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Correlation Analysis of Manual Handling of Materials, Foreign Trade and Productivity and Quality Levels Based on Business Management and University Educational Programs With the Occupational Health in the Electronic Industry in Tijuana

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Abstract – A study was conducted to evaluate the deterioration of electronic components and electronic boards by handling action, generating damage of these materials and subproducts in an electronic industry located in the Tijuana city. Also was analyzed the foreign trade topic, correlated with the business management and the relation of educative programs of a prestigious university of this important city of the northwest of the Mexican Republic. In this investigation was evaluated the damage of the materials utilized in the manufacturing areas of this industry, when it was handling with the hands by personnel of the industrial process, being called as action of the "Good Practices of the Manufacturing (GPM)", about the handling of electronic devices and electronic board, being evaluated, as a part of the relation of the foreign trade and the business management. The analysis indicated that around 50% of workers do not follow the instructions of the GPM and were damage this type of materials (Ibegbulem A. et al, 2015). Also was made and analysis of the productivity and quality indices, correlated with university-level educational programs of a prestigious university located in the city of Tijuana, regarding the subjects and topics of the use and manufacture of industrial materials. The correlation of the university study programs was to determine if they were adequate

for the teaching-learning process of recently graduated students, and to evaluate their operational performance with respect to quality and productivity indices, which are part of the income and expenses as a foreign trade theme of the industry where the research was made. The scientific study was prepared in 2024. The four relevant aspects evaluated were correlated with the presence of some accidents or diseases of workers of manufacturing areas with the statistical analysis mentioned, and in this way, they were evaluated, as a thematic of occupational health, because were presented some accidents and diseases by the "Bad Manufacturing Practices" (BMP), linked with the business management actions.

Keywords: Materials management, productivity and quality levels, business management, foreign trade, electronics industry.

1. INTRODUCTION

The handling material is a delicate thematic in any type of industry at the worldwide, because, in base of this action, both raw materials and materials, by-products or manufactured products from any industry anywhere in the world can be affected by poor material handling (Asaolu et al, 2012). For this reason, an investigation, was made in an electronic industry, to evaluate specialized strategies about handling materials as "Good Practices of the Manufacturing", foreign trade, business management and a relation of educative programs to be correlated with the occupational health, and with these statistical procedures mentioned above. The foreign trade was evaluated together with the business management to the obtention of raw material and subproducts and planning, organization and control of the industrial activities in this industrial plant evaluated. The results show that were necessary apply the four relevant aspects in this industry and was improve the operative yielding of workers, productivity and quality indices and economical gains in these industrial plants (Dhafr et al, 2016). In this scientific study was made a statistical analysis with the Spearman analysis and correlation analysis to determine the principal factor that was have in the negative effect about the productivity and quality levels. The scientific study was made in the manufacturing areas of an electronics industry located in the city of Tijuana, which manufactures cell phones, where were analyzed the principal aspects of the presence of electrical failures of the cell phones manufactured in this important industry located in this relevant city of the northwest of the Mexican Republic. In this scientific study was observed as nake eye, the presence of small stains in the electrical micro connections of the electronic boards of the cell phones evaluated (Abu Jadayil et al, 2017). Figure 1 represents the relation of the four interesting factors, which are explained in the next text:

a) Good Manufacturing Practices, to be related with the adequate use of the handling of raw material, diverse electronic devices and electronic boards, electronic subproducts and electronic products.

b) Business Management, generating a relationship with the GMP, and the planning, organization and control of the industrial processes, by the managers (specially of part of Production Manager, couple with the Engineering Manager, Quality Manager, Accounting Manager and Human Resources Manager), and supervisors and specialized persons of industrial plants.

c) Educative Programs Linked with Operative Yielding, which have a relation with the operative yielding, with respect about the material handling and with this about the productivity and quality levels of the manufacturing products in the industrial plant that permits this scientific study.

d) Foreign Trade with respect to obtain the best raw material to be handled in the industrial processes in adequate form, with the income taxes to enter to Mexico as raw material and income taxes to enter to United States of America (USA) as final product manufactured in the industrial company located in the Tijuana city.

The four relevant parameters explained and represented in figure 1, were related with the occupational health, to determine the principal aspect that have a negative or positive effect in the productivity and quality indices, and with about the economic gains or economic losses. After made this investigation, was observed that the four important factors were effect as negative action (before use the specialized strategies to improve the GMP), and positive action (after use the specialized strategies to improve the GMP). Figure 1 illustrates the relation mentioned above (Del Vecchio P. et al, 2022).

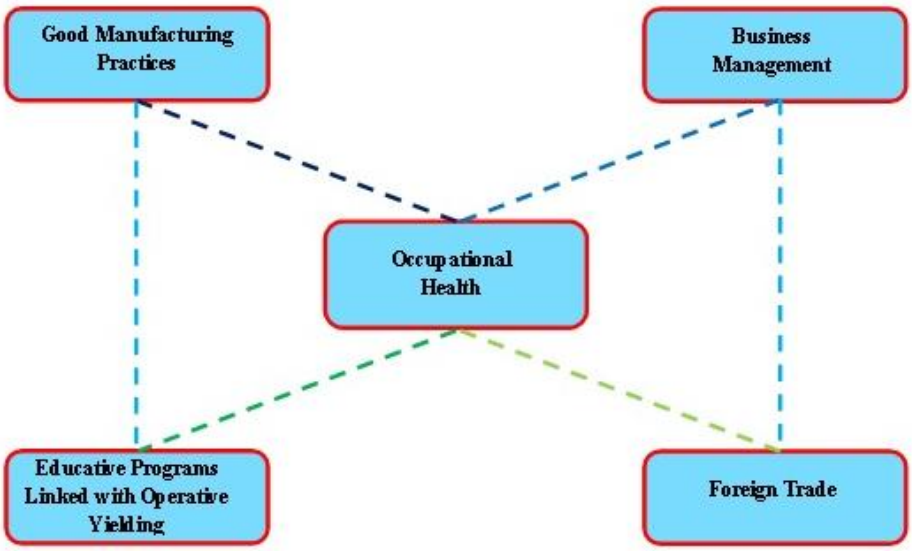

Fig -1: Relevant aspects related to the occupational health in the electronics industry evaluated (2024)

Good Manufacturing Practices in the Electronics Industry

The GMP is a specialized strategy utilized in the industrial processes of industrial plants of any part of the world, where industries of any type are installed such as aerospace, biomedical, electronics, metallic, plastics, textile and wood industries, essentially (Chioma A. et al, 2018). The Good Manufacturing Practices can support to elaborate the industrial activities adequately, generating good and correct fabricated products in each industrial plant. Each worker of manufacturing lines of production, quality, supervision and manager activities, debit realize his functions correctly, to obtain the goals of the productivity and quality indices every day, week, month, season and year (Hama Kareem et al, 2017). In this scientific study, was evaluated at nake eye and with specialized strategies and instruments in a production line with ten industrial operations and 15 workers (ten womens and 5 men), analyzing the adequate movements Actually, are some relevant actions of the GMP, which are explained now in table 1, as is illustrated the diverse factors that requires this relevant topic in the manufacturing activities (Susan Rose et al, 2023).

Table -1: Factors of the GMP utilized in this investigation (2024)

Good Manufacturing Practices
Each industry debit maintains high hygiene standards, to avoid any type of development of microbes or virus that can generate negative health in workers of manufacturing areas.
Debit elaborate the cleaning of the facilities frequently, to prevent dust from adhering to oil or grease from industrial equipment and machines and making it more difficult to remove and this can cause electrical or mechanical failures.
Is necessary utilize adequate clothing and appropriate equipment, to make the industrial operations to avoid at the very least, staining personal clothing or having any action that damages the skin, eyes or respiratory system; and can cause a serious health situation.
Comply with personal hygiene standards, to maintain the good health of workers of manufacturing areas.
Have the control of new workers of production lines, to not permit that make errors and care his integrity and not generates any type of health symptoms with industrial equipments, machines and materials.
Use specialized strategies to prevent cross contamination in manufacturing products, principally in food, medical and metallic materials, which can be defective product, for the strict regulations at worldwide.
New personnel of industrial activities of any industry, debit trained to avoid any type of health symptom and generates adequate productivity and quality levels.
Apply specialized strategies to avoid delays during the different steps of the manufacturing areas, using methods and techniques adequate to reach the goals of productivity and quality levels.
Is necessarily have control of the transport vehicles, to avoid accidents in indoors of the industrial plants.
Debit takes care to avoid contact between raw materials without specialized gloves or tools, and also handle adequately the semi-finished products, and final products.

1.1 Occupational Health

Is an interesting thematic in the industrial plants, because in base of this analysis can design, develop and apply new systems or strategies to care the health of workers of the production lines, which are elaborated by specialized persons in industrial ergonomic and medical persons that analyze every movement of personnel of the industrial processes (Carlos Raúl Navarro González et al, 2024). This part of the investigation was relevant, because some persons were elaborating his functions with Bad Manufacturing Practices, and suffer of discomfort or even serious health symptoms in your arms, neck, back, hands, wrists and legs. Occupational health is a topic that is currently and continuously being evaluated due to the speed and risk at times with which industrial operations are carried out or the need to made actions with great effort (Taber, 2018). This has caused accidents in workers in manufacturing areas, who are analyzed in the health consultation areas of the industries or, where appropriate, in the public or private health institutions of the city where this relevant scientific study was made (Dr. Hugo Lee Martínez et al, 2024). The process of developing industrial activities in any type of industrial plant in the world, where they are installed, whether in the suburbs or in areas of low population, with the utmost care to avoid accidents or illnesses. That is why, with this, the risk premium can be increased, which is a relevant factor in the economic gains or losses of industries, as it is considered a fine by the labor authorities of the Mexican government or another country ((Carlos Raúl Navarro González et al, 2024).

1.2 Relation of GMP and Educative Programs with Operative Yielding

The educational universities of any part of the world, have a good responsibility in the formation of students, which are considering as the formation of human resources to generates adequately the capacitation of the students to have good productive yielding in any type of industrial company. Industrial plants of the Tijuana city have the responsibility to the training in the manufacturing areas and can be support, but need receive students that are studying or have his studies finalized, and with good attitude to make his functions in the industrial processes (Sekwaila Mokgadi Clentine et al, 2020). When some students, not have the required skills, can't make his functions correctly and can make a lot quantity of errors, decreasing the productivity and quality indices, and with this, are presented economic losses (Lizeth Abigail Figueroa Corral et al, 2023). Is for this reason that are very important the relation between universities and the industry in any place of the world. In this scientific study was obtained important information, which was correlated with the productivity and quality levels, and was evaluated the economic gains or losses (Ana Paula Rodríguez et al, 2022).

1.3 Actions of Business Management and Foreign Trade with Production Indices

This triple relation supports to obtain interesting information to elaborate the correct GMP and have the planning, organization and control of the industrial processes, and obtain the correct raw material to the industrial activities in this industrial company located in this relevant city of the northwest of the Mexican Republic. The action of the foreign trade was made to evaluate the process to obtain the required by a specialized person, which was made calling, negotiating and evaluating the budget of this electronics industry (Guo C. et al, 2017). The person who was working with important function debit be knowledges in accounting, materials and business management to have the raw material of each product at the necessary time to make the industrial process and obtain the final product fabricated (Chaisumpunsakul W. et al, 2018). The materials utilized to manufactures the cell phones in this electronics industry evaluated, are very dedicated with the climatic and pollution factors that overpass the air quality standards (AQS) in some days of this city with a lot 600 industrial companies of diverse type of products manufactured, and with a lot cars with around 200,000 vehicles.

2. METHODOLOGY

The scientific study elaborated has good relevance in the thematic evaluated and the information obtained that was organized, analyzed and validated, was utilized to develop some improvement continues, which were evaluated by specialized people of the electronics industry that permit to make this interesting investigation. This was made with the next activities mentioned now:

a) Evaluation of the activities of workers of manufacturing areas, about the Good Manufacturing Practices, and the relation with the productivity and quality levels.

b) Analysis of the actions of the business management strategies as planning, organization and control of the industrial operations, to correlate with the correct flow of the raw material, subproducts and final products fabricated in this electronics industry.

c) Evaluation of the educative programs of a university and be related with the operative yielding of the students' recent graduates in the industrial processes of this electronics plant.

d) Analysis of the foreign trade actions to obtain the correct raw material to fabricate an optimal electronic product of this industrial plant.

3. RESULTS

The information generated in this scientific study, supports to specialized people, supervisors and manager to improve some industrial processes, and with this avoid accidents and diseases (principally respiratory diseases), and obtain efficient manufactured products in this electronics industry and, in this way, reach the optimal productivity and quality levels. The results are explained in the next sections.

3.1 Analysis of Good Manufacturing Practices

This part of the investigation was made to detect in 20 workers of a production line of the industrial company where was made this scientific study, evaluating the GMP as the actions that personnel of this industrial operations, where was manufactured a lot cell phones of a prestigious commercial brand in the 2024 year, and were commercialized the majorly of these cell phones in the 2024 year. The numerical analysis of this evaluation consisted in the evaluation of functions of the workers of the production line analyzed and the type of movements required at the correct action, and was correlated with the productivity and quality indices in percentages, and is observed in table 1. This analysis was elaborated in some and different period of each day, where was made this evaluation. Workers were made his functions in a period of 10 hours at day, being analyzed each three days of the first month to understand about the function of each industrial process. The period evaluated consisted in the first six days (From Day 1 to Day 6 of January, 2024) of the 20 workers, and was repeated two times more (from Day 11 to Day 16 of January, 2024) and (From Day 21 to Day 26), with different results of numerical data, which are presented in the productivity and quality levels, and separated each numerical value with a comma.

Table -1: Analysis of the GMP related with the productivity and quality indices (2024)

Factors Evaluated Workers	Quantity of Movements	Period of Evaluation at Day	Productivity Level, %		Quality Level, %	
			BI	AI	BI	AI
1	4	8:00 – 9:00 (Day 1)	45, 57, 71	75, 86, 90	40, 54, 69	75, 84, 89
2	5	11:00 -12:00 (Day 1)	48, 63, 75	82, 88, 92	38, 48, 65	70, 80, 86
3	3	15:00-16:00 (Day 1)	44, 52, 69	73, 80, 88	44, 59, 75	70, 79, 84
4	4	9:00 – 10:00 (Day 2)	42, 59, 70	72, 80, 85	37, 48, 65	70, 77, 85
5	3	12:00 -13:00 (Day 2)	44, 55, 73	76, 82, 90	43, 50, 71	75, 84, 89
6	4	16:00-17:00 (Day 2)	43, 54, 68	73, 80, 89	45, 56, 65	74, 82, 88
7	5	8:00 – 9:00 (Day 3)	41, 55, 73	74, 81, 92	44, 57, 68	70, 80, 90
8	3	11:00 -12:00 (Day 3)	43, 55, 73	76, 87, 93	42, 56, 72	77, 87, 94
9	4	15:00-16:00 (Day 3)	40, 50, 63	72, 80, 94	42, 51, 65	77, 83, 88
10	3	9:00 – 10:00 (Day 2)	43, 53, 67	69, 80, 88	42, 55, 65	77, 88, 93
11	3	12:00 -13:00 (Day 2)	41, 54, 75	76, 85, 88	44, 56, 70	75, 80, 87
12	4	16:00-17:00 (Day 2)	45, 53 74	73, 82, 89	42, 56, 73	77, 86, 93
13	5	8:00 – 9:00 (Day 4)	47, 63, 75	77, 88, 94	45, 56, 67	73, 80, 85
14	3	11:00 -12:00 (Day 4)	43, 60, 75	75, 83,88	44, 55, 72	77, 86, 95
15	3	15:00-16:00 (Day 4)	42, 52, 67	77, 83, 86	38, 50, 60	73, 81, 88
16	4	9:00 – 10:00 (Day 5)	46, 58, 74	76, 83, 89	43, 52, 73	76, 80, 91
17	4	12:00 -13:00 (Day 5)	45, 53, 76	78, 89, 94	43, 55, 73	74, 80, 88
18	5	16:00-17:00 (Day 5)	43, 52, 70	76, 83, 88	44, 56, 74	74, 82, 88
19	3	8:00 – 9:00 (Day 6)	44, 51, 67	70, 80, 90	42, 56, 67	72, 80, 85
20	4	11:00 -12:00 (Day 6)	43, 54, 74	74, 80, 92	42, 56, 72	74, 80, 90

BI. Before of the improvement (in January, 2024), AI. After of the improvement (in February, 2024)

In table 1, is showed the rate of increment, from the first of this investigation in January 2024 to the end in December 2024. This numerical data was obtained of a questionary of 10 questions with diverse answers, to determine la principal factors of not use the workers of the manufacturing areas, the GMP.

3.2 Evaluation of Business Management Strategies

Once the previous stage was completed, an analysis of the business management strategies was made, obtaining the following results, which are shown in Table 2. The numerical data was obtained with a questionary with ten questions and diverse answers.

Table -2: Evaluation of business management strategies and relation with productivity and quality levels (2024)

Factors Evaluated	Planning Level, %		Organization Level, %		Productivity Level, %		Quality Level, %	
Workers	BI	AI	BI	AI	BI	AI	BI	AI
1	56	80	54	88	56	88	62	89
2	54	78	56	90	55	84	58	90
3	53	84	57	88	52	85	55	92
4	52	80	53	84	60	90	55	87
5	53	88	54	80	57	92	53	90
6	57	87	52	85	57	90	49	83
7	51	79	56	83	52	83	56	88
8	54	83	57	86	52	80	57	88
9	56	78	60	83	54	87	56	83
10	58	83	53	88	50	90	55	92
11	55	79	54	84	57	91	54	88
12	49	82	56	89	50	80	53	83
13	53	80	57	84	54	83	56	80
14	56	89	57	84	50	80	54	84
15	55	81	56	88	50	84	55	80
16	53	83	54	84	50	79	58	93
17	52	80	55	83	58	84	54	80
18	56	83	52	87	53	83	59	88
19	54	82	55	92	54	90	53	88
20	53	84	56	79	55	84	58	91

BI. Before of the improvement (in January, 2024), AI. After of the improvement (in February, 2024)

Table 2 illustrates the different evaluations of the 20 workers of the industrial processes, which participate in this investigation, where was observed that the actions before each improvement about the planning level in percentage (BI and AI), which was checking the form of plain his functions from the first minute to the final minute of the operative activities, analyzing the way to prepare his functions, and also, was evaluated too, the organization level (BI and AI), analyzing the form of the organize workers of manufacturing areas, his daily functions.

3.3 Correlation Analysis of Educative Programs and Operative Yielding

This part of the scientific study was made to relate the impact of the university programs as educative planification, which are utilized in the teachers to the teaching-learning with the students, to reach the maximum competitivity that will be used in the labor activities in industrial, commercial or government functions. The correlation analysis takes about the effect of the university programs and the impact in the operative yielding of recently graduated students and those who have already graduated for some time and are working in the electronics industry, especially in the manufacturing areas, where was made this investigation. This is represented in table 3. Of the 20 workers evaluated (six men and fourteen women), there were five students as workers recently graduated students (RGS) and three students as workers who had graduated one year ago (GOYA).

Table -3: Analysis of students recently graduate and one year of graduate (January 2024)

Factors Evaluated	Knowledge Level, %		Operative Yielding Level, %	
Workers	BI	AI	BI	AI
1 (GOYA)	48	79	50	86
2 (GOYA)	43	78	44	78
3 (GOYA)	46	80	45	82
4 (RGS)	33	67	39	70
5 (RGS)	37	70	40	72
6 (RGS)	36	72	41	71
7 (RGS)	37	69	38	72
8 (RGS)	33	70	39	70

BI. Before of the improvement (in January, 2024), AI. After of the improvement (in February, 2024)

The results of table 3 indicated that depending of the operative yielding was the correlation analysis with the relation of the university programs of a prestigious university of this important zone of Mexico.

3.4 Evaluation of Foreign Trade Actions

Also, in this scientific study was evaluated the capacity of personnel dedicated to obtain the adequate raw material, at near places to receive very fast the principal materials utilized in the fabrication of the cell phones in this relevant electronics industry. To determine the relation of the Knowlagent's of foreign trade about obtention of raw material to this electronics industry, the laws of international commerce and type of percentage of income of sales and buy. Also, was related the factors mentioned with the operative yielding to obtain the adequate and fastly the materials, was analyzed the capacity levels of three workers, which need obtain know about the industrial process to have knowledge of each industrial operations, about the operation of industrial equipment and machinery to process to know about to transform the raw material in the final product manufactured, and finally debit know about the topic of materials. This information is represented in table 4.

Table -4: Evaluation of knowledge of workers of materials actions and obtention of materials (January 2024)

Factors Evaluated	Knowledge Level, %		Obtention Materials Level, %	
Workers	BI	AI	BI	AI
1	78	94	80	95
2	67	88	70	92
3	78	92	76	90

BI. Before the improvement (in January, 2024), AI. After of the improvement (in February, 2024)

Table 4 shows the increase of the relation of the parameters mentioned. In all analysis elaborated, was related with the occupational medicine, indicating that in all evaluations, at the moment was analyzed with each parameter evaluated and presents an increase of the correlation analysis of each parameter, indicates good actions in the industrial processes and this was represented a decrease in the generation of accidents or diseases of workers of the manufacturing areas. This was presented in table 5.

Table -5: Correlation analysis of occupational health and industrial parameters (2024)

Factors Evaluated	GMP, %		Business Management Level, %		Educative Programs Levels, %		Foreign Trade Levels, %	
Workers	BI	AI	BI	AI	BI	AI	BI	AI
1	78	34	83	40	80	44	76	35
2	69	32	78	44	76	40	83	42
3	70	34	76	44	80	45	78	41
4	89	45	80	43	79	50	84	39
5	74	45	84	48	80	45	85	35
6	77	56	84	36	79	37	84	33
7	88	38	83	36	80	46	79	40
8	84	50	80	38	79	50	84	46
9	69	29	78	44	83	41	80	40
10	83	48	88	50	79	50	82	46
11	80	44	82	47	78	39	76	40
12	79	35	83	52	69	34	70	40
13	79	43	84	40	86	42	85	45
14	75	36	80	45	83	50	77	35
15	77	41	69	45	83	50	88	56
16	87	43	86	34	79	54	85	44
17	76	50	80	30	81	44	80	39
18	83	54	89	46	80	44	79	54
19	83	46	80	40	82	53	87	54
20	89	57	80	56	82	58	79	49

BI. Before of the improvement (in January, 2024), AI. After of the improvement (in February, 2024)

Table 5 indicates that conforms was advances the investigation, the percentage of accidents of diseases in workers of the manufacturing areas, were decreased, improving the environment of the work activities, applying the continuous improvement, and improve the health of personnel of the industrial process of this electronics industry evaluated.

4. CONCLUSIONS

This investigation is relevant at the moment to made the relation with the four parameters, being important to have an efficient operative yielding of workers of the industrial processes evaluated, and in the prevention of accidents of diseases, being very interesting have workers of good health and with this can reach the goals of productivity and quality as an optimal record. Is necessary correlate the parameters evaluated in this scientific study to obtain the goals required in each moment and place of this industrial plant located in the Tijuana city, which is recognized as important city of the northwest of Mexico. With this, the economic actions were as economic gains.

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