

Evaluation of Function and Costs of ICT Tools, Management Communication, Labor Psychology and Law Regulations in Industrial Process of an Electronics Industry of Tijuana

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Abstract – An investigation of the use of Information and Communication Technologies (ICT) tools, utilized in the industrial process of an electronics industry was made to evaluate its use, and improve the industrial operations in the manufacturing area. The use of the ICT tool as cloud services was utilized to apply technological resources and supports as flexible, accessible, and scalable ways to improve the management of the information of the industrial processes, as operative yielding of operative workers and industrial equipment and machinery. This was evaluated as labor psychology and law regulations to workers to avoid any type of bad event that can reduce the operative yielding of any person in the manufacturing areas in this industry that permitted the realization of this scientific study. This information obtained of the industrial processes, was sending to the management areas, as Production, Quality, Maintenance, Human Resources, Accounting, Safety, Materials and Store Departments, as the main places of an industry that need be checking every time of the day the information of the industrial processes, to act very fast in the case of any critical situation. In this scientific study, the use of the ICT, was improved the productivity and quality levels, because was acted managers of the Departments mentioned above, being increased around in a 25% of both production factors. This electronics industry was in the Tijuana city, which is a relevant city of the northwest of the Mexico country. Also some important factors were evaluated as temperature, relative humidity and light intensity, were evaluated in indoors of this electronic industry, where are manufactured cell phones and tablets. The investigation was made in 2025.

Keywords: Industrial process, ICT, electronics industry, Productivity and quality levels, Psychologic, Social, law regulations, Industrial design.

1. INTRODUCTION

One of a concern of the management areas, are the evaluation of the productivity and quality levels in industrial processes in any type of industrial company, and especially in the electronics industry where are single and complex processes¹. This is very important in the economic gains or losses, and the growth of any industry. Also, in this scientific study was evaluated the use of ICT tools as cloud services that receive special information of the industrial processes and was stored in specialized computers to be sent to the Departments mentioned above². This was very relevant to detect any critical situation in this electronics industry and improve every time the industrial operations and obtained high levels of productivity and quality, and for this reason economical gains. The labor psychology and law regulations are very important to

conserve the human right as important factors in the development of the industrial operations of workers that realizes his functions in the industrial process of this industry evaluated. The control of the factors mentioned above, was relevant to reaching the goals of the productivity and quality levels³.

2. ICT

ICT are a relevant tool in computation topics, being evaluated the functionality of the computer systems, specially as is mention in this investigation, in the industrial processes, where elaborates a lot tasks with controlled and strict regulations, which depends of the type of industry analyzed⁴. ICT involve tools, devices and systems that realizes operative activities in the manufacturing areas, which are controlled by computer systems to improve the continuous improvement, avoid errors of industrial equipment and machinery in automatized operations, and workers in manual activities in the industrial processes⁵. The ICT are utilized to store, manipulate, and transmit data as text or numerical values; as a digital way to transmit very fast from any place as a begin point to the final point, where be evaluated with specialized software. This process transforms digital communication. In the use of the ICT, are necessary utilize basic and specialized computer systems, digital devices as electronic sensors coupled to specialized computers, smartphones and audiovisual systems, to detect any anomalies in the industrial equipment and machinery, and also in electronic devices as digital components that elaborates some special functions to detect parameters of relevance. In Tijuana city, are around 600 industries, where the 65% are of the electronics industry⁶.

3. OPERATION OF TICS IN INDUSTRIAL ACTIVITIES

The ICT utilizes a lot operations in the industrial companies, where are evaluated and controlled diverse type of factors of importance to each industrial process in the manufacturing areas⁷. The use of the ICT are very relevant because can be coupled with electronic sensors, obtain the numerical data of the industrial operations and control the parameters required to have stable industrial processes and with this, can reach the goals in every day, week, month, seasonally and yearly periods. This is very important because can obtain economical gains in the industries, and of this way, can be inventive to workers to work correctly, with economical bonus. Some relevant factors that was evaluated in this investigation need be controlled in the manufacturing areas, being explained now⁸:

- a. **Temperature.** Is necessary to maintain a comfortable environment in indoors of industrial companies, to workers of elaborates the industrial activities with high operative yielding and avoid the presence of errors to reach the goals. Also, industrial equipment, machinery, systems and electronic devices can generate bad function and can cause electrical or mechanical failures and with this, the presence of errors in the fabrication processes, being destabilized in it industrial operations and can't reach the goals of the productivity and quality indices.
- b. **Relative humidity.** As the temperature factor, this parameter, is very important be controlled, because if not have the control, can generate a lot sweat and have uncomfortable periods of times in person of the manufacturing areas to realizes his functions of the correctly way. Also, the uncontrolled situation of this relevant parameter can cause deterioration of the metallic parts, by the presence of corrosion phenomena, originating electrical or mechanical failures of industrial equipment, machinery, systems, devices and electronic components. With this bad action, can't reach the goals of productivity and quality levels.

- c. **Light intensity.** This important factor was important to elaborate the industrial operations, because in according to the light intensity, occurred some errors in the manual operations of workers.

These three important factors were relevant in the correct functions in the automatized and manual activities of this electronic industry evaluated, being of interesting aspect in the comfortable action to realizes the industrial operations. To understand the ICT systems are used in the industrial activities, is exposed a photography of the relation of the ICT with industrial systems³.

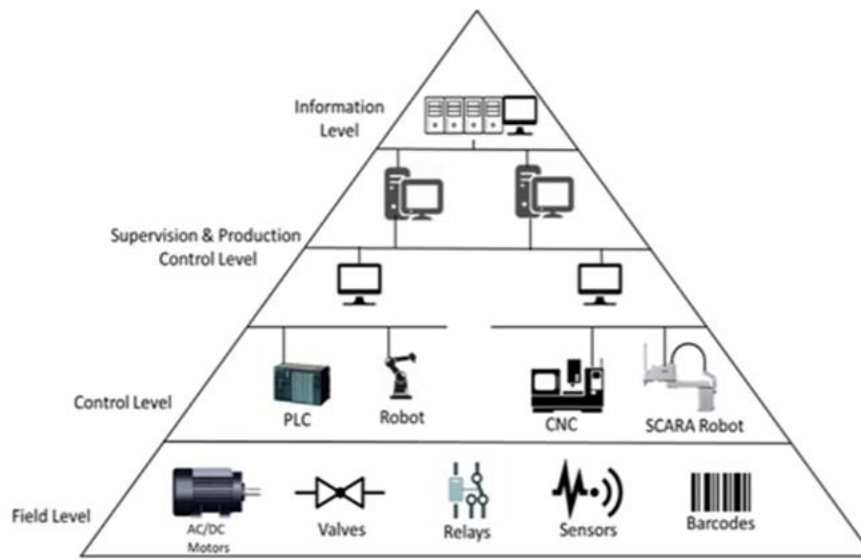


Fig -1: Representation of the use of ICT in industrial activities

Source: Industrial Communication Networks and the Future of Industrial Automation | Semantic Scholar

Figure 1 shows some activities that are controlled and obtain numerical data to be improved the industrial operations in this industrial company evaluated, illustrating the diverse industrial equipment and machinery, which were same as the industrial systems in this electronics industry evaluated.

The main ICT used in this scientific study are described next⁵:

- Communication ICT (CICT).** Are used between persons and companies or institutions, as the email, social networks, instant messaging and videocall.
- Data Processing ICT (PICT).** Is very utilized with computer systems, servers, operative system and management software (ERP, CRM); which supports obtaining, evaluate and elaborate presentations of numerical data from industrial processes, of adequately manner.
- Store ICT (SICT).** Are used by hard disks, USB memories and SD cards, mainly; as cloud store (Google drive and Dropbox), to have security and availability of numerical data of industrial processes.
- Connectivity and Networks ICT (CNICT).** Is very utilized as Wi-Fi, 5G and network cables; to connect to internet and communicate between digital devices.
- Informatic and Security ICT (ISICT).** Are used by informatic tools that protect the relevant information of industrial processes; against threats a informatic virus, firewalls and encryption actions.

- f. **Educative ICT (EICT).** Is very utilized to develop courses in any type of industry, where in this case were used to capacitate workers.

4. ELECTRONICS INDUSTRY

Is an important industry at the worldwide, where manufactures a lot electronic products to be used in the daily life of persons in the world². In this electronics industry are manufactured cell phones and tablets to an important company that sales in the world and is recognized as the good quality by users of these fabricated products. This type of industry uses diverse industrial equipment, machinery, systems and electronic devices, and need maintain the adequate climatic conditions and light intensity to detect very fast any type of anomalies and avoid electrical and mechanical failures that delay the production flow and with this the goals of the productivity and quality indices. In table 1 is presenting the principal industrial equipment, machinery, systems, and electronics devices utilized in this scientific study, in this electronics industry⁸.

Table –1: Main industrial systems utilized in the manufacturing area of the electronics industry evaluated (2025)

Important Parameters	Functionality	Operative Yielding
Industrial Systems		
Barcode Systems	Can be affected by the inadequate climatic parameters and bad manage of workers.	Could reduce the operative yielding up to 50% when climatic factors not are regulated.
CNC Machines	Can suffer of deterioration of metallic parts and can generates electrical and mechanical failures.	Could reduce up to 30% its operative yielding, by the presence of corrosion phenomena.
PLC	Are affected in a lot periods of times and not elaborates the correct function and not can obtain the numerical information.	The bad functionality can reduce up to 70% of its operative yielding and not will collect and receive relevant numerical information.
Robotic Systems	Are affected the elaboration of activities because can operate good and its mechanics can't realize the functions correctly.	The inadequate function can reduce up to 60% its operative yielding, causing delay in the manufacturing processes and high cost in the maintenance.
Sensors	The principal sensors utilized in the electronic industry are the electronic sensors, and are affected by the presence of corrosion in its metallic connections.	Could be reduce up to 25% its operative yielding, because not will function good and will generates a lot errors, being drastically uncontrolled the industrial processes.
Valves	Are affected by the presence principally of high levels of relative humidity, being important on its functionality.	Its operative yielding could reduce up to 35% when the metallic parts of this system are deteriorate by the corrosion phenomena.

Table 1 shows the principal industrial systems utilized in the electronics industry evaluated, being relevant in adequate functionality and operative yielding.

4.1 Labor psychology and law regulations

These two relevant factors were very important in the operative yielding of workers, the operative yielding of the industrial equipment, machinery, systems and electronic devices analyzed; being necessary evaluate its



functionality, because in base of this, was reached the goals in this electronics industry evaluated³. The labor phycological is an interested topic because can support workers to control the stress originated by the industrial operations and the trend of reach the goals of the productivity and quality levels⁴. Workers are stressed when the industrial equipment, machinery, systems and electronic devices fail, and are stooped or not function good, reducing its operative yielding and not reaching the goals of production. When workers reach the goals receive extra payment by this industrial company and other industries, being good because salaries in Mexico not are very good. About the law regulations, is necessary check every time the human right conditions, because when industrial systems fail, a chaotic situation are generated and can originates stress between managers, supervisors and specialized people in the workers of the industrial processes, causing bad moments of stress and reducing his operative yielding. This can be evaluated in the use of ICT systems⁷.

4.2 Costs in industrial operations

When the operative yielding is reduced in the industrial operations, not reach the goals of productivity and quality, and for this reason, the costs are increased, being relevant in the economic gains or economic losses¹. Every industry want to have economic gains, but sometimes, when are depending about the two climatic factors mentioned about and light intensity are uncontrolled, could be presented errors in automatized and manual industrial operations. For this reason, industrial companies want to be controlled all parameters that can affected the industrial processes and can controlled the industrial activities to reach the goals of productivity and quality without stress and not generates health symptoms that reduce his operative yielding. With this every industrial company will have economic gains and the possibility to increase its company and people contracted. This relevant aspect can be analyzed utilizing the ICT systems⁵.

4.3 Industrial design and operative yielding of industrial systems

This is a relevant factor, because the industrial design of industrial equipment, machinery, systems and electronic devices, and also the industrial products fabricated, can have the correct functionality⁴. When the industrial design is not adequate, errors of failure can occur, as electrical or mechanical failures. For this reason, every time is very important, because can control the operative yielding of industrial systems. The evaluation can be applied to the use of ICT systems⁷.

5. METHODOLOGY

In this scientific study an analysis was made of three important factors that were relevant in the functionality and operative yielding of the ICT systems utilized in the electronics industry that permitted the elaboration of this investigation. The actions elaborated are expressed now:

- a. Analysis of the ICT systems evaluated in this electronics industry.
- b. Evaluation of the functionality and operative yielding of industrial systems utilizing ICT and be analyzed in this scientific study.
- c. Analysis of operative yielding of worker with the relation of productivity and quality indices.

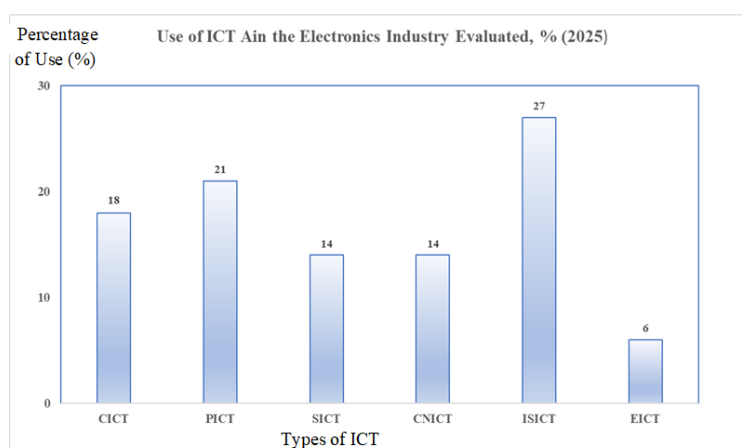
6. RESULTS

This investigation illustrates relevant information to the evaluated electronics industry and other type of industrial companies to improve the industrial processes and operative yielding of industrial equipment,

machinery, systems and electronic devices; and the operative yielding of workers. The numerical information are expressed in the next sections.

6.1 Evaluation of the use of ICT systems

In this part of the investigation was made and analysis of the use of the ICT systems in the electronics industry evaluated, being represented in the figure 2 with the percentages of the use, where are observed that the ISICT, which is the ICT about informatic and security to avoid the loss of relevant numerical data, which represented the major percentage, and were obtained from the industrial processes of the electronics industry that permitted the realization of this investigation. Then appear in second level was presented the PICT that illustrates the processing numerical data, being relevant to determine the actions of the industrial processes of this electronics industry. In third level was the CICT, which represents communication and information about the manufacturing areas actions. In the 4 and 5 level with the same percentage were SICT and CNICT, which represents the store process and the connectivity and use of networks, respectively. And at the final level was the EICT, representing the educative courses about the manufacturing activities and specialized strategies. The paragraphs describe above indicating that is necessary the use of the ICT, and are marked the use of the major ICT tools in this investigation, as is illustrated in figure 2.



6.2 Analysis of the operative yielding of industrial systems

Table 2 represents the

Table -2: Main industrial systems utilized in the manufacturing area of the electronics industry evaluated (2025)

Relevant Factors	Functionality			Operative Yielding			Functionality			Operative Yielding		
Industrial Systems	UCT	UCRH	UCL	UCT	UCRH	UCL	UCT	UCRH	UCL	UCT	UCRH	UCL
Barcodes Systems	XX-2	XX-1	XX-1	XX-2	XX-1	XX-2	X-2	X-3	X-1	X-2	X-2	X-2
CNC Machines	XX-3	XX-3	XX-3	XX-3	XX-3	XX-3	X-3	X-3	X-2	X-2	X-2	X-2
PLC	XX-3	XX-3	XX-2	XX-3	XX-3	XX-3	X-3	X-3	X-2-2	X-3	X-3	X-2
Robotic Systems	XX-3	XX-3	XX-3	XX-3	XX-3	XX-3	X-3	X-3	X-3	X-3	X-3	X-3
Sensors	XX-3	XX-3	XX-2	XX-3	XX-3	XX-3	X-3	X-3	X-2	X-3	X-2	X-3
Valves	XX-1	XX-2	XX-2	XX2	XX-2	XX-2	X-3	X-3	X-2	X-2	X-2	X-2

UCT. Uncontrolled Temperature; U-ICRH. Uncontrolled Relative Humidity; UCLI. Uncontrolled Light Intensity

CT. Controlled Temperature; CRH. Controlled Relative Humidity; CLI. Controlled Light Intensity

(X) In good state and good function; (XX) In bad state and mal function.

Grade of control and uncontrol actions (1- Low Grade,2- Medium Grade,3-High Grade)

Table 2 shows the correlation analysis about the effect of the parameters involved in this investigation, being with more negative effect in the functionality and operative yielding the temperature and relative humidity, as a climatic parameter, as is observed. In this table is illustrated the negative effect of the presence of the three factors evaluated, and the level of grade that were generating a bad or good actions in the functionality and in the operative yielding. This means that climatic factors debit be controlled in indoors of this electronics industry and other type of industries to have good function of industrial equipment, machinery, systems and electronic devices to reach the goals of the productivity and quality indices.

6.3 Evaluation of the operative yielding of workers

Table 3 represents the percentages of the productivity and quality indices, about the relation with the functionality and operative yielding of the industrial equipment, machinery, systems and electronic devices as systems, and about the manual operations of the workers of industrial processes. This analysis was made by month from January to December of 2025.

Table -3: Evaluation of the productivity and quality indices of the electronics industry (2025)

Production Factors	Productivity, %			Quality, %		
Months	UCT	UCRH	UCLI	UCT	UCRH	UCLI
January	54	53	48	75	74	73
February	58	55	50	77	76	77
March	63	59	56	78	77	78
April	66	63	59	79	79	80
May	70	67	63	80	82	83
June	73	71	65	83	85	85
July	75	74	69	86	88	88
August	77	76	74	88	89	89
September	80	79	77	90	90	90
October	83	80	9	92	92	91
November	85	83	83	94	93	93
December	87	85	85	96	94	94

UCT. Uncontrolled Temperature; UCRH. Uncontrolled Relative Humidity; UCLI. Uncontrolled Light Intensity

CT. Controlled Temperature; CRH. Controlled Relative Humidity; CLI. Controlled Light Intensity

(X) In good state and good function; (XX) In bad state and mal function.

Table 3 illustrates the percentages of the evaluation of the productivity and quality indices, which were lower with the uncontrolled parameters and high with the controlled factors, being relevant in the reach of goals of the productivity and quality indices.

7. CONCLUSIONS

This investigation was very important in the determination of the parameters evaluated that were more effect in the functionality and operative yielding of the industrial equipment, machinery systems, and electronic systems as systems, and too about the manual operations, where workers of the manufacturing areas were participating with great energy in the industrial processes. This scientific study can be replied in other type of electronic industries in all of the world and generate information for any type of industries at worldwide. This investigation determines that is necessary to control all parameters evaluated, principally the climatic factors to avoid failures as electrical or mechanical failures.

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