Chapter

Impact of ICT to Improve of the Manufacturing in a SME Biomedical of Mexicali, Mexico

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Abstract

This work presents a way to optimize the manufacturing processes in a small biomedical industry considered in the micro-, small-, and medium-sized enterprises (SME) group and located in the Mexicali city, using a specialized software that act as design and test of a new model, being the COSIMIR (Cell Oriented Simulation of Industrial Robots) software. With this software was designed a new industrial process in a workstation separated of the main step of a manufacturing line, where are fabricated biomechanical knees pads. The process was made as a manual activity in a work station and had to be separated from the conveyor belt of the main activities, because where previously made by an automatized device that was failing continually and was delaying the delivery to the next steps of the manufacturing processes and to the customers as a final product fabricated in this industry. In this place of the company, an operation was made to organize the biomechanical knee in a plastic container with divisions and to be transported safe and quickly to other area by a conveyor belt with linear process flow. The investigation was conducted from 2018 to 2019.

Keywords: ICT, SME biomedical industry, COSIMIR software, manufacturing processes

1. Introduction

The optimization in industrial process reduces and eliminates a lot quantity of failures and errors, generating more control in any step of the manufacturing areas. The majorly of the times are used specific improvements tools, as Ishikawa diagram and control graphs, principally; and in this times is used information and communication technologies (ICT) as complement of the optimization of the fabrication processes, with software to simulate the industrial activities, before applied in the industrial processes of any type of industrial company [1]. This has been to optimize the industrial operations and supports greatly to the industrial plants, where software have developed by specialized programmers, simulating the functionability of each step of the manufacturing processes and to have an idea of the industrial operations, as the possible fails and errors to

avoid unnecesary costs [2]. One of the most important industries worldwide is biomedical, which manufactures various devices used in everyday life in the SME biomedical industry of the Mexicali city [3]. There are much software to simulate industrial operations with design and test functions, being one of most used in the industry for the design of equipment, machines and tools, the COSIMIR software. This software contains basic and specialized functions with illustrations are made for industrial certain operations. In this investigation, this software was used to design a new work table, being developed in a special step of a manufacturing line out of the conveyor belt where biomechanical knee pads were organized in a plastic container divided into sections. This evaluation was made because, in this industrial operation, they were presented high indices of deffective products manufactured, before be organized in the containers, for the rawhen processing them quickly as the operation of the conveyor belt. Due to this, the following operations on the conveyor belt could not be developed by workers, causing delays in delivery to the following areas and to the customer. This generated concern in managers and supervisory personnel, the solution being the implementation of a work table in an annex place at the conveyor belt where it previously was made. One aspect observed was the evaluation of development of operations with security and comfort, analyzing the movements and postures of workers in each operation of the new workstation as ergonomic way [4, 5]. This caused at first, a greater concern of the operating personnel by the possible presence of a fatigue and stress, by inadequate postures and quantity of movements but was solution-ated by ergonomic methods, to elaborate the activities in a manual way adequately, with correct light as is showed in **Figure 1**.

1.1 Impact of ICT in the industry

Mexicali, which is located in the northwest of the Mexican Republic, is considered an industrial city where there are around 50 SME industrial companies of various types of manufacturing, which use the ICT [6, 7]. ICT are a very basic tool in industrial activities of big and SME industries, where they have infinity of software in various operations. In all industries, various analyzes are elaborated with software that support the improvement of functions, being mainly to develop

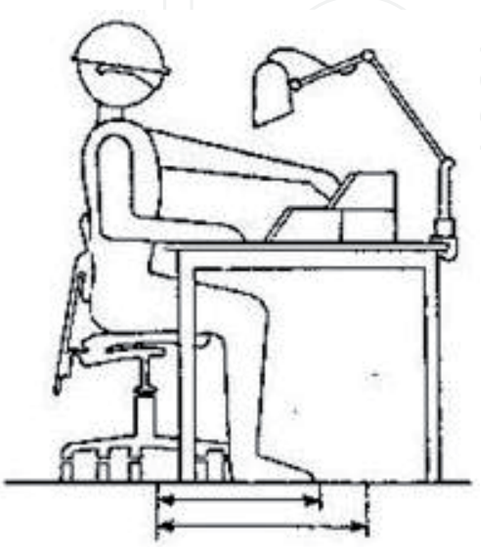

Figure 1.
Correct posture and installation of the new worktable proposed in the investigation (2018). Source: https://www.monografias.com/trabajos101/a-estaciones-trabajo-aburridas-solucion-aplicacion-ergonomia/a-estaciones-trabajo-aburridas-solucion-aplicacion-ergonomia2.shtml

simulation evaluations, which determine if it is possible to apply the pertinent improvements for the solution of problems [4]. This is evaluated to increase levels of certain parameters such as production and quality and to reduce or eliminate human errors or occupational risks [4]. When in an industry integrates to the use of the Internet, ICT are part of it, requiring specialized services and evaluating costs to obtain the greatest benefit from ICT and achieve optimum growth for the company [8]. The ICT have managed to impact the work centers in such a way that sometimes the interaction between workers in administrative and production areas is through mobile or desktop computers, and if there is no control over this, the communication between industrial equipment and machinery, is more difficult, originating sometimes fails and errors, as is showed in **Figure 2**. The ICT have successfully brought people together through videoconferencing, information exchange, and remote process assessment of industrial processes, which has greatly supported in the optimizing of operations and decision-making without being in the manufacturing areas. Another important aspect is to be able to easily and quickly obtain relevant information to the company, to elaborate the pertinent analysis and continuous improvement, to increase the operating performance of both workers and industrial equipment and machines from any place of the world [5].

1.2 COSIMIR software

This a very friendly and easy to learn software that was developed by the FESTO Company for analysis of robot operations, but as its users have specialized in this software, it has been used for other types of designs, such as the work table of this investigation [9]. A main feature of this software is to be able to add objects for any type of industrial or other activity to be used in industrial plants [10]. This company created this software to develop and evaluate simulations with robots in industrial processes and dedicated educational institutions to optimize the teaching learning processes, so that the students had notions at the time to begin to work. In this investigation, this software was applied to elaborate the development of new tools and structures to improve working conditions, increasing the production and

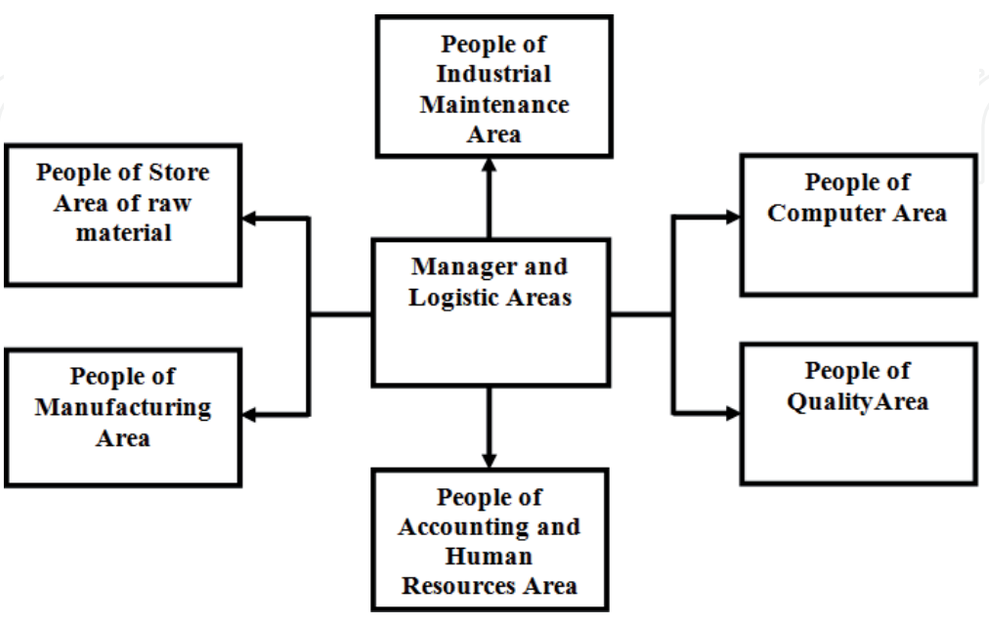

Figure 2.
Adequate communication using ICT in the SME biomedical industry evaluated.Source: Analysis of the investigation.

quality indices and reducing fails and errors. With this software, was made previous simulations very easy that supported to determine the types of adequate workstation to any type of workers. This modeling software allowed knowing the operation of new designs workstations and determine the most efficient, of by applying integrated manufacturing tools by computer that is showed in **Figure 3**. The ICT are very useful in the automation of industrial processes, such as the one used in this study, with a coupling system with the computer and a specialized database [11]. Manufacturing processes were found to improve productivity and quality rates with automated electronic systems controlled by ICT. The COSIMIR software that can be evaluated objects and figures in 3D, has been very utilized from the late twentieth century in educational activities and investigation laboratories, and in industries this software began to use in industries and in the last 10 years was increased its use. It is a friendly software to students and was generated a great interest to be utilized in some industrial activities. The ICT are very useful in the automation of industrial processes, such is showed in this investigation with a docking system between a computer system and a specialized database.

1.3 Computer integrated manufacturing

There are countless industrial processes that are the main structure of the activities of industrial plants, and are constituided of automated and manual operations, which use the Computer Integrated Manufacturing (CIM) processes. The functions that are performed manually are developed in assembly lines and in worktables, where they are grouped by manufacturing cells. In all industrial processes there are relevant factors that improve quality and tend to increase productivity, applying process optimization methods. This generates competitiveness in industrial companies. One factor is the safety and comfort of the operating personnel who elaborate

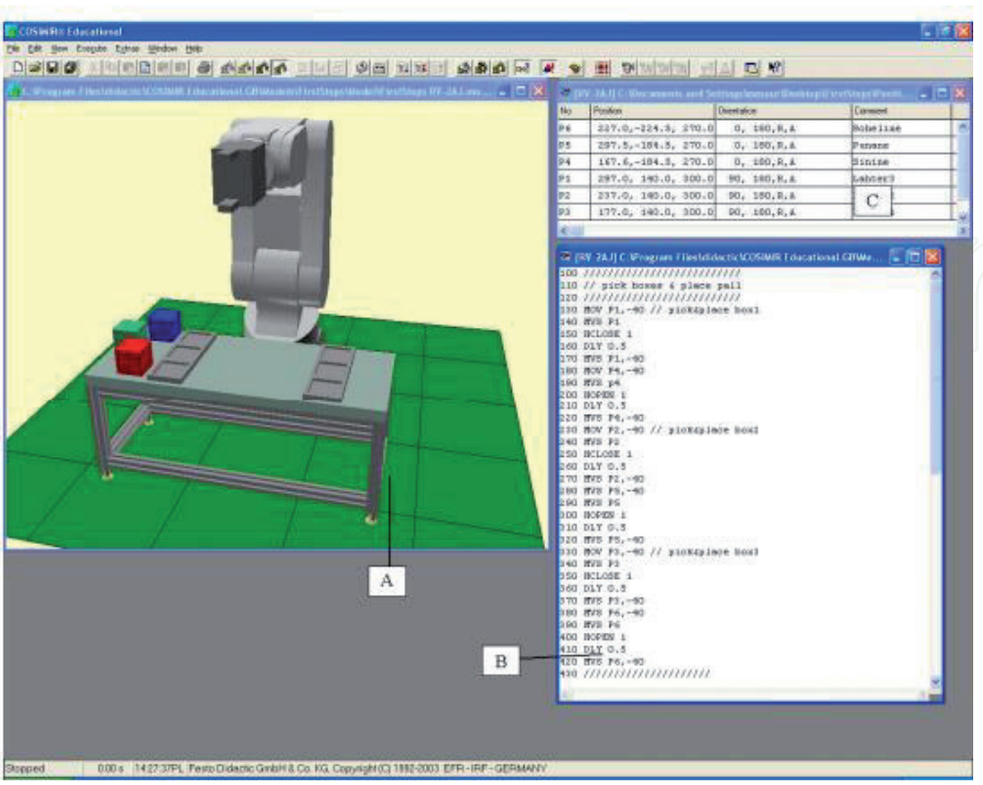

Figure 3.
View of an industrial process with robot using the COSIMIR software. Source: http://www.ene.ttu.ee/elektriajamid/oppeinfo/materjal/AAR0040/Pt31_COSIMIR_Educational.pdf

the activities, since musculoskeletal disorders are sometimes generated, caused by cumulative trama by inadequate postures and movements of workers. In this study elaborated, was suggested to evaluate the industrial processes in a work station and optimize them to obtain maximum operative yielding of industrial equipment and machinery, and of people that was working in manufacturing areas. For this reason, a new industrial process was collocated with a new worktable to improve the industrial process of the manufacturing line evaluated [11]. In this industry evaluated, there are areas with computers, from where are controlled industrial processes analyzing the information with the COSIMIR software to control functions of industrial machinery and equipment with automated functions. Also, manual operations elaborated by workers to evaluate their operational performance were evaluated, and improvements to be developed to optimize manufacturing processes were analyzed. Simulations with COSIMIR software are also generated in these areas. **Figure 4** illustrates an area of computer systems that control the industrial processes.

1.4 Optimization of industrial processes

The operation of industrial plants is made up of tasks with decision-making at the different hierarchy levels, such as planning and scheduling, in addition to optimization and control. Increasing competition from any type of industry requires an operation to have a more agile distribution of manufacturing areas, in order to increase productivity with flexible operations, generating a decrease in the total cost of production [12]. This requires optimization in various industrial processes of the manufacturing areas, applying two essential techniques such as real-time optimization (OTR) and optimization represented by a mathematical model in steady-state conditions and with linear or non-linear equations of industrial processes [13, 14]. In both cases, there are certain limitations to achievable flexibility and economic benefit, especially when considering the use of dynamic processes as continuous processes and with batch operations. In the industries it is common to use control systems based on the feedback of the output variables with the Proportional, Integral and Derivative (PID) controls. A representation of manufacturing processes is in **Figure 5**.

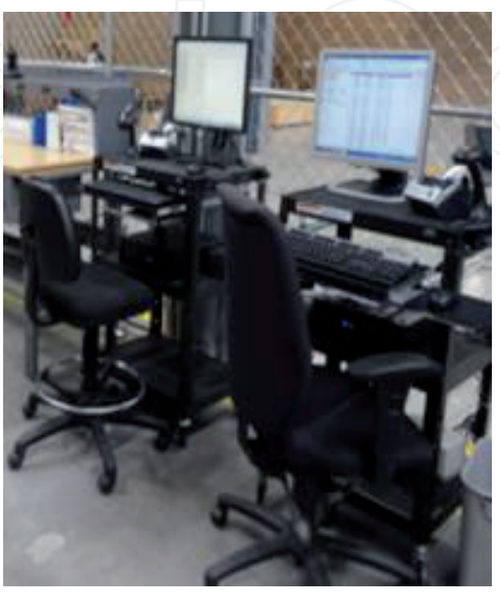

Figure 4.
Area which is controlled by computer the industrial processes. Source: Photography of manufacturing area of a biomedical industry in Mexicali.

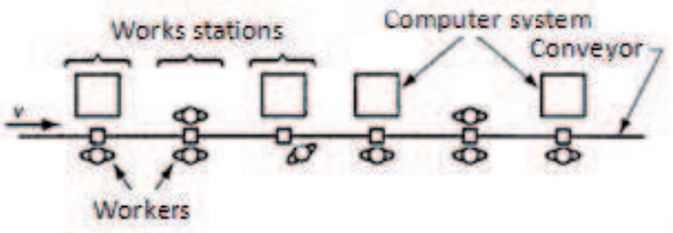

Figure 5.
Schematic diagram of manufacturing area in the electronic industry in Mexicali. Source: Analysis of the investigation.

1.5 Numerical analysis

Only in high level efficiency equipment, it is necessary to use the OTR, with analysis of processes in current periods and with future predictions. In this investigation was used the MATLAB software [15] with mathematical and statistical analysis, to develop the evaluations which the current conditions and the improvements necessary of the manufacturing processes for the optimal operational performance of the evaluated new workstation. Industrial operations are constantly evaluated by MATLAB software that indicates by means of numerical values or representations with signals of various figures in tables or graphs. The specialized personnel of this type of activities have the function of developing analyzing the information obtained from the operational performance of equipment, devices and industrial machinery and developing new prototypes based on the needs of the industries.

Ishikawa diagram used to evaluate industrial processes.

The Ishikawa diagram was is an important tool of continuous improvement and was utilized in this investigation, to evaluate the six parameters that are presented more frequently in any type of operations in any type of industry [16, 17] and in this case was analyzed each step of the process explained in the last section. The Ishikawa diagram is showed in **Figure 6**, and was used with six factors involved in each operation of the company evaluated, being the analysis of:

1. **People:** Evaluation of workers in the manufacturing line investigated, analyzing the time and movements in each operation.

2. **Environment:** Analysis of the relationship of management and supervision personnel with workers who elaborated the industrial activities in each step of the manufacturing line evaluated.

3. **Industrial equipment and machinery:** Evaluation of the operative yielding in each step of the manufacturing line analyzed.

4. **Material:** Evaluation of raw material used in the store and manufacturing areas, to obtain the final fabricated product, and analyze the necessary materials to make the industrial operations.

5. **Method:** Analysis of the way to make the industrial operations, standing or sitting, movements and times of the activities made in the new worktable.

6. **Measurement:** Evaluation of the appropriate measurements and compare them with quality standards established by specialized institutions or organizations.

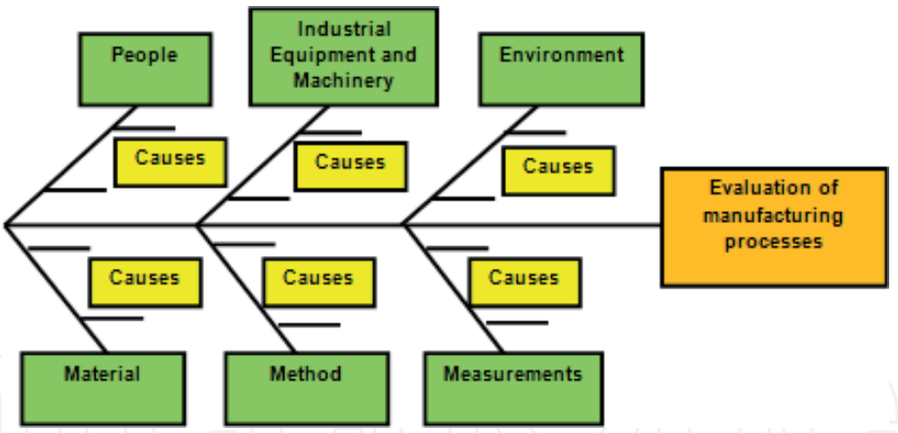

Figure 6.
Steps of Ishikawa diagram used in industries. Source: Analysis of the investigation.

2. Methodology

The study was very relevant to be able to establish a new process attached to the manufacturing line, and to determine with the COSIMIR software, the optimal conditions for the new industrial process. The investigation was elaborated in four phases, as explained below, explaining each of these:

a. Analysis with the Ishikawa diagram of times and movements of the operation of organization of microcomponents in the process in the conveyor belt.

b. Examination of modifying the process flow by eliminating a stage and being processed outside the conveyor belt.

c. Evaluation of friendly software for the design and simulation of industrial processes.

d. Analysis of the implementation in the manufacturing area of the electronic micro-industry.

3. Results

The implementation of the new work table once the design and simulation analyzes were made with the COSIMIR software determined the need to extract the operation of organizing biomechanical knee pads to avoid production stoppages and delays to the subsequent areas and to the customer with the final product to avoid production stopped and delays to the subsequent areas and to the customer with the final product. With the COSIMIR program, the work table was designed and manufactured and the required personnel were quickly trained. Once the expected results have been obtained, was proposed to replicate this procedure in other manufacturing line of this industrial company evaluated where the investigation was elaborated.

3.1 COSIMIR used in the industry

The initial focus of this software was for educational activities, subsequently using it for industrial operations research and the development of new prototypes. This software developed simulations to evaluate the possible improvements of

adding structures, devices or working methods to obtain an immediate and lasting solution to problematic situations that was presented in the manufacturing areas. With this software, a new work table was designed that the SME biomedical industry did not have and was manufactured in this same company by design personnel of new processes and products. **Figure 7** shows the process of development of the work station used in this investigation and was designed by COSIMIR for the new industrial activity. The use of workstations in this industrial plant evaluated, increased in recent years, with the design of new prototypes for the development of manual activities, with the aim minimizing costs and maximizing economic gains, and that are ergonomically suited to operating personnel. The costs of these types of workstations sometimes exceed the expectations of companies that do not include such expenses in their budget, and due to this, they have been implemented in the manufacturing areas without optimizing operations in these.

3.2 Quality of ICT in industrial processes

In this investigation was evaluating the quality of the intensity of signals about the communication of data. This is showed in **Figure 8**, which is very important to determine the capacity of memory of the computer system in the manufacturing areas and the velocity to control industrial processes and the actual version of the COSIMIR software. As is observed in **Figure 8**, the different colors indicate the presence of diverse velocities of intensity of transition data by computers in the manufacturing areas. The development of a new workstation generated maximum efficiency originating an increase of levels of production (86%) and quality (89%) and decreased costs (82%) by having an optimization of processes based on the use of fingersine prepared in the COSIMIR software and similar evaluations that confirmed the need for this continuous improvement. This analysis was based in the reflection of less use of rework, less quantity of people in the manufacturing areas that were resintalled in a new manufacturing line of new product fabricated and the less quantity of fails and errors.

3.3 Correlation analysis of quality control

In this investigation, the distribution by flow of the product was evaluated, where, in this form of work, the distribution of the work tables was organized, as

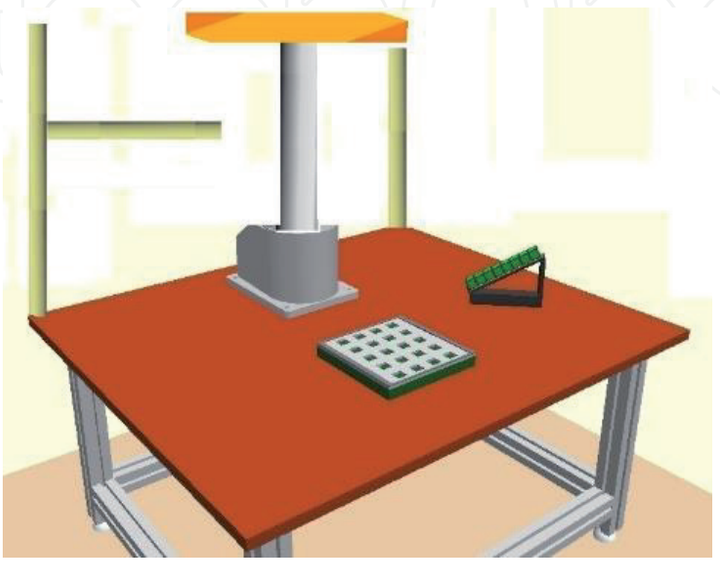

Figure 7.
Development process of the work table with the COSIMIR program.

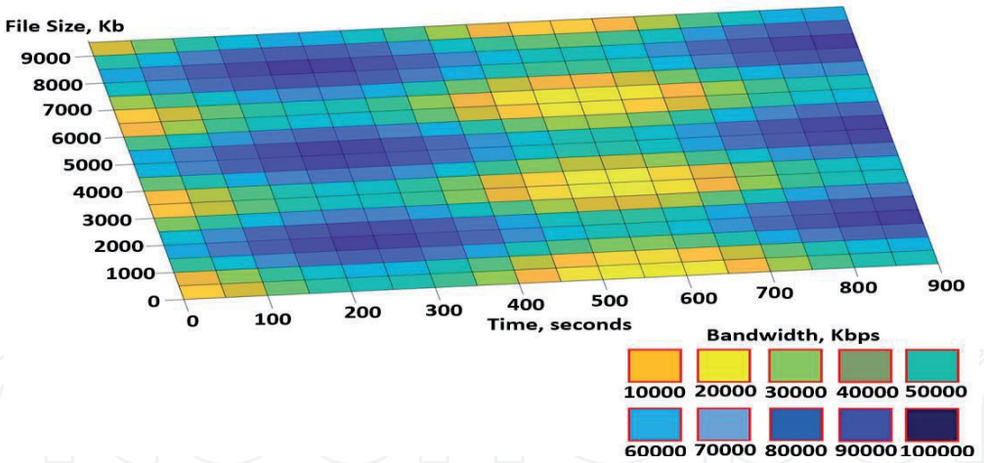

Figure 8.
Analysis of transition and reception of data in an computer system with COSIIMIR software (June, 2018).

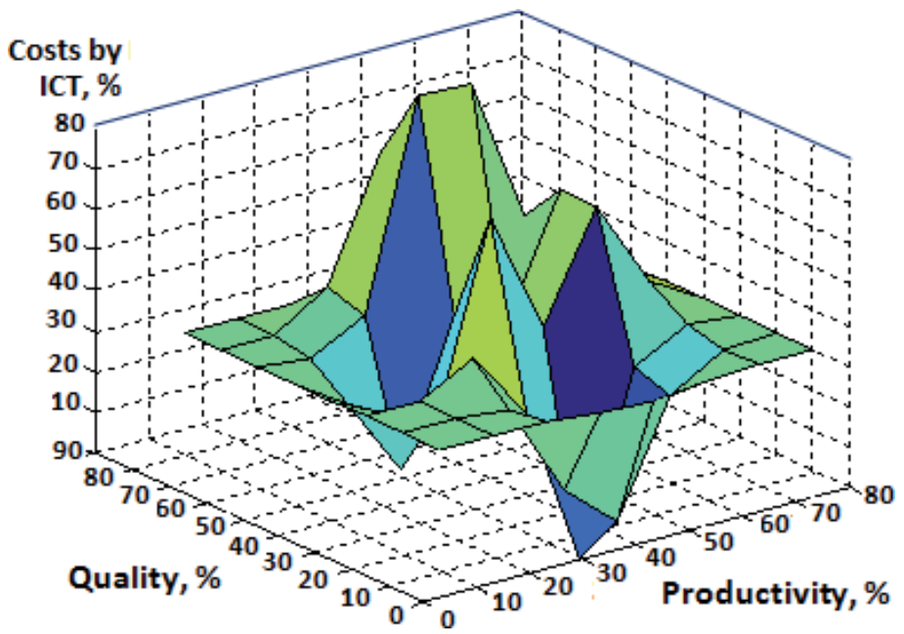

Figure 9.
Correlation analysis of productivity, quality and costs generated by ICT.

well as industrial equipment and machinery at each stage of the manufacturing process, with a sequence of operations to perform during the manufacturing of the product. The use of ICT has been considered as a new tool for business development, because transactions can be processed from anywhere in the world without having to wait for banking systems. This improves efficiency and management in the industries, which evaluate the costs of applying ICT in your company and carry out a comparative analysis of this aspect with the productivity and manufacturing quality indices. With this technological tool, what is called electronic commerce was formed, where financial operations are carried out quickly and easily from the matrixes of industries located in their countries of origin to where their branches are in other countries of the world. This is showed in **Figure 9**.

4. Conclusions

The use of ICT with the Cosimir software in the SME biomedical company, was very relevant in the evaluation of continuos improvement to determine the

principal actions of the parameters evaluated of the operative yielding pf industrial equipment and machinery and the workers. With the simulations in the Cosimir software, in this new process and new worktable, was detected very easy and fastly, the functionability in the worktable and the possible fails and errors. This improve ensure the way to operation of the industrial process in the worktable, both to increase the production and quality indices and to eliminate errors, as well as to have operations of the operating personnel of this manufacturing area with the optimal conditions of postures and movements to avoid any health complications of the workers. The use of COSIMIR software was very relevant because specialized people of this company evaluated, can designa and fabricate a new workstation outside of the conveyor and improve the productivity and quality levels. Manufacturing processes were found to improve productivity and quality rates with automated electronic systems controlled by ICT. With the use of ICT such as COSIMIR, the evaluated micro-industry generated great reliability in its industrial processes and in its manufactured products, so that its profits increased.

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