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Evaluation of Luminosity Levels in Industrial Operations of the Electronics Industry in Mexicali, Mexico, and Its Effect on Health Symptoms (Visual System) of Operational Personnel and Use Special Strategies of Internal Marketing

Gustavo López Badilla[1], Dr. Hugo Lee Martinez[2], María Elena Garibi Chapula[3], Carlos Raúl Navarro González[4], Verónica Arredondo Robledo[5], Ana Laura Sánchez Corona[6], Lizeth Abigail Figueroa Corral[7], Myrna Meling Toledo[8], Raúl Iván Castaneda Quiñones[9], Rosa María Duque Sevilla[10]

[1]Departamento de Ciencias Básicas, Universidad Vasconcelos, Campus Murua-Tijuana, Tijuana. Baja California, Mexico.

[1]Departamento de Tecnología, Secundaria Federal Emiliano Zapata No. 32, Valle Las Palmas, Campus Tijuana, Baja California, Mexico

[2,3]Departamento de Ergonomía aplicada, Ergomedical de México, Astrónomos 13802, INDECO Universidad, Tijuana, Baja California, México.

[4,5,6]Departamento de Ingeniería Industrial, Facultad de Ingeniería, Universidad Autonoma de Baja California, Mexicali, Baja California, Mexico.

[7]Departamento de Investigación, Facultad de Turismo y Mercadotecnia, Universidad Autonoma de Baja California, Tijuana, Baja California, México.

[8,9]Departamento de Ciencias Aplicadas, Centro Bachillerato Tecnologico Agropecuario # 146, San Quintín, Baja California, México.

[10]Departamento de Ingeniería Industrial, Tecnológico Nacional de México, Instituto Tecnológico de Tijuana, Tijuana, Baja California, México.

Abstract - The luminosity levels in the industrial operations of the electronics industry for the welding operation activities of electronic components on electronic boards, which are used in building alarm control systems. When the welding process is not efficient due to inadequate levels of luminosity that generate risk situations for the health of the operational personnel who work in this type of activities in the industrial processes of the electronics industry evaluated. When a complicated types situation arises in the visual system in workers of this type of functions, welding operations can be generated with defects of lack or excess of solder, causing false electrical contacts or even short circuits that can cause cases of lack of functionality of the alarm control systems (that do not activate) or even a possible fire in buildings where these types of alarms are installed, due to a short circuit. This represents a chaotic occupational health situation in the electronics industry evaluated, indicating that many defective products were generated and with it the lack of compliance with productive performance goals (production and quality levels) and workers in these functions with burns. due to lack of adequate lighting in welding activities in the electronics industry evaluated. An automatized system was designed and used to control the luminosity generated in the metallic industry where was made this investigation. Also was made special

strategies of internal marketing to improve the productivity and quality indices. This investigation was made in an electronic industry installed in the Mexicali city in 2023.

Keywords: Brightness levels, electronic industry, occupational health, soldering operations, visual system, automatized system.

1.INTRODUCTION

The electronics industry is a relevant industry at the worldwide, because manufactures a lot electronic products, which are utilized by a great quantity of persons in each place of the world, being necessary to a lot activities in the daily life (Harrison et al, 2020). In the electronics industry installed in the Mexicali city was manufactures principally cell phones, computer systems, tablets and televisions, which are utilized in a lot regions of the world and a small percentage fabricated in this industrial company, are sold in this important area of the Mexican Republic, and are expressed in figure 1 (Zhang et al, 2020).

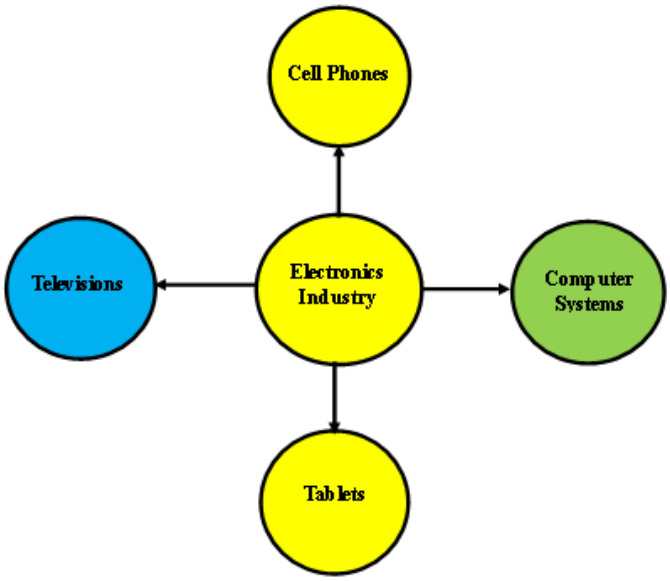

Fig -1: Main products manufactured in the electronics industry evaluated in Mexicali (2023)
Source: Analysis of the investigation

1.1 Electronic Industry

Is one an important industry in the world that generates a lot millions of dollars of the manufactured products and sales of the electronic products mentioned above, which have basic and complex industrial operations to each industrial activity in the manufacturing aeras, being supervised with a strict regulations to an optimal function of the fabricated products. In table 1 is showed the essential industrial operations utilized in the industrial company where was made this scientific study (Baloch et al, 2021).

Table -1: Main industrial operations in the automatized areas of the electronics industry evaluated (2023)

Characteristics	Function
Industrial Operations	
Sequencer Machine	Elaborates the functions of obtain a sequence of electronics devices to be used in the next machine.
Axial Machine	Realizes the installation of the electronics devices in a horizontal form, which are jointed to the electronic board.
Radial Machine	Elaborates the installation of the electronic devices in a vertical form.
Verification Machine	Realizes the function of verify the position of the electronic devices in the respective position of each one to an optimal operation.

Table 1 shows the four industrial operations, where are manufactured one part of each electronic product fabricated in this industrial company are manufactured.

1.2 Manufacturing Processes

This activity is an important industrial operation because have five relevant actions that are represented in figure 2, and explained after the figure, indicating the manufacturing process and steps life period of the electronics products of any place in the world (Kralikova et al, 2016).

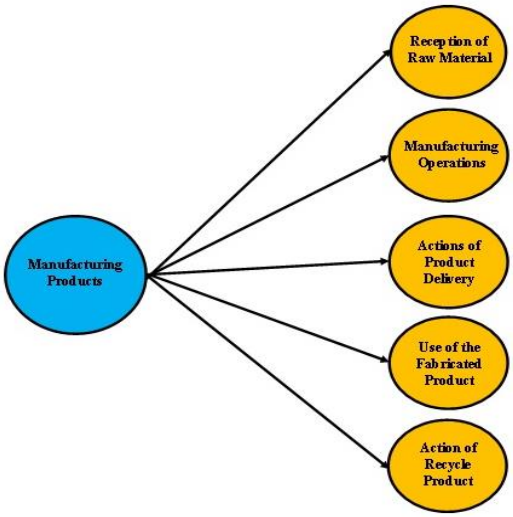

Fig -2:Steps of life period of electronics products manufactured in the electronics industry evaluated (2023)

Source: Analysis of the investigation

The last figure shows the five essential steps of manufacturing processes and the life period of the electronics, which are explained now:

a. **Reception of Raw Material**: In this step, the raw material will be transformed to manufactured products, being the begin of the fabrication process in any industrial company in the world.

Personnel of the reception of raw material, debit be specialized and with the good conscience to organize any raw material to any manufactured product.

b. **Manufacturing Operations**: This step is where the raw material is transformed in fabricated products in any industrial company, with specialized industrial methods with manual activities, elaborated for workers of the manufacturing areas and automatized operations, realized for industrial equipments, machinery and systems of any type of industrial companies at the worldwide.

c. **Actions of Product Delivery:** This action is elaborated to make the delivery of the manufactured products by each industrial company to distribution centers or specialized stores in all places of the world, to be utilized by consumers.

d. **Use of the Fabricated Product**: In this section of the fabricated products is check with the use of the consumers, the efficiency of the manufactured products, the life period, and if some fabricated products of industrial companies give some special warranty, and if this is fulfilled.

e. **Action of Recycle Product**:This step is important to conserve ecosystems, being supported with specialized strategies to avoid damaging it, and can be reutilized some parts or all parts of the manufactured products.

1.3 Occupational Medicine

This branch of the medicine is an interesting thematic in the labor activities of industries, where was supported to the industrial safety and hygiene departments of each electronics industry of the Mexicali city, to avoid and reduce the accidents or diseases as health symptoms of workers of the manufacturing areas (Markkanen, 2014).

Table -2: Essential functions of the occupational medicine in the electronics industry evaluated (2023)

General Aspects Occupational Medicine Functions	Characteristics
Prevent accidents or diseases associated to labor activities	This action is applied to prevent any type of health symptom in any industrial operations, before occurred it.
Control industrial risk in manufacturing operations	This action is utilized to generates safe industrial operations, designing specialized devices, methods and systems.
Decrease the accidents or diseases associated to labor activities	This action is used to monitoring all industrial operations, being the industrial activities with more risk, which are evaluated strictly.

Table 2 illustrates the three principal functions of the occupational medicine, where are evaluated with strict strategies, to avoid any type of labor risk and generation of labor accidents or diseases, and have safe industrial operations and with this increased every time the productivity and quality indices (De Kort et al, 2010).

1.4 Luminosity Levels in Industries

This relevant factor was important in the activities of soldering process in the electronics industry evaluated, considering the three essential aspects in the effectiveness of the luminosity in these interesting industrial operations, being explained now, and is showed in figure 3 (Fukumura et al, 2021, Andrejiová et al, 2019; Papatsimpa et al, 2020).

1. **Use light colors for walls and ceilings when a higher level of lighting is required**: This action is evaluated to increase the visibility of workers, specially of the personnel that works in the soldering process, where are make special industrial operations, soldering electronic devices to relevant functions of the electronic products fabricated in the electronic industry evaluated.

2. **Eliminate shiny surfaces**: This activity is used to avoid that generates a light reflection and originates any discomfort of the workers that are in the soldering process and damage the vision of personnel of this type of relevant industrial operations of the electronics industry evaluated.

3. **Prevent light from lamps from reaching workers' eyes directly**: This action is very important to generate any type of discomfort in eyes of workers of the soldering process.

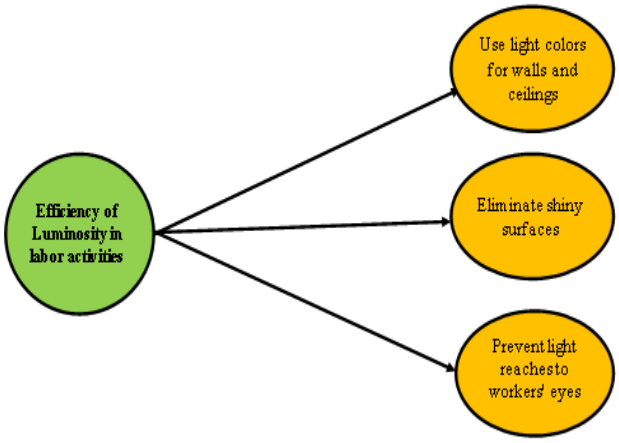

Fig -3: Steps of life period of electronics products manufactured in the electronics industry evaluated (2023)

Source: Analysis of the investigation

The three characteristics of the luminosity indices are utilized to avoid any medical visit to medical attention in the electronics industry evaluated or public health institutions around the electronics industry, where was made this investigation, and are illustrated in figure 3 (Lee et al, 2020).

1.5 Soldering Process in the Electronics Industry

Is a relevant industrial operation, where is necessarily have the optimal labor conditions to elaborate these industrial activities with the major efficiency and avoid any electrical failures in the electronics devices fabricated in the electronic industry evaluated in this industrialized city. In figure 4, is showed the form of elaborates the soldering process, but in this figure was being elaborated with incorrect method, because was observed that the luminosity not was efficient and workers (specially women's) were made this

important operation at the way easier to they, to avoid any discomfort, accident or diseases (Peña-García et al, 2021).

Fig -4:Soldering activity elaborated by worker (women), with incorrect method, generating stress and tired very quickly in the electronics industry evaluated (2023).
Source:Analysis of the investigation

2. METHODOLOGY

This investigation supported in the electronics industry evaluated to reduce health symptoms of the eyesight of workers of the soldering process in the manufacturing areas, where was elaborated in three steps and are explained now:

a. Evaluation of types of health symptoms for ineffectiveness luminosity in the soldering process.
b. Analysis of the medical attention of workers of the soldering process.
c. Evaluation of an improvement with an automatized system to detect ineffectiveness luminosity and send a light message with a light color focus and adjust the luminosity to obtain optimal productivity and quality levels.

3. RESULTS

This scientific study was made to supports to reduce the medical attention for ineffectiveness luminosity in the soldering process, obtained relevant information and illustrated in the next sections.

3.1 Evaluation of Types of Health Symptoms in the Soldering Process

This part of the investigation generated important information to be utilized in the health symptoms data, and inform to directive, managers and supervisor people about the correlation of the labor conditions and the health symptoms occurred principally in the soldering process. With this information, was observed by colors the presence of the four essential health symptoms, where was presented more health symptoms and is analyzed in next section. The blue light color represents the headache symptoms, which was the major percentage in this relevant analysis, and followed by the orange color that indicates the presence of

eye fatigue. Then was observed the gray color, which is presented as the sleep generation and finally with the less percentage of negative effect the neck and back pain

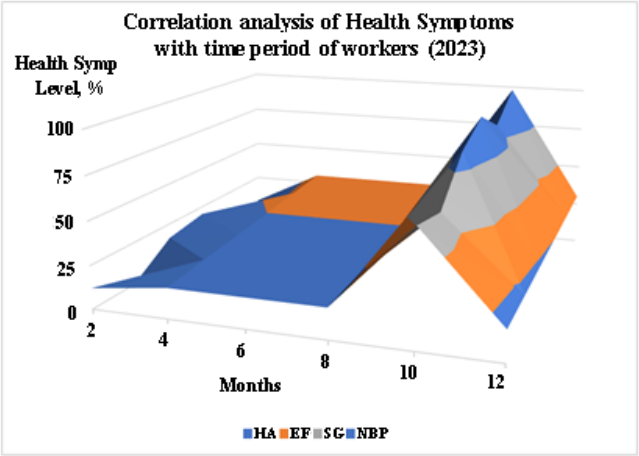

Fig -4: Evaluation of the health symptoms levels in workers of the soldering process (2023) Headache (HA), Eye fatigue (EF), Sleep Generation (SG), Neck and back pain (NBP)

3.2 Analysis of the Medical Attention of Workers

This was made to evaluate the negative effects of sue infectives luminosity, illustrating the principal parts of the human body affected by the incorrect luminosity level required to the soldering process in the electronics industry evaluated. This information is observed in table 3.

Table -3: Evaluation of medical attention of workers of soldering process of the electronics industry (2023)

Events	Slight Health symptoms					Slight Health Symptoms				
Actions	EF	SGHF	SDA	SDS	SDN	BFHA	SPHF	SPA	SPS	SPN
Low luminosity intensity	X	X	X		X	X	X		X	X
High luminosity intensity	X	X		X		X	X	X	X	
Shiny in surfaces of table	X		X	X	X	X		X		X

Slight Health Symptoms: EF. Eye Fatigue; SDHF. Slight Discomfort in Hands and Fingers; SDA. Slight Discomfort in Arms; SDS. Slight Discomfort in Shoulders; SDN. Slight Discomfort in Neck.

Severe Health Symptoms. BFHA. Burns on Fingers Hands and Arms; SPHF. Severe Pain in Hands and Fingers; SPA. Severe Pain in Arms; SPS. Slight Pain in Shoulders; SPN. Slight Pain in Neck.

Table 3 shows the main health symptoms, observing in different actions the slight discomfort or severe pain of fingers, hands, arms, shoulders and neck; representing the negative effects of the visits of workers, specially of the soldering process in the manufacturing aeras of the electronics industry evaluated.

3.3 Evaluation of Improvement Automatized System

In this part of the scientific study, was observed in figure 5, the good conditions of health without symptoms, in according to the improvement made about a new automatized systems to control the luminosity intensity in the soldering process of the fabrication areas of the electronics industry where was made the investigation, which is illustrated in figure 5.

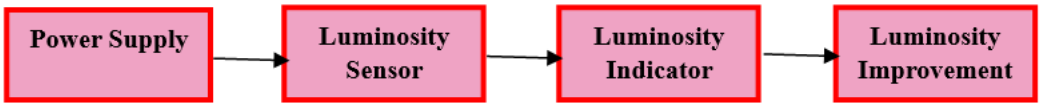

Fig -5: Automatized system to improve the luminosity intensity in the soldering process of the electronics industry evaluated (2023)

Figure 5 presents the four relevant steps that are explained next:

a. **Power supply:** Is part of the supply of the electrical energy to begin the function of the automatized system.

b. **Luminosity sensor:** Detects the luminosity levels, represented by the luminous flux (LF), which unit of measurement is the lumen (lm), then luminous intensity (LI), with the unit is the candela (cd), and finally the illuminance (IM), which the unit is the lux (lx).

c. **Luminosity indicator:** Represents the adequate luminosity to the soldering process.

d. **Luminosity improvement:** Is used to the can modify the luminosity to change to the adequate luminosity to the soldering process.

In base of the information explained, was made an evaluation with the adequate luminosity to obtain information about the labor good conditions, being represented in figure 6, with the diverse six relevant aspects, which are expressed by color, as is mentioned now. The first is the (1) dark blue color represents the no headache, (2) yellow color the not eye fatigue, (3) orange color the high energy of person to works, (4) light blue color to not neck and back pain, (5) gray color to not respiratory problems and (6) not cardiopulmonary circulation problems.

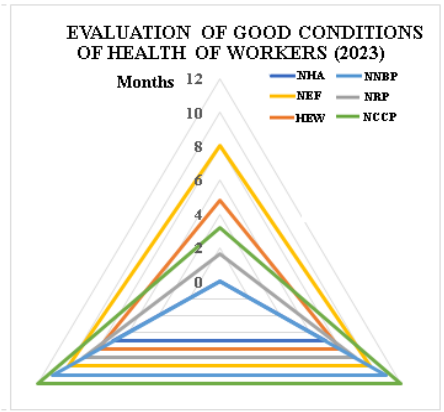

Fig -6: Not-Headache (NHA); Not-Eye fatigue (NEF); High Energy to Work (HEW); NBP. Not- Neck and Back Pain (NNBP); Not-Respiration Problems (NRP); Not-Cardiopulmonary Circulation Problems (NCCP).

4. CONCLUSIONS

This investigation shows interesting information to any industrial company in the world to be improve the labor conditions about this relevant factor as the luminosity intensity, where was observed some health symptoms that are generated by strong industrial activities, when the industrial operation evaluated the soldering process, which with an effectiveness luminosity intensity, this industrial operation can be realized without or less stress and not originate any type of health symptoms. This was important, because with this scientific study, it was proven that was necessary elaborate this type of analysis in the soldering process respect to the luminosity intensity. For this reason, this investigation was supported to the electronic industry evaluated, and decrease the medical visits to medical attention in the industrial company where was made this scientific study, and in the public medical attention of the Mexican government. With this, the productivity and quality indices were increased in this electronic industry.

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