

# The Impact of Ergonomics on Employees' Productivity in the Architectural Workplaces

Nadine Sinno, Mariam Ammoun and A.S.A. Ferdous Alam

**Abstract---** *The office work is a working ecosystem entirely dependent on humans. Office ergonomics focuses on the human well-being and adapts all office components to suit workers' needs and comfort. The unawareness of the Lebanese designers in particular and the global designers in general on the importance of applying ergonomics programs and implementing well-designed workplaces reached its borders. Therefore, stressing on the significance of ergonomics programs especially in the architectural field is needed to raise the attention for the essentiality of this topic. The major reason for conducting this project is to enhance the awareness on ergonomics importance and its impact on increasing employees' productivity specifically among Small and Medium Enterprises (SME's). The study starts with a general literature review shedding the light on the meaning of ergonomics, its types, factors, and how to enhance employee productivity through applying ergonomics. After the theoretical part which revealed an important background to start on investigating the hypothesis of the project the fact findings and conclusions of the project were drawn. Using SPSS program and other tools the research demonstrated and drew the facts in a statistical and graphical way to show clearly the exact outcomes. The data used to emphasize and validate the suggested hypothesis was all collected through questionnaires and interviews at both Block Tech Line sarl and L'artquitecte. Both companies are well-known in the architectural field among small and medium enterprises. The main reason for choosing this kind of enterprises was its expansion in the Lebanese market at first, and it obtained an important competitive advantage through ergonomics ISO certified programs. The study showed the strong impact of ergonomics on employees' productivity, and how the absence of one element may influence negatively the employees. The conclusion which is underlining the stated objectives at the beginning of the study, a list of recommendations was suggested on how to enhance implementing ergonomically designed workplaces.*

**Keywords---** *Ergonomics, Workplace, Employees' Productivity, Architectural Field, Interior Design, Performance.*

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## I. INTRODUCTION

Our world is changing, turning into a global village. Time is moving quickly, and as if we're running after a train to append the station. In this moving world, working hours are in a progressive motion from five hours per day to eight hours and even much more in Lebanon and almost all the Mena Region. (Olson, 2008)

Therefore, work is the second domicile for any employee, the first thing that comes to mind when you think about home is cosiness and comfort. And, since a large slice of people especially in our country belittle the effect of

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well-designed workplaces on many aspects such as employees' productivity, job performance, and many others it is very important to identify the hidden truth behind this issue.

This project aims to emphasize the impact of well-designed workplaces and ergonomics on human's capital productivity.

This topic is interestingly important to identify the best practices, strategic approaches to be used in a company to increase employees' productivity resulted from enhancing the environmental working conditions.

## **II. LITERATURE REVIEW**

Business executives remain beneath a misguided impression that the level of employees' productivity on the job is connected to the immensity of employees' compensation package. Though we cannot refuse that compensation package is one of the utmost motivational extrinsic tools, but it has a limited short-term effect on employees' productivity.

It's a generally recognized assumption that well-designed workplace inspires employees and boost their performance, engagement, and productivity. (Leblebici, 2012)

Great looking spaces can energize employees to do their best. Even though many organizations are far from realizing that the productivity is actually a factor in employee's satisfaction, and interior design can impact effectiveness ranks in a number of noteworthy means.

The role of interior design expert is to intelligently implement a tactical methodology to workplace layout, a one in which interiors experts incorporates goals and business objectives- to facilitate reengineering of work procedures, reassure collaboration and teamwork, and lead to a nourishing enlightening atmosphere at a certain company. Accordingly, organizations can diminish or abolish barriers to productivity by purifying interior design in accordance with evolving companies' objectives. (Leblebici, 2012)

Ultimately, organizations must frequently reanalyze workplace design in relative to business practices to accelerate efficacy enhancements.

### ***A. Definition of a Workplace***

Workplace is defined by BusinessDictionary.com (2012) as the location where a certain task is competed, and as establishment or facility at a particular location containing one or more work areas. An effective workplace recognizes that employees are the organization's greatest resource. Furthermore, to be truly effective, a workplace –its design, practices and policies- must benefit both the organization and its employees.

### ***B. Key Elements of a Workplace***

A productive workplace consists of a number of elements. According to a study in the Open University of Malaysia (2009), furniture, noise, flexibility, comfort, lighting, temperature, and air quality are the constituents of an office design and productivity (Open University of Malaysia, 2009). In the figure below elements are shown clearly.



Fig 1: Ergonomics Elements

### C. *Office Interior Design and Ergonomics*

It is essential before elaborating the influence of interior design and ergonomics on employees' productivity to shed the light on the meaning of both key terms Interior design and Ergonomics.

Cephas states that "Interior design is the total creative solution for a programmed interior, it encompasses the conceptual planning, aesthetic, and technical solutions applied to achieve the desired result. A programmed interior means a specific intended purpose or use of the built environment" (Cephas, n.d.)

Interior design is more than just the visual or ambient enhancement of the interior design space, yet it does seek to boost, blend, and harmonize usages to which the assembled setting will be arranged. Hence, according to the U.S. Bureau of labour statistics, it is applied, aesthetic, and encouraging to proposed reasons, for example fostering productivity, marketing merchandise, or refining lifestyle. (Cephas, n.d.)

When formulating the design approach various considerations come into the play. From these considerations, first the place must be categorized –its measurements and compositions- with its possibilities and restrictions. Subsequently, the space should be classified or known how it is going to be used, either it is a workspace, or a leisure space, entertainment space or a worship place, therapeutic or learning. Consequently, this classification plays an important role in defining the suitable settings that should be settled up. After revealing the category of the space, its meaning should be also clear. The meaning of the space signifies what it should reflect, this reflection could be power, authority, achievements, security, safety, playfulness, or serenity. In addition to all what is mentioned previously, it is important to consider the practical aspects, such as, the ease of access, quantity of light, acoustics, audibility, seating, and archiving systems. As well as wellbeing, health, and safety considerations, attention to special needs and more (Cephas, n.d.)

Its elements should include visual (light, colour), tactical (surface, shape), and auditory (noise, echo).

Ergonomics is defined as the science of burnishing products and workspaces design to adjust them for human use. Height, weight, and proportions areas some of the human characteristics that should be considered, as well as data approaching human hearing, vision, temperature and preferences (Whatis.com).

The office work is a working ecosystem entirely dependent on humans. Thus, office ergonomics focuses on the human well-being and adapts all office components to suit humans' needs and comfort. Such human focused designs must take into consideration working force, physical characteristics i.e. dimensions, capabilities, and preferences (Kroemer, 2001).

Key ergonomics elements in the office are listed in "The Office Ergonomics Handbook" (2008):

- Chair and workstation.
- Keyboard, Mouse, and Monitor.
- Office Lights.
- Office arrangement and environmental concerns.
- Indoor air quality and thermal comfort.
- Noise level.

#### ***D. Ergonomist: A Deep View***

Ergonomist's responsibility is to design objects, services, and atmospheres to improve individual well-being and overall system performance, applying theoretical principles, and information concerning the connection amid human and corresponding technology, inspect and examine features of individual behavior and performance as it relates to the usage of technology in a certain workplace.

An ergonomist plays an essential role in developing and enhancing work capabilities like increasing productivity. The ergonomist must have enough knowledge in many fields in order to design a suitable workplace in harmony with the environment and the nature of the workplace (O\*Net, 2015). Some of the knowledge that the ergonomist needs to know:

**Design:** Acquaintance of design practices, instruments, techniques, and principals involved in construction of precision mechanical and technical plans, drafts, drawings, and models.

**Psychology:** Understanding of human behaviour and performance, capability variances in each individual, personality, and interests learning and motivation, and the assessment and treatment of behavioural and affective disorders.

**Training:** Awareness of principles, syllabus and training design, instruction for individuals and groups, and the measurement of training effects.

**Sociology and Anthropology:** Realisation of group behaviour and dynamics, societal trends and influences, human migrations, ethnicity, cultures and their history and origins.

**Public Safety and Security:** Familiarity with relevant equipment, policies, procedures, and strategies to promote effective local, state, or national security operations for the protection of people, data, property, and institutions.

**Administration and Management:** Knowledge of business and management principles involved in strategic planning, resource allocating, human resources modelling, leadership technique, production methods, and coordination of people and resources.

**Computer and Electronics:** Knowledge of processors, electronic equipment, and computer software and hardware, including applications and programming.

Furthermore, an ergonomist should develop many skills that can help generating a healthy environment to fulfil all

employees' needs to perform enthusiastically (O\*Net, 2015).

Some of these skills are: Critical thinking, complex problem solving, systems evaluation, active listening, social perceptiveness writing, and active learning.

Furthermore, many abilities are a must for an ergonomist to design properly such as:

**Deductive Reasoning:** The capability of applying general rules to specific problems to construct answers that make sense in order to solve them.

**Inductive Reasoning:** The capability of combining information's pieces to form broad general rules or deductions.

For an ergonomist to design a program for a certain work atmosphere or organization environment, it is important to start with certain activities that will ensure that his/her work is going well and correctly especially when an ergonomist is redesigning a program, so editing is harder than implementing from A to Z. An ergonomist must start with receiving raw data throughout witnessing, obtaining, acquiring material from significant resources. Thenceforward, to analyse raw data and acquired information through recognising the fundamental principles, motives, purposes, or proofs of information by breaking down information or raw data into separate segments (O\*Net, 2015).

Other detailed work activities are as follows:

- Analysing active information towards evaluating processes, methods, and products.
- Developing technical methods or processes.
- Researching the productivity of human, the related factors to engineering or design activities.
- Advising employees on health as well safety concerns.
- Documenting operational test results of design.
- Investigating security and safety at the work environment.
- Training employees and staff on proper operational processes.
- Inventing testing protocols for professional research results.

#### ***E. Sustainability Through Ergonomics***

The term sustainability became widely known from the United Nations World Commission on Environment and Development. Sustainability is defined as the development that meets the need of the present without compromising the ability of future generations to meet own needs (The United Nations World Commission on Environment and Development, 1987).

Poor working condition may affect many aspects such as work-related health problems. This poor working condition is mostly attributed to poor ergonomic design. Sustainability can be achieved through ergonomics; good ergonomics and interior design enhance the long-term preconditions for safe and healthy work. (FEES, 2016)

If ergonomics is forgotten in the workplace, it may be so difficult, costly or even impossible to achieve good working conditions later by corrective measures.

That what happens in poor working conditions it is difficult for companies to maintain healthy and safe work. For this reason, it is better when ergonomics is planned in the design stage, for which solutions are profound: the designers are free to choose best solutions at each stage and all possible effects can be anticipated and taken into account. Moreover, application of ergonomics in the design process requires proper collaboration of all groups concerned, starting from management, designers, supervisors, workers, to the work, health and safety (OHS) personnel. By this collaboration all requirements (both well-being related and productivity-related) brought together ensuring sustainable solutions (FEES, 2016).

#### ***F. The Concept of Employees' Productivity***

Flex time, hygiene, organization's image, training and development, compensation, and ergonomics are some of the inducements that enhance motivation. Whenever employees' contribution to the job is higher than inducement that will decrease their motivation to be more productive. As the inducement increases more than the contribution this will absolutely enhance motivation of employees to produce more (Akiki, 2016).

Productivity is designated as a measure of the efficiency of a person, machine, factory, system, etc., in converting inputs into useful outputs. Productivity is computed by dividing average output per period by the total costs incurred or resources (capital, energy, material, personnel) consumed in that period. Productivity is a critical determinant of cost efficiency (Business dictionary, 2016).

#### ***G. Conceptual Framework***

Before proceeding in categorizing the variables of the suggested hypothesizes, below is an overview about variables, and their types.

**Independent Variable:** is the factor that is measured, manipulated or selected by the experimenter to determine its relationship to an observed phenomenon.

**Dependent Variable:** is the factor that is observed and measured to determine the effect of the independent variable.

**Control Variable:** is the factor which is controlled by the experimenter to cancel out or neutralize any effect they may otherwise have on the observed phenomenon (dependent Variable).

Based on the literature review, the relationship between office ergonomics and employee productivity can be conceptualized in the below figure.

The conceptualized framework defines the impact of ergonomics on employee productivity. Therefore, ergonomics and well-design office elements are essentially independent variables affecting employees' productivity, the dependent variable. Whereas, architectural field is the control variable.

For instance, poorly designed and implemented ergonomics in a workplace will most likely increase employee stress and decrease both engagement and productivity of employees.

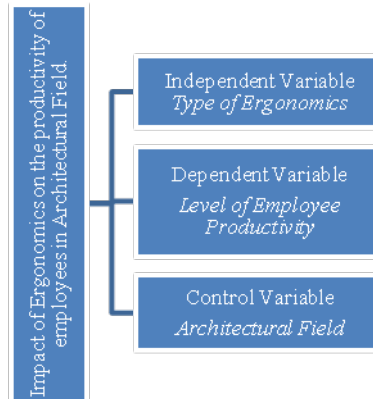


Fig. 2: Conceptual Framework Variables of the Hypothesis

### III. RESEARCH METHODOLOGY

#### a) Data Collection Method

Data collection method phase required using articles, websites, along with business themed books; in addition to specialized ergonomics books that helped in forming a sufficient background about workplace ergonomics and productivity.

In addition, interviews with experts in this field were accompanied to link the data of books and articles directly with realistic examples that would make it clear for the reader's understanding.

The research resources are clearly listed in the table of references. Besides these references, an in attempt to explore the impact of implementing ergonomics programs on the productivity of employees, and to study how this affects the managerial work of the organization several structured interviews were also conducted at different companies.

At L'artquitecte, three interviews were conducted with the CEO and founder Mr. Mohammed Beydoun, the Director Managing Mrs. Caroline Chehadi, and with the Quality Manager Ms. Karen Ghrawi. Nevertheless, at Block Tech Line sarl, group interviews were carried out with the CEO and founder Mr. Hasan Chouman, Hr and PR Manager Mr. Ali Chouman, and with the Executive Quality Manager Ibrahim Chouman. Through these collected interviews qualitative information was gathered to be analyzed at a later stage. On the other hand, close-ended questionnaires were distributed to the employees to collect enough data at the two organizations. A deductive reasoning method is applied in this project, because of the use of quantitative data collected through questionnaires which can lead to either accept or reject the hypothesis mentioned before and validate based on the data collected through interviews.

The study target population is the architectural sector in Lebanon, mainly the curators of decision making in such fields who can notice the importance of ergonomics and have the authority to implement it. In this study, two organizations were taken as a sample to proceed with the project, L'artquitecte and Block Tech Line sarl. Quantitative method was the main method used for the deductive reasoning of this research, via data collected from surveys, which

was proved by the help of descriptive information gathered from the conducted interviews. Another tool that helped in the data collection is observation, where at the two companies' employees were observed for several times. The observation included type of desk, heights, chairs, circulation, lighting, air quality, and the rest criteria mentioned in the questionnaire.

Interview questions were open-ended questions unlike the survey questions that were close-ended. Questions of the questionnaire were all united and twirled around ergonomics and productivity. Employees were allowed to respond to the questions based on Likert Scale. The scale of answers chosen was from 1= Extremely yes, 2=Yes, 3= Neutral, 4= No, 5= Extremely No. This kind of scales, in particular, was used where it best suits the study as more accurate result will be revealed. Questions included topics about furniture, lighting, temperature and productivity.

Furthermore, Interview questions consisted of ten questions that were discussed with all the interviewees equally. The aim beyond the interview with manager at several companies was to have an overview or a highlight about the organizations work under the presence of ergonomics programs, this provided the study with more detailed information about how to implement such programs and its effect on management, productivity, and performance of employees.

Eventually, the collected data from the questionnaire are entered into the SPSS program to be analyzed and come up with the final result. Qualitative information of the interview will be analyzed and discussed to end up with a study that shows the impact of ergonomics on employees' productivity.

#### **IV. STUDY LIMITATIONS**

Although this research fills an important gap in the literature, yet there are more few limitations that are worth noting.

To complete this research, at least two companies were supposed to be chosen for applying needed data collection tools (surveys, questionnaires, observations, interviews, etc..), this made an obstacle in finding a company that may accept to provide the needed information, especially when it comes to distributing questionnaires to its staff, even if the aim beyond the survey services only the study and has to do nothing with the personal issues, or the flow of work at the organization, this obstacle took some time to be resolved after many calls and interventions of networking, and the refusal of many companies. It was a pleasure that Block Tech Line sarl, and L'art-qui-tecte accepted the request to carry out the project about their organizations.

Moreover, the topic of this project needs quantitative data, it was necessary to conduct many interviews and questionnaires to all the staff at the organizations. It was hard to find all the employees at once at the organizations due to work responsibilities, especially it's an architectural sector, it is difficult to find all the employees gathered, which required more time to conduct all the interviews.

As for the interviews, it generated an important reference for both overviewing the company, as a reference to support the hypothesis, but some of the interviews results are under the affect exaggeration in describing the company's situation as perfect and no modifications are needed.



As a conclusion, the limitations were overcome by collecting enough data to complete the study.

## **V. FINDINGS AND RESULTS**

### ***a) Data Analysis Method***

Managers, Managing Directors, and Quality Managers were interviewed in each company in order to collect the needed data. This data is stated and analysed through comparing and relating it to the main topic.

Whereas the main data, that was analysed to draw a conclusion about, was collected through distributing surveys for employees at different positions. Questionnaire results were entered into the SPSS and many tables were obtained in reference to the data entered.

Additionally, the observation method revealed to be constant base for emphasizing on the validity of the data collected.

Tables and results outputted from the SPSS were furthered analysed to accept or reject the stated hypothesis. The results were summarised in tables where questions of the surveys categorised in groups according to their relatedness to the hypothesis.

### ***b) Fact Finding Results***

#### ***1) Overview of the Companies***

The dialogue started at both companies with an overview. An overview about history, main services, employees' situations. Moving on to the theoretical part, a general idea about both organizations was stated as well. In addition to what was mentioned by Mr. Hasan Chouman who pointed out that Block Tech Line sarl is one of other businesses which are a factory for furniture production, and a coffee shop; all under the same management with different employees than Block Tech Line sarl employees, but all follow the same rules and regulations of the registered main company Block Tech Line sarl.

On the other hand, according to Mr. Mohammed Beydoun the CEO and founder of L'artquitecte, which is a well-known successful organization that grew up in a well-structured manner to expand in a short period of time to Hazmieh, and Dubai. As it became one of the most successful SME's in Lebanon which has executed recently more than 50 projects during this swift period across Lebanon and the Mena Region.

#### ***2) Organizational Success***

Both companies' successes were highly linked to the final product they both serve, and due to the customer satisfaction, as they believe that certificates, productive team main objective for them to serve customers. To serve customers well a productive team should be ready to do that rigidly through applying ergonomics programs and implementing well designed workspace in both institutions.

Both companies found that ergonomics play an important role in affecting employees' productivity even though Block Tech Line sarl doesn't apply a well-structured ergonomics program, and that's a gap, but at least Block Tech

Line sarl believes that applying ergonomics program in the near future will definitely enhance their employees' productivity and this will allow the organization to expand more and more.

Whereas, L'artquitecte, the general atmosphere is more than okay, but this doesn't cancel the presence of a tiny gap. The values of L'artquitecte are literally applied within the atmosphere of the organization.

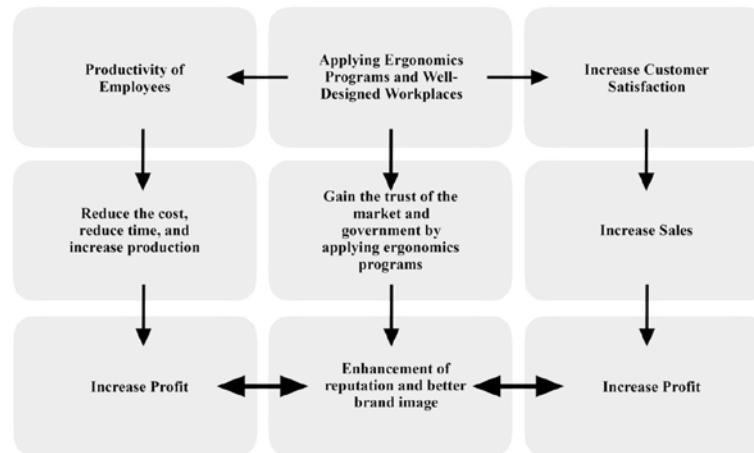


Fig 3: Benefits of Applying Ergonomics at Block Tech Line sarl and L'artquitecte

### 3) Alignment of Ergonomics Programs with Organizational Strategic Goals

As spotted ergonomics programs are critical, some are ISO licenced that involve major sections of management and documentation work that shall be aligned amid organization's mission statement and strategic goals. Then, cascade all over the departmental levels to meet anticipated results. Block Tech Line is aspiring to increase productivity it is one of many other planned goals. Increasing sales, decreasing time, and cost, all these measures are highly related to the core goal behind implementation of ergonomics program which is highly applied at L'artquitecte. The mission statement is exceeding customers' expectation; this is definitely related to employees' productivity. In accordance to L'artquitecte all branches should apply same spirit, mission, work's environment in order to grasp the constant vision. Similarly, Block Tech Line and L'artquitecte mutually declared the importance of ergonomically certified. Although many elements of ergonomics are applied at both companies, but it is more significant to be Ergonomically ISO certified.

### 4) Ergonomics Barriers

Sustaining employees' capabilities, attracting new talents, and retaining human capital are some of the aspects beyond ergonomics. Several barriers may face both companies when implementing programs:

**Cost:** Obviously good ergonomics will affect productivity, but this equation can't be realistic without a detailed calculation deducing the expenses and incurred costs of implementing ergonomics programs. Knowing that in few months all expenses will be saved in a way or another, like the costs saved from a decrease in absenteeism, in production costs, and an increase in profits.

**Purchasing:** It is hard to purchase any ergonomic program and apply it, especially if its ISO certified then an

organization must apply all rules and regulations issued by the ISO board.

Education and Training: Education and training are crucial for the success of any system or program. Thus, training is considered a barrier because any failure or gap can fail the whole system. As well the cost of the training and education could be a barrier for some companies.

### **5) *Ergonomics and Productivity***

The chosen companies Block Tech Line and Lartquitecte are SME's. These types of enterprises were chosen since it represents 40% of the Lebanese enterprises according to a study done by Inventis (COMTRADE, 2014). SME's have several positive impacts on the Lebanese Economy, it generates employment, increases growth, decreases poverty, creates competition, increases firms and national competitiveness and productivity, and nurtures entrepreneurship culture.

Numerous interviews were held. The CEO, quality manager, and director manager of L'artquitecte and Block Tech Line sarl were interviewed in order to investigate on how ergonomics is affecting the overall performance and productivity of their employees, determine the gaps and compare between the desired situation and the actual one.

At L'artquitecte, Mr. Mohammed Beydoun the CEO was proud of the overall culture he initiated. He believes that the company is growing at an exponential rate and attracting talents from overall Lebanon and the Mena region. With a low turnover, employees' productivity is at its best. Mr. Beydoun stated that several facilities are provided to L'artquitecte employees, such as free parking lots, great hygiene i.e. the whole working area and toilets are cleaned up on a daily basis, greenery is available in places yet Mr. Beydoun inspires to increase the green space and provide employees with a garden, he revealed that greener spaces will reduce stress, increase creativity, and provide calmness to the environment. He added that open spaces will foster employees' interaction empathy, and teamwork which will lead to an increase in productivity and creativity. Furthermore, once an opportunity rises, he will be adding a fun space filled with music to the workplace, knowing that a massage chair is available at the workplace.

On the other hand, Ms. Karen Ghrawi the quality manager who was interviewed stated that the space is a little bit small in respect to the number of employees, yet it is 70% compatible with ergonomics standards. She believes that the spatial arrangement of the workplace would be better if divided into open spaces departments to reduce unnecessary noise. On the other hand, she thinks that the overall lighting furniture disposition and noise is a productive agent to a certain extent.

Mrs. Caroline Chehadi, the managing director insisted on the importance of ergonomics in sustaining employees, increasing their productivity, and unleashing their creativity. The only thing that is disturbing Mrs. Chehadi is the noise and privacy issue, since she is the managing director she cannot stay all day in an open space with many distraction, although she found it healthy for other departments like communication and visual department but she claimed that some positions need more privacy and calm offices. Whereas, in respect to the rest elements of ergonomics such as temperature, lighting, and furniture she illustrated that all are fair enough to her to be productive. And when she was asked about suggestions, Mrs. Caroline suggested isolating some departments to enhance teamwork.

At Block Tech Line same positions were interviewed using the same open ended questions. Mr. Hasan Chouman was overwhelmed with our investigation since he insisted on the important role that well-designed workplaces play in impacting employees' productivity. He knows that there is a gap in achieving that well, he sees that the reason of this gap is somehow clear which is being a family business sometimes makes the work less professional to a certain extent. But he is proud about the expansion of the company and he is sure that in implementing structured ergonomics program the company will witness a revolution in its market. Returning to the conducted interview, Mr. Hasan Chouman gave an overview about the company the beginning and the good and hard situations the company passed through during establishment. Block Tech Line CEO indicated that hygiene is from the first priorities for them, then the quality of desks and chairs they use is one of the best to give employees that they are safely equipped with all the needed materials to perform with passion. More than three toilets exist at Block Tech Line, one kitchenette and a gathering space. The quality manager Mr. Ibrahim Chouman specified that with time Block Tech Line will be one of the ergonomically certified companies in Lebanon. He was asked for the gaps and suggestions to improve the productivity, he emphasized that privacy is important for employees and it's an aspect that should be worked on, since most of employees' offices and desks are inside the showroom it's hard to divide many offices in respect to the space wise, but he sees that sometimes lack of privacy creates conflict between employees and decreases productivity although it is recommended sometimes to unleash employees creativity, and motivate brainstorming and loud thinking that will facilitate reaching organizational goals.

Manager assistant Mr. Ali Chouman is sure that ergonomically programmed spaces can enhance productivity, increase ROI rates and lessen employees' turnover and that's what every company strives for. But he highlighted that expected costs are high especially for a SME. He said: "I believe that ergonomics programs should be aligned with the main strategic plan of any company" he continued overviews Block Tech Line main goals in the near future, and how will ergonomically certified organizations will be expanding in the coming era.

The overall impression of the two companies was good, since they both agree on the idea of investing in employees through good ergonomics programs and well-designed workplaces.

#### **6) *Data Analysis and Interpretation***

The overall questionnaires collected were 51 from different positions among the two organizations, they revealed as an important incentive to start the pace of this study to validate the suggested hypothesis at the end. Subsequently, the outcomes obtained were analysed by entering the responses revealed into both EXCEL and SPSS programs. Excel was used to draw the relation between each element of ergonomics in respect with employees' satisfaction; whereas, SPSS to test the suggested hypothesis and validate it.

Questionnaire type is close-ended questionnaire divided into 6 parts, the first five parts are the elements of ergonomics and the last one regarding productivity using Likert Scale of 5 values mentioned earlier. Each set of questions were grouped in relation to a criterion under the elements of ergonomics and productivity yet with no direct link of each group to a specific hypothesis. The hypotheses created were 5 to upkeep the core subject of the study in which it is the impact of ergonomics on the productivity of employees in the architectural field among SME's in

Lebanon.

On the first level, data analysed were showed in graphical charts specifying at both Block Tech Line and L'artquitecte employees' satisfaction with each element of ergonomics aside. Then, descriptive and frequencies were revealed that help to calculate the average of questions. After that, the relation between the variables to reject to accept the suggested hypothesis. Through SPSS many tools were used, starting from Regression analysis to Mean Analysis moving into T-test and descriptive analysis in order to support and clarify the relation.

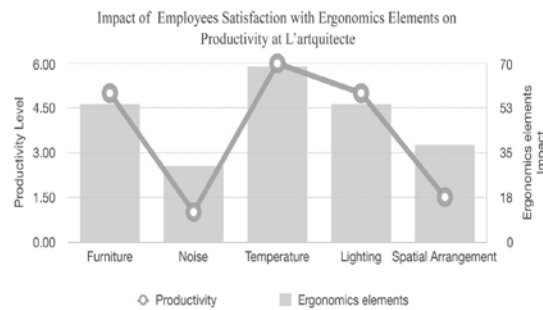


Fig. 4: Employees' Satisfaction with Ergonomics Elements and its impact on productivity at Block Tech Line sarl.

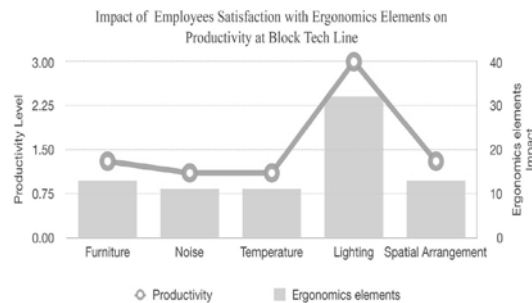


Fig. 5: Employees' Satisfaction with Ergonomics Elements and its impact on productivity at L'artquitecte

By overviewing the charts, we can notice a correlation between the elements of ergonomics and productivity. Yet, we can't emphasize that since no statistical evidence declares that 100%, in the coming pages a Pearson analysis will be done to identify the type of relation between them. To determine that graphically the charts were done of scale 1 -10 level of productivity. And 10 to 100 ergonomics elements impact.

At L'artquitecte when employees are satisfied with temperature their productivity level go to the extreme 6. As it decreases or increases productivity fluctuates with the presence or absence of ergonomics elements. Then, a satisfaction of employees appears when all the elements of production exist. The same for Block Tech Line, since not all the elements of productivity are well implemented the levels of productivity with respect to employees' satisfaction with the implemented ergonomics elements differ. As noticed, the highest well implemented element at Block Tech Line is the lighting element. And it is clearly showed that with any move down or up in the elements of ergonomics employees satisfaction increases with the increase of productivity which is a result of well implemented ergonomics.

The Chart (fig.5) above shed the light on the satisfaction of employees at each of the examined companies, with statistical rates and data to clarify and demonstrate the hypothesis. However, charts can't alone display the actual statistics and numbers trustworthily. Other tools should be used to uncover the genuine numbers and validate the hypothesis.

For that SPSS tests were necessary to come over with the desired results. The tests were divided into two parts; first a T-test was done individually for each company to examine the results of questionnaire outcome. As a summary for the first T-test done, it is spotted that questionnaire is divided into parts in respect to their relevance to a certain element of ergonomics all compared to the productivity the dependent variable. For each element of ergonomics, a set of 4 or 5 questions were arranged to examine the significant relation between the independent variable which is in this case ergonomics or the elements of ergonomics and on the other side the dependent variable that is employees' productivity. It was important to start with uncovering the significant relation between the variables in order to release the type of relation between the variables, and the equation of productivity. Equation of productivity will absolutely tell how each element of ergonomics will impact productivity.

The following are the revealed results of Regression tests done at L'artquitecte and Block Tech Line. Interpretations of the tests will be constructed hereafter the tables.

Table 1: SPSS Results at L'artquitecte.

Model Summary <sup>b</sup>							
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	df1
1	.979 <sup>a</sup>	.959	.954	2.78153	.959	169.643	5

Model Summary <sup>b</sup>		
Model	Change Statistics	
	df2	Sig. F Change
1	36	.000

### 7) Regression test Interpretations (L'artquitecte)

The questions tested are critical and clear to both examine and validate the suggested hypothesizes, and they cover all the hypothesizes materials. Furniture questions are four covering the kind of furniture used, how its comfortable and if the physical conditions have an impact over employees' productivity. Afterwards, noise element that was covered by a set of four questions about the general environment situation, if there are many distractions and how will noise affect productivity negatively or positively. Then, temperature and lighting each individually with a set of 4 questions. Investigating whether temperature and lighting can impact in a way or another employees' productivity, moving to knowing whether employees have control over the settings of lighting and furniture what was obvious at L'artquitecte that almost all the employees can modify lighting and temperature settings. Customising the lighting can be one of the most affecting elements since light and the type of light may let the employee for example feel dizzy, or sleepy, or active. So, it all depends on the quality and quantity of lighting. The last element is the spatial arrangement also reveals a significant value 0.00 sig, with 95% confidence. All the tests showed positive results of the presence of a relation between the ergonomics and employees' productivity.

For R2 in all the previous statistics conducted via SPSS all appear to be relatively large > 1, sig=0.00 very small number, less than 0.005 level of significance so the risk is less than 5%. So we fail to accept H0, thus we reject H0 and accept H1. We have sufficient statistical evidence to support our hypothesis. Therefore, well-Designed workplace and ergonomics will enhance employees' productivity. 95% confidence that the hypothesis is accepted.

To illustrate, starting with the descriptive analysis of the regression test we can notice each variable mean, standard deviation and N which the number of respondents for the questionnaire 53 in this project. Adding to that regression modal summary that contain the R2 which is 0.959 which indicates that X variable can demonstrate about 9.95% of the change in Y. Elements of ergonomics represent X which are responsible about 9.95% in the change of Y variable which is the productivity.

The F is relatively larger than 3.6 as well a significant rate to emphasis on the relation between ergonomics elements and productivity. Moving on to Anova test we can obtain that it is obvious the 0.00 significant of the suggested hypotheses. The coefficients gave us values these Beta values are going to be used in the productivity regression equation. Regression equation specifies exactly the most variables impacting the dependent variable which is in this case the productivity. Following the employee productivity equation drawn.

$$8) \text{ Employee Productivity} = -1191 + 359.05 F - 0.862 N - 0.973 L - 0.941 T - 0.916 SA$$

From this equation we can notice that at L'artquitecte employees' productivity is linked mostly to lighting element of ergonomics. And that emphasize what was mentioned by them via the observations and through the questionnaires. The constant variable (1191) and the elements of ergonomics variables vary at L'artquitecte employees seem not to be impacted by furniture that an indicator that the furniture is suitable, and here a good indicator noticed from observation that at L'artquitecte employees have a massage chair to be used by employees at any time they need a massage. So as a summary it is well noticed that at L'artquitecte all the tests results shows significant value to accept the suggested hypothesis. In addition to the histogram that shows the motion of the slope of the two variables Productivity and Ergonomics.

Table 2: SPSS Results at Block Tech Line sarl.

Model Summary <sup>b</sup>							
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	df1
1	.988 <sup>a</sup>	.976	.973	2.09113	.976	292.896	5

Model Summary <sup>b</sup>		
Model	Change Statistics	
	df2	Sig. F Change
1	36	.000

### 9) Regression Analysis for Block Tech Line

Although the results of employees' satisfaction at Block Tech Line showed negative results and almost all the employees are not satisfied with the implemented ergonomics, that's why all employees results are positive and emphasize that the elements have an impact on the employees' productivity. N is 42, DF or the degree of freedom

among all the tests, because of the constant numbers of employees who responded to the questionnaire. The same as the previous segment all the tests revealed with a positive result according to the questionnaires filled by the employees at Block Tech Line.

For calculated T in all the previous statistics conducted via SPSS all appear to be relatively large  $> 1$ , sig=0.00 very small number, less than 0.005 level of significance so the risk is less than 5%. So, we fail to accept H0, thus we reject H0 and accept H1. We have sufficient statistical evidence to support our hypothesis. Therefore, well-Designed workplace and ergonomics will enhance employees' productivity.

The F is relatively larger than 3.6 as well a significant rate to emphasis on the relation between ergonomics elements and productivity. Moving on to Anova test we can obtain that it is obvious the 0.00 significant of the suggested hypotheses. The coefficients gave us values these Beta values are going to be used in the productivity regression equation. Regression equation specifies exactly the most variables impacting the dependent variable which is in this case the productivity. Following the employee productivity equation drawn

$$10) \textit{ Employee Productivity} = -380.945 + 137.09 F - 0.48 N - 0.56 L - 0.59 T - 0.66 SA$$

From this equation we can notice that at Block Tech Line sarl employees' productivity is linked mostly to spatial arrangement element of ergonomics. And that emphasize what was mentioned by them via the observations and through the questionnaires. The constant variable (380) and the elements of ergonomics variables vary at Block Tech Line sarl employees seem not to be impacted by furniture that an indicator that the furniture is suitable. Then, as a summary it is well noticed that at Block Tech Line sarl all the tests results shows significant value to accept the suggested hypothesis. In addition to the histogram that shows the motion of the slope of the two variables Productivity and Ergonomics.

The revealed results from the SPSS showed that coefficient of determination R2 is significant, this value indicates the ratio of explained variation. Thus, the proposed hypotheses were as follow, all with significant statistical evidence to support the suggested hypothesis.

Null Hypothesis (H0): Well-Designed workplaces and ergonomics does not enhance employees' productivity.

Hypothesis (H1): Well-Designed workplace and ergonomics enhance employees' productivity.

So, we accept H1 and reject H0 for the sufficient statistical to evidence to support our hypothesis.

Null Hypothesis (H0): Employees will not be more engaged to organization after implementing ergonomics program and this will not show continuous improvements of employee productivity.

Hypothesis (H1): Employees will be more engaged to organization after implementing ergonomics program and this will show continuous improvements of employee productivity.

So, we accept H1 and reject H0 for the sufficient statistical to evidence to support our hypothesis.

Null Hypothesis (H0): Employees will not be motivated in the presence of ergonomics programs especially with well-designed furniture which will not allow organization to save money, time, and resources.



Hypothesis (H1): Employees will be motivated in the presence of ergonomics programs especially with well-designed furniture which will allow organization to save money, time, and resources.

So, we accept H1 and reject H0 for the sufficient statistical to evidence to support our hypothesis.

## **VI. CONCLUSIONS & RECOMMENDATION**

### ***a) Conclusion***

The conclusion should be a beginning. Yes, a beginning for bringing to life professional SME's. Employees should be as any other asset; organizations must invest in them to achieve competitive advantage among a certain market.

While researching for this project's topic, many notifications were deduced. It was noticed that international organizations started to implement and apply ergonomically certified workplaces a long time ago, yet locally it's not implemented. Thus, there is a huge gap that should be bridged in order for organizations to achieve its targets through competitive edges.

Moreover, ergonomics programs must be aligned with the strategic plan of any organization, since it is important to know how to align a mission and a vision of a certain company through the simple details such as the type of wood used for the desks, or the quality and quantity of light, and the level of temperature, all are aspects that reflect a culture of a company. This automatically can affect performance, productivity, absenteeism, and employee's turnover.

Besides, the objectives behind the research noticeably fulfilled between the theoretical part which is the literature review and the fact findings part.

Awareness about the importance of ergonomics was emphasized at first in the literature review where ergonomics impact on productivity theory was mentioned. In addition to the fact findings results that uncovered the importance of ergonomically programmed workplaces.

Tests showed that functional and aesthetic benefits can also contribute to enhance the ability to work communicate, interact, reflect, and heal. Regression analysis results show that lighting is the most important factor but beside lighting also furniture and spatial arrangement do impact employees.

The organizations we conducted questionnaire and interviews at emphasized on the relation between employees' health, well-being, and productivity within the workplace.

A conceptual workplace was presented and suggested by both managers at both organizations for how to maintain and enhance employee engagement and involvement to a certain organizational culture.

After examining the suggested hypothesizes, many conclusions were drawn in respect to the hypothesizes:

Well-Designed workplace and ergonomics will enhance employees' productivity.

Enhancing productivity is not only linked to well-implemented ergonomics programs, yet ergonomics can be the first on the list. Ergonomics motivates an employee to work, it sustains existing employees, and in the future

well-designed workplaces and ergonomically programmed places attract talents, skilled employees. Thus, the role of ergonomics skips to just enhance productivity. In the long term, this indicator which productive employees will be the patent of an organization and its capital to compete.

Employees will be more engaged to organization after implementing ergonomics program.

Many organizations arouse many question marks when it comes to engage employees to a certain organizational culture. Ergonomics can be a facilitator for that aspect since well-designed workplaces and the way of implementing ergonomics can tell a lot about the culture of the organization, for instance, usage of huge glass and stainless steel when designing Bank Audi in Lebanon can give transparency, clearance, and credibility and they are the core values of Bank Audi. The same apply for L'artquitecte the culture is friendly, impresses high impact on the importance of communication and that what the physical environment tells. An open space for everyone one to talk and freely move. So that it is crucial and critical to build and create the physical environment that mimic the whole place.

Employees will be motivated in the presence of ergonomics programs especially with well-designed furniture.

As explained in the literature review, one of the most incentives for employees is the presence of ergonomics. However, implementing ergonomics will recommend always upgrading and updating for the program to always suit the general atmosphere and requirements of employees to perform at their best.

Implementing ergonomics programs including suitable lighting and temperature will show continuous improvements of employee productivity.

As concluded in the fact findings, lighting is one of the most influential elements in ergonomics, and it does have the most impact on employees according to the examination of the hypothesis. Therefore, an organization must point out the importance and the impact of well-structured lighting and ventilation systems in the improvements of employee productivity.

An organization can save more time, money, and resources by applying ergonomics programs.

Due to the increase rates of productivity an increase in the time, money, and resources will take place. These indicators will inevitably increase the Return on Investment and the Return on Equity. So, companies should never belittle in investing in ergonomics and well-designed workplaces even though it's a cost at first. Yet, the outcomes will appear in less than six months especially regarding employees' motivation, engagement, and decreased absenteeism.

### ***b) Recommendations***

Even though many organization's managers do not consider ergonomics as a part of a business strategy and a mean to achieve business goals, yet the National Business Group on Health indicated lately that organizations who apply ergonomics programs are capable of reducing disability days by 10% to 35%, increasing return on investment 3.1 to 15.1.

Ultimately, in the interpretation of the fact findings and the conclusion of the project, the following recommendations are made to be taken into consideration by Block Tech Line and L'artquitecte as an approach of

utilizing their ergonomically applied workplace to enhance productivity.

Before implementing ergonomics programs, an organization should be aware of the reason behind the implementation and the importance of implementation. This will assist in the prosperity of a certain program or system.

Any company's success or failure is related inevitably to its employees' performance; thus, managers should understand the relative impact of implementing ergonomics programs on employees' productivity.

Employees should be trained on ergonomics programs, though they seem at a certain level simple to be utilized, but education and training are fundamental for the success of implementing any new program.

Organizations must deliver workshops for new employees to train them on office ergonomics concerns as the correct sitting posture, computer adjustments to avoid tension. This kind of workshops are essential to instruct employees on the topic to support them contribute significantly to the progress of office ergonomics interventions.

Ergonomics programs must be planned within the whole strategic planning of an organization. It is an essential factor for creating company's vision, mission, and culture.

Some organizations cannot afford the cost of implementing ergonomics programs; thus, this kind of organizations can apply simple tips,

Investing in employees must be a priority for any organization, they constitute as the human capital a company has.

Many aspects should be taken into consideration when implementing ergonomics program, some jobs require poor lighting, others require daylight or artificial lights. This must be considered to increase productivity.

Giving employees options to choose their furniture shape, size, and arrangement will positively increase their engagement and satisfaction.

Employees must have control over their immediate office design like temperature, noise, and lighting. This will make the employee involved with the settings she/he wants. As well, this will increase his loyalty to the organization since you will feel nostalgic to the things you chose, or you designed and customized by yourself.

Greenery is essential to give employees freshness; this will change their mood therefore will increase their productivity. So, implementing greenery is essential to give a vivid and vital atmosphere of the employees. Many assume that it is as well important to prepare ready-made gardens to increase employees' engagement and involvement.

Ergonomics shouldn't have implemented without giving the employees the know-how on how to practice with ergonomically programmed spaces, as well without explaining for employees how ergonomics is affecting in the strategic planning of the organization, and how any gap will give a drawback in the general planning of a company

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