2.479	.058	.013	-------→	Sig.	.102	Product Quality Engineering
Environmental Human Engineering		.186	.196	3.393	.055	.000	-------→	Sig.		
Organizational Human Engineering		.212	.204	3.537	.060	.000	-------→	Sig.		
Cognitive Human Engineering		.038	.037	.639	.060	0.52	-------→	not sig.		

The results of (Table 4) indicate the following:

1. The effect of physical human engineering on the quality engineering of Diyala State Company's products, because the significance level (0.013) is less than 0.05 and (C.R. = 2.479) is greater than the standard specified for its acceptance (C.R. > 1.96) to infer the significance of the effect.

2. The impact of environmental human engineering on the quality engineering of Diyala State Company's products, because the significance level ((0.000) is less than 0.05 and (C.R. = 3.393) is greater than the standard specified for its acceptance (C.R. > 1.96) to infer the significance of the effect.
3. The effect of organizational human engineering on the quality engineering of Diyala State Company's products, because the significance level ((0.000) is less than 0.05 and (C.R. = 3.537) is greater than the standard specified for its acceptance (C.R. > 1.96) to infer the significance of the effect.
4. The lack of influence of cognitive human engineering on the quality engineering of Diyala General Company's products, because the significance level (0.52 is greater than 0.05) and (C.R. = 0.639) is less than the standard specified for its acceptance (C.R. > 1.96) to infer that the effect is not significant. .

Based on the results of the influence relationships, the third hypothesis is accepted. We can put it in a multiple linear regression equation, as follows:

PQE = 1.293 + .144 (PHE) + .186 (EHE) + .212 (OHE)

- **Fourth Hypothesis:** There is a significant and positive impact relationship of HE applications in Diyala State Company's Operations Engineering.

Table (5): Testing the effect of HE applications on the dimensions of the second variable.

HE applications	α	β	βS	C.R.	S.E.	P.	direction	Sig.	R^2	
physical Human Engineering	1.082	.065	.072	1.294	.050	.196	-------→	not sig.	.163	Production Process Engineering
Environmental Human Engineering		.279	.327	5.865	.048	.000	-------→	Sig.		
Organizational Human Engineering		.142	.152	2.733	.052	.006	-------→	Sig.		
Cognitive Human Engineering		.157	.168	3.017	.052	.003	-------→	Sig.		

The results (Table 5) indicate the following:

1. There is no impact of physical human engineering on the engineering operations of Diyala State Company's production, because the significance level (0.196) is greater than 0.05 and (C.R. = 1.294) is less than the criterion specified for its acceptance (C.R. > 1.96) to infer the insignificance of the effect.
2. The impact of environmental human engineering on the engineering operations of Diyala State Production Company, because the significance level (0.000) is less than 0.05 and (C.R. = 5.865) is greater than the standard specified for its acceptance (C.R. > 1.96) to infer the significance of the effect.
3. The impact of organizational human engineering on the engineering operations of Diyala State Production Company, because the significance level (0.006) is less than 0.05 and (C.R. = 2.733) is greater than the standard specified for its acceptance (C.R. > 1.96) to infer the significance of the effect.
4. The effect of cognitive human engineering on the production engineering operations of Diyala State Company, because the significance level (0.003) is less than 0.05 and (C.R. = 3.017) is greater than the standard specified for its acceptance (C.R. > 1.96) to infer the significance of the effect. .

Based on the results of the influence relationships, the fourth hypothesis is accepted. We can put it in a multiple linear regression equation, as follows:

POE = 1.082 + .279 (EHE) + .142 (OHE) + .157 (CHE)

FOURTH SUBJECT: THE FINAL FRAMEWORK OF THE RESEARCH

First: Conclusions:

- Diyala State Company indicated a high level of application of physical human engineering, because the workers feel the company's seriousness in determining the appropriate tools, and their perception of this is reflected in the lack of risks resulting from these operations, as well as the ease of implementation.
- The company has proven its interest in environmental human engineering, by removing the negative effects of environmental factors affecting individuals of all kinds, and that it is devoid of these factors to an extent acceptable to workers, and takes the necessary measures to address them if they exist.
- The company has shown a remarkable interest in organizational human engineering as evidenced by the employees' awareness and awareness of

the company's interest in organizing work based on specifications it adopts in designing operations and organizing production activities.

- The company is keen to take into account the employees' knowledge capabilities when designing work and distributing tasks, which is reflected in the adaptation of their qualifications to the current work environment in the company, indicating that they have no difficulty in understanding the tasks assigned to them.
- The company has shown great interest in engineering the quality of its products, which indicates the availability of the appropriate ground for understanding value engineering studies and their direct impact on increasing the quality of products.
- The company has great interest in improving the quality of its production processes, which gave the company the advantage of simplicity and uncomplicatedness in its production processes.
- The results of the correlation confirmed that the company, whenever it applies HE, it will achieve great value in the quality of its products and production processes.
- The impact results confirmed that the company's interest in HE applications will positively affect the quality of products and production processes.

Second: Recommendation:

- Enhancing the applications of human engineering in Diyala State Company and employing them in a scientific manner in order to reach the general welfare in the work environment, whose effects are reflected on achieving the maximum possible value for the quality of its products, production processes and work system.
- The need to pay attention to physical human engineering in terms of creating tools, equipment and sustainable work technology in order to facilitate the completion of activities and work in all body positions, and reduce stress at work.
- Strengthening the environmental human engineering in the company and removing all its negative influences, because of its great role in increasing the performance of employees and their productive efficiency, and reducing the stress pressures that may be caused by weakness in this aspect.
- Focusing on organizational human engineering when designing and organizing its production processes, in order to achieve occupational safety and avoid work risks, because of its impact on achieving job satisfaction, and

reducing stress pressure that may be caused by weakness in this aspect.

- Emphasis on taking into account the individual's cognitive and cognitive abilities with the requirements of the job he occupies, even if it requires re-designing jobs, which makes them feel belonging to the company and which will be reflected in their acceptance and acceptance of the responsibilities entrusted to them.
- Working on developing the infrastructure of the company's research and development department to conduct more applied scientific studies related to the engineering of its products, with the necessity of involving technical workers in these studies and engaging them in intensive training courses.
- The company should simplify its production processes, both manufacturing and service, to the extent that does not affect the efficiency of work performance, and avoiding routine and the complexity of carrying out activities and tasks in a way that achieves the required productivity with the least steps, efforts and costs

REFERENCES

1. Ahmed, Khaled Ali. & Pandey, R. K. (2016). **"Concept of Value Engineering in Construction Industry"**. International Journal of Science and Research, Vol 5 Issue 4.
2. Alves, Anabela Carvalho. Et al. (2019). "**symbiotic relationship between Lean Production and Ergonomics: insights from Industrial Engineering final year projects".** International Journal of Industrial Engineering and Management (IJIEM), Vol.10 No 4, 2019, pp: 243-256.
3. Aujan, Dima Mithqal Abd. (2019). The impact of human engineering on organizational energy: the mediating role of the absorption strategy: a case study in the Aqaba Water Company in Jordan. Master's Thesis, College of Business, Middle East University.
4. Barkhuiezen, W. F. (2002). **"Life Cycle Management for Mining Machinery"**. http://smealsearch.psu.edu/81540.html.
5. Baydur, Hakan. Ergör, Alp. Demiral, Yücel. & Akalın, Elif. (2016). **"Effect Of Participatory Ergonomic Intervention On The Development Of Upper Extremity Musculoskeletal Disorders And Disability In Office Employees Using A Computer".** Celal Bayar University School of Health, Manisa, Turkey.
6. Bock, Stefan & Pütz, Markus. (2016). **"Implementing Value Engineering Based on a Multidimensional Quality-Oriented Control Calculus within a Target Costing and Target Pricing Approach"**. International Journal of Production Economics, School of Business and Economics, University of Wuppertal, Germany.
7. BOGOJEVIC, LEONARD. (2020). "**Ergonomic evaluation using a digital human modelling tool simulation".** Department of Industrial and Materials Science, Division of Production Systems, Chalmers University of Technology Gothenburg, Sweden.
8. Bridger R.S. (2003). "**Introduction to Ergonomics**". First ed, British Library Cataloguing in Publication Data, Taylor & Francis e-Library. London. UK.
9. Broberg, O. (2007). **"Integrating Ergonomics into Engineering: Empirical Evidence & Implications for the Ergonomics, Human Factors & Ergonomics in Manufacturing 17"**.
10. Burnham, J. C. (2009). **"Accident prone: A history of technology, psychology and misfits of the machine age"**. Chicago, The University of Chicago Press.
11. Christensen, David Ryan. (2014). **"Creating Total Value Engineering Through Combining Design for Manufacturing and Design for Six Sigma Constructs"**. Master of Science thesis, School of Technology, Brigham Young University.

12. Christy, Veena. (2019). **"Ergonomics And Employee Engagement"**. International Journal of Mechanical Engineering and Technology, Vol.10, Iss.02, PP:105-109.

13. DAHOOIE, Jalil H. DEHSHIRI, S Jalaladdin. BANAITIS, Audrius. & VĖLIENĖ, Arūnė B. (2020). **"Identifying And Prioritizing Cost Reduction Solutions In The Supply Chain By Integrating Value Engineering And Gray Multi-Criteria Decision-Making"**. Technological and Economic Development of Economy. 26(6): 1311–1338.

14. Dekker, Sidney W. A. (2015). **"Ergonomics, Accountability And Complexity"**. Safety Science Innovation Lab, Griffith University, Brisbane, Australia.

15. Dul, Jan. & Neumann, W. Patrick. (2009). "Ergonomics contributions to company strategies". journal homepage: www.elsevier.com/locate/apergo, Applied Ergonomics. P: 745–752.

16. Evans, James R. & D, A. Collier. (2007). **"Operation Management: An In Targeted goods & Services Approach"**. 6th Ed, Thomson South Western, China.

17. Gualtieri, Luca. Rauch, Erwin. Vidoni, Renato. (2021). **"Emerging research fields in safety and ergonomics in industrial collaborative robotics: A systematic literature review"**. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license, Industrial Engineering and Automation (IEA), Faculty of Science and Technology, Free University of Bolzano, Piazza Università 5, 39100 Bolzano, Italy.

18. Heizer, Jay, Render, Barry. & Munson, Chuck. (2015). **"Operation Management: Sustainability and Supply Chain Management"**. 12th ed. Upper Sadale River.

19. Helali, Faramarz. (2008). **"Developing an Ergonomics Process for Improving Work System in Organization in an Industrially Developing Country and It's Mate - Reflection"**. Doctoral thesis, University of Lulea, Iran.

20. Hill, Arthur V. (2012). "**The Encyclopedia of Operations Management: A Field Manual and Glossary of Operations Management Terms and Concepts**". Published by Pearson Education, Inc, New Jersey.

21. Holden, Richard J. Cornet, Victor P. & Valdez, Rupa S. (2020). **"Patient ergonomics: 10-year mapping review of patient-centered human factors"**. Contents lists available at Science Direct, Applied Ergonomics. journal homepage: http://www.elsevier.com/locate/apergo.

22. Jeyakumar, Ratnam. (2013). **"The Implementation and Effectiveness of Value Engineering in the United Arab Emirates"**. Doctor of Philosophy thesis, Faculty of Advanced Technology University of Glamorgan.

23. Khayal, osama Mohammed. (2019). **"Human factors and ergonomics".** www.researchgate.net/publication/334458657.

24. Limerick, Robin Burgess. (2019). **"Participatory ergonomics: Evidence and implementation lessons"**. ELSEVIER 21.

25. MACIVER, SCOT. (2018). **"Value Engineering Cities"**. Master of Science Thesis in Civil Engineering in the Graduate College of the University of Illinois at Chicag.

26. Marek, Tadeusz et al. (2014). **"Human Factors of a Global Society: a system of system Perspective"**. Series Editor Waldemar Karwowski**,** CRC Press is an imprint of theTaylor & Francis Group, an informa business**,**

27. McNeese, Nathan J. (2015). "**The Human Factors of Intelligence Analysis".** Article in Proceedings of the Human Factors and Ergonomics Society Annual Meeting ·

28. Norling, Erika Salguero & Dávila, Daniel Kaufmann. (2020). **"Ergonomic Case Study Of An Assembly Line And Solution Implementation In ECCO Finishing / Carlisle Fluid Technologies (CFT)".** Bachelor degree project in Product Design Engineering, Level G2E 30 ECTS. University of SKOVDE.

29. Österman, Cecilia. (2007). **"Cost-benefit of Ergonomics in Shipping"**. Master Thesis, Department of Management and Engineering, Division of Industrial Ergonomics, LINKÖPING UNIVERSITY.

30. OTOO, FRANCIS. (2017). **"Ergonomic Risk Factors And Work-Related Musculoskeletal Disorders Among Workers In The Cement Block Manufacturing Companies In TEMA"**. Master Of Science Degree In Occupational Hygiene, School Of Public Health College Of Health Science University Of Ghana.

31. Peters, Terri and D'Penna, Kristen. (2020). **" Biophilic Design for Restorative University Learning Environments: A Critical Review of Literature and Design Recommendations"**. Article Department of Architectural Science, Ryerson University, Toronto, ON M5B 2K3, Canada.

32. Russell, Roberta S. & Taylor, Bernard W. (2010). **"Operations Management: Creating Value Along the Supply Chain"**. 7TH ED, JOHN WILEY & SONS, INC. Printed in the United States of America.

33. Santos, Zélio Geraldo dos. Vieira, Leandro. & Balbinottic, Giles. (2015). **"Lean Manufacturing and ergonomic working conditions in the automotive industry"**.

Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license, Peer-review under responsibility of AHFE Conference

34. Sharples, Sarah. Shorrock, Steven & Waterson, Patrick. (2015). " **Contemporary Ergonomics and Human Factors 2015".** Printed and bound in Great Britain by CPI Group (UK) Ltd, Croydon, CR0 4YY. Taylor & Francis.
35. Shorrock, Steven. & Williams, Claire. (2017). **"Human Factors and Ergonomics in Practice: Improving System Performance and Human Well-Being in the Real World".** Taylor & Francis Group, Boca Raton London New York. http://www.taylorandfrancis.com.
36. Slack, Nigel. Chambers, Stuart. & Johnston, Robert. (2010). **"Operation Management"**. 6th ed, Pearson Education Limited, Edinburgh Gate, Harlow, Essex CM20 2JE. British Library Cataloguing-in-Publication Data. England
37. Stephens, Derek. (2020). **"Tools for Ergonomic Intervention: The Development and Analysis of a Cost Calculator"**. Master of Science, College of Engineering and Technology of Ohio University.
38. Stevenson, William J. (2018). **"Operations Management"**. 13th ed, Rochester Institute of Technology, Library of Congress Cataloging-in-Publication Data. New York USA.
39. Tao, Jing & Yu, Suiran. (2018). **"Product life cycle design for sustainable value creation: methods of sustainable product development in the context of high value engineering"**. 25th CIRP Life Cycle Engineering (LCE) Conference, 30 April – 2 May 2018, Copenhagen, Denmark.
40. TASSINARI Robert. (2006**). "ANALYSE DE LA VALEUR: La réduction des coûts de production… sans altération de la qualité du produit et sa valeur pour le client"**. CNAM Principes et outils du management- EME140 TD n°2 Analyse de la valeur.
41. Trebu, P. & Petriková, A. (2017). **"Influence of Physical Factors of Working Environment on Worker"**. â€TM S Performance From Ergonomic Point of View, 1-9.
42. Waterson, Patrick. (2017). **"Ergonomics and Ergonomists Lessons for Human Factors and Ergonomics Practice from the Past and Present"**. Taylor & Francis Group, Boca Raton London New York. http://www.taylorandfrancis.com
43. Zink, Klaus J. & Fischer, Klaus. (2014). "**Do we need sustainability as a new approach in human factors and ergonomics?"**. This article was downloaded by: [University of Sussex Library] On: 03 September 2014, At: 01:27, Publisher: Taylor & Francis

44. Zohoori, Bahareh. Verbraeck, Alexander. Bagherpour, Morteza. & Khakdaman, Masoud. (2018). **"Monitoring production time and cost performance by combining earned value analysis and adaptive fuzzy control"**. Computers & Industrial Engineering, Tehran, Iran. doi: https://doi.org/10.1016/j.cie.2018.11.019.

45. Zunjic, Aleksandar. (2017). **"A new definition of ergonomics**". IETI Transactions on Ergonomics and Safety. Volume 1, Issue 1, http://ieti.net/TES/.