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Organizational Analysis of Work and Cognitive Ergonomics in Self-Management Working Groups in the Cosmetic Industry

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Abstract

This study aims to analyze the cognitive development of the employees of a company that produces articles and perfumery in the metropolitan region of Curitiba, after implementation of the semi- autonomous management. The chosen industry is responsible for producing all of the groups make up lines and two lines were selected for the study, which were responsible for producing all of the different brands of Lipsticks Company. The lines were chosen because they have fewer steps in the production process along with a greater maturity of its employees associated with good organizational climate. In the current literature, there are a limited number of studies that address the cognitive ergonomics, this being responsible for mental processes and that has been increasingly needed and used in production processes. Even behind the apparent simplicity of the tasks, there is a huge cognitive mobilization to maintain the fluidity of the production process and to solve problems. Thus, to conduct the study two questionnaires, psychometric were applied in order to obtain the perceptions of employees against the possible gain of autonomy and responsibility over the production process along with analysis of some indicators from January 2012 to September 2012. Certainly, the semi autonomy represents a step forward in socially responsible management and humanization of large companies, demonstrating that these systems can work very well within the context of integration and flexibility, thanks to cognitive ergonomics activity that exists in each production process.

Keywords: Semi-autonomous management; Cognitive ergonomics

Introduction

The management model semi-autonomous, by respecting the nature of human social organization, assists in the generation of an environmentally sustainable relationship between the company and its employees, where both can benefit according to Marx (1998) [1].

Due to the growing need for mass production industries have increasingly sought a labor organization, which can be achieved the highest productivity associated with the adaptation of the worker to the work context, generating, in addition to efficiency, safety and health contexts processes.

The proposal currently more targeted, and main study of this work, is the implementation of the semi-autonomous management, which will now consider the culture, skills, behaviors and emotions of the human being as these items are very important to increase productivity , second Bueno (2002) [2].

This new approach requires a strong mobilization of workers for mental understanding of work and all the variables and indicators that surround it. This perspective has imposed increasing demands of cognitive process to the employees, through decision- making processes involved in the control of the labor process and the resolution of problems arising. With this format the worker participates effectively in the decisions of their work , which is called participatory ergonomics , this science that uses the knowledge already accumulated by workers developed thus valuing their ideas and experiences.

According to Wisner (1987) " all activities, including work, have at least three aspects namely: the physical, cognitive and mental" [3]. All activity involves the development of motor and cognitive actions, therefore, take into account the skills already developed by workers is extremely important, because through it they are able to be encouraged to search for more knowledge, stimulating creativity until now possibly inhibited.

According to several authors, such as Vidal (2008) Luria (1994) and Abraham (1996) the development of new skills is a mental activity that involves the processing of information, associated with the experiences of the individual [4-6].

The autonomy acquired after the development of the individual has very important consequences, as both the system dynamics formed in each of the individuals within that context and the environment considered, as well as on the conditions of their knowledge.

According to Wisner (1994) "... one of the most notable features of living things is the diversity of their reactions in a given situation" [7]. Ergonomics strives increasingly to demonstrate that the tasks that seem more monotonous and strictly organized require continuous adjustment of workers to changes in machinery and raw [7]. It's clear that knowing only the prescribed work is not enough to allow an approximation of totalized more work situation.

Semi-autonomous management

In Marx's view (1998) with this new format of action, what is sought is a reduction in costs, promoting an increase in the speed of responses in the cycle because since the interfaces are integrated in their goals for better flexibility for negotiations in the form of production the main goal is acquired: rescue workers as part of the process, causing him to have knowledge of the goals and responsibility for search results [1].

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Vidal (2008) addresses the idea that through the semi-autonomous management will be an increasing range of autonomy in cells and automatically from their employees, because the priority is to use the intellectual capital of them, who will be in direct contact with their performance indicators due to lack hierarchy directly [4]. When it says about the absence of hierarchy actually only is deviated the responsible of the small processes containing over his role in new demands, increasing the improvements in the competitive process and in the fields of work.

The tools used in this case as information, technical devices, indicators, among others, must always be within reach of the group by increasing the speed of response soon after diagnosis in some different situation daily, according to Marx (1998) [1].

Through these trainings the employees develop new skills, always being aligned with business objectives and decisions facing this demand, always aiming to improve the process.

Marx (1998) believes that the implementation phases of the semi-autonomous management are the result of continuous investment in the development of technical and behavioral skills of individuals [1]. The development of technical skills, according to *Augustine (2003) and Marx (1998)*, is by seeking the technical improvement of the employee, due to the new demands that he find daily [1,8].

Cognitive physiology

Among its many definitions, one can say that neuroplasticity, besides being a natural property of individuals with regard to injuries, drug use, among other changes, also is the adaptability of the nervous system related to the environmental changes that the individual suffers daily, including learning processes. In the adult, plasticity occurs in response to muscle use and mental also play a role in central nervous system function in relation to learning and memory [9].

A sensory-rich environment is essential for the acquisition of various capacities of the brain, since they provide the excitation required for permanent modification of neural circuits [10].

Learning and memory involve changes in persistent and lasting power of synaptic connections (Batshaw, 1992). The neuroimaging reveals that large regions of the brain show diffuse and synaptic activity during the early stages of learning [11].

The plasticity of the nervous system is clearly necessary for learning and memory. Some noninvasive techniques demonstrate significant increases in neural activity during the acquisition of new skills [9]. According Luria (1994), learning is behavior modification as a result of experience or acquire new knowledge about the environment, and memory is the retention of this knowledge for a certain time [5].

Anunciatto (1995) and Kolb (2002) show that daily we suffer different types of neuronal connections, all modulated by our experiences [9,12]. Due to the repetition of the stimulation naturally occurring more permanent structural changes, in this case leading to a reduction of synaptic connections. This process is known as habituation, leading to weaker stimuli.

Holloway (2003) emphasizes that the adult brain, the cortical areas constantly adjust the way they process information, retain the ability to develop new functions [13].

Consensus in the literature on brain plasticity is that the practice of motor tasks induces plastic changes and dynamics in the central nervous system. The practice of some motor activities and learning new skills as we are of our knowledge, synapses can alter or reduce molecular events.

In their various studies, Jacobs (2002) showed that the functional changes in synapses, individual entail the reorganization of the brain that can have major functional consequences [14].

If a person regularly performs a motor task specialized cortical representation of the area will increase production levels and growth factor and other neurotropic factors may be associated with protective mechanisms that help make specific neurons more resistant to injury and promote survival and plasticity neurons.

Application and Principles of Cognitive Ergonomics

The cognitive ergonomics refers to mental processes such as perception, attention, cognition, motor control storage, memory retrieval, and how these factors affect the interaction between humans. The most relevant include mental workload, vigilance, decision making, precision work, skilled performance, human error, interaction between humans, machines and computers, stress and fatigue [15].

It is an application field of ergonomics that aims to explain how it's articulated the cognitive processes dealing with situations of problem solving in different levels of complexity. It is important to note that the cognitive ergonomics has no goal to create general theories on general human cognition, according to Green and Hock and Hollnagel [16,17].

Cognitive processes, according to Weill-Fassina, are not stable, they adapt to what should be done, under the circumstances. The same author also proposes, as one of the goals, understanding how individuals regulate the work situation, to solve the problems arising from the discrepancy between what is prescribed (task) and found reality [18].

In this working relationship versus human cognition there is the assumption that each new artifact to a particular task to be performed requires the user differentiated competence for action [19].

Thus the analysis and intervention adopted in such circumstances consider the capabilities and limitations as far as the physiological nature of the human cognitive and, in turn this way, it is possible to explain, in most cases, the origin of mistakes and incidents placed as human errors.

According Luria, these processes support the capacities of individuals, which are made from its action in a situation where it will be defended by their representations to understand the situation. The relationship between representations and strategies are not sequentially. The cognitive processes involved in each of them, to interact, aggregates information and defining quantity and quality of knowledge required for that action [5].

It's important to note that for cognitive ergonomics skills are not related to performance, so, it is inappropriate to say that only competent one who performs the task perfectly tender. Montmollin also states that the powers are inherent in all individuals [20].

Rasmussen, believes that the organization of work also impose severe restrictions on the temporal order and hence the possibilities of developing new skills, where the restrictions of possibilities of knowledge exchanges arising from situations perceived during the production process can compromise the learning resulting and the solution of problems. It's important to remember that this process also includes mental modifications to action responses [21].

For cognitive ergonomics, knowledge about perception are important because the work activities of one form or another, require of their agents perceptive capacities before, during and after the occurrence of some specific situation that can take the situation to some interdiction, even temporary of the productive process (Figure 1).

According to Wisner "Many activities has actually a complex and intensive cognitive component. In this way one precise analysis of the mental activities, perception, identification, decision, short memory duration and actions programs must be done. This analysis must be attached, not to what workers were supposed to do, but in really what they do to answer the issues of the systems." [7].

Methodology

The chosen company initiated the project implementation of self-manageable groups in late 2010 in some pilot places and sought the measurement data for project expansion. The main objective was to evaluate the degree of autonomy perceived by employees after the implementation of the semi-autonomous management.

To develop this research some steps were created:

Stages of the research

Step 1: Choice the sector and the places for the research.

The chosen industry is responsible for the production of all makeup products. Two lines were chosen with similar production processes and with a reduced number of activities in the production process. The areas presented good organizational climate.

Step 2: Choice of indicators for lines evaluation.

Five indicators were chosen to be followed. These indicators were coordinated by employees. The data were collected from January 2012 until September 2012.

⎫ Absenteeism;

⎫ Global efficiency, it means the calculation of production achieved within 8 hours of daily work. In this calculation were not included hours of shutdowns and not programed hours. This indicator is calculated by producing programmed x actual production.

⎫ Production Efficiency, it means the calculation of production conducted considering only the worked hours, not being included stops during the shift (lunch time, set up, unscheduled stoppages for maintenance, etc.)

⎫ Average set up time; it means the period which production is stopped adjustments of the equipment for the next production. The set up time is directly related to the variations of the product and production planning done by the company.

⎫ Fail: Index of products that not acquired the targets imposed by the Bureau of Quality Assurance.

Step 3: Data Collection. The chosen indicators were tracked each three months and analyzed in the timeline of research looking to their averages.

Step 4: Preparation of questionnaires.

As the study is objective evidence that there is an improvement of cognitive issues after implantation of a semi-autonomous management, two questionnaires were used, considering the perception of the employees gaining responsibility of autonomy and developing new skills.

The first questionnaire was the NASA TLX Task Load Index that is a tool developed by the Group Human Performance Research Center (NASA AMES). The objective is search the multidimensional measurement of the load on physical and mental activities experienced by the subject. This measure is based on an overall score given to the workload based on the weighted average of other six sub - scales, divided as follows: three dimensions describe the demands (requirements) imposed on the subject (mental, physical and temporal) and three dimensions in the relationship between the subject and the task (stress, frustration and accomplishment).

Figure 1: Projection of new competences development.

Two other questionnaires were used in this research: The evaluation of stress level (Couto) and Screenplay interview with the workers - Adequacy of work to the physiological and psychosocial characteristics of workers Couto. In its content there was eight closed questions related to the perceived gain of autonomy of employees after the implementation of the semi-autonomous management.

The second questionnaire (Appendix II) was developed from the Likert scale, which is a type of psychometric response scale, possessing statements where the employee shall classify each according to five measures applied in the questionnaire development.

Results

Quantitative results

The first result presented is the reduction time to set up, where, from observations made by the employees; they suggested the decrease of time to perform the task, through small improvements in the programming sequence. There were production schedules of lipsticks with very different colors. A production order of dark color and a production order in sequence of colored lipsticks, leading to a longer time during the set-up. Because of it, to ensure the product quality of cleaning machines and accessories, the time was longer than necessary. After the improvements suggested by employees, tested and approved by developers and industry leaders, the production order facilitates the work during the set-up and both the order of the product as the colors are scheduled according to their similarities.

It's possible to observe that both lines showed one improvement overall average time of set up with a 5% of decrease in overall time.

These results point objectively that small improvements achieved early in the new format management, affirming the idea that rescuing the employee into the process can bring benefits in the short term, since that be provided a good planning during the project implementation.

Even in the face of numerous obstacles that this new approach has brought to individuals with regard to the new changes and absorption of new information, the process flow has always been maintained in accordance with the targets set for each interface; thanks to the ability to adapt individuals confront new situations.

Recalling once again that this adaptation is only possible when previous experiences are taken into account and each individual characteristic are respected.

Vidal defends the idea that behind the apparent simplicity of the manual tasks performed, there are simultaneously complex cognitive activities, ensuring the attention needed to accomplish the task, now being understood by the employee more broadly [4].

Following it's possible to view that the two lines (charts 3 and 4) together achieved an increase of approximately 10 % in its Global Efficiency, proving that teamwork, sharing of responsibilities in management and control of the indicators shows that there is no need for a hierarchy exercising supervision because each individual has his activities and being made with responsibility within the process.

When was the implementation of the project it became clear the search by forming groups that possesses their social dynamics much more accepted and adapted to work compared to the period preceding the implementation of the project. On this basis it's viewed the evolution of the responsibility for the process through rates overall efficiency and production efficiency.

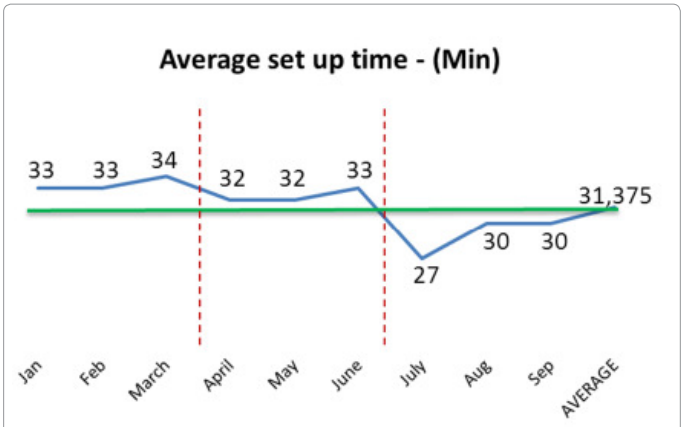

Chart 1: Line I – Average setup time.

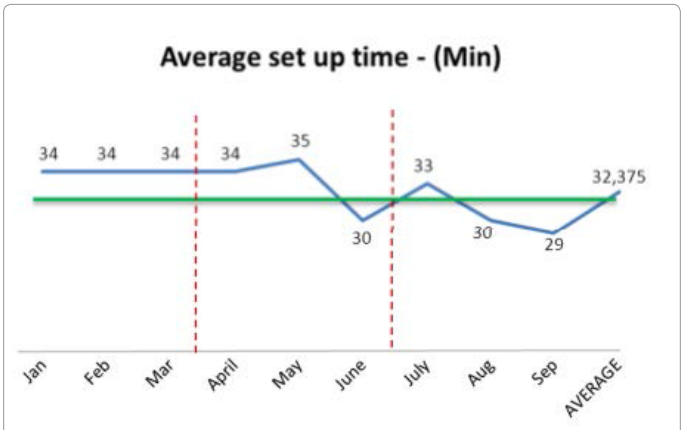

Chart 2: Line II – Average setup time.

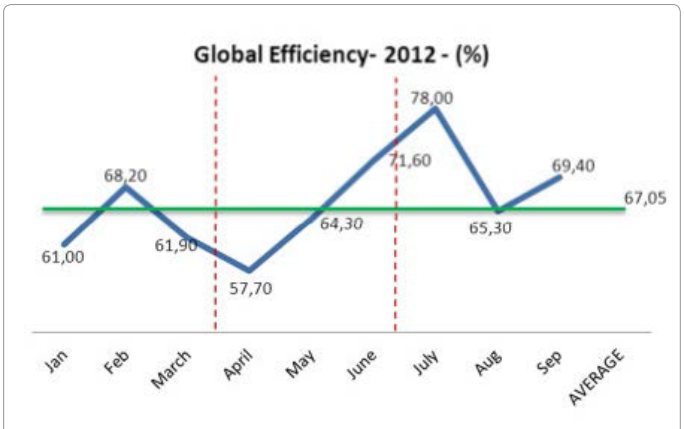

Chart 3: Line I – Global Efficiency.

The production efficiency index are more expressive, since the calculations contemplated only the hours worked by isolating any stop, from a simple break up until scheduled maintenance shutdowns.

Qualitative results

From the results of the questionnaires it was observed that the perception of employees regarding their autonomy, responsibility and other issues of cognitive order were met successfully.

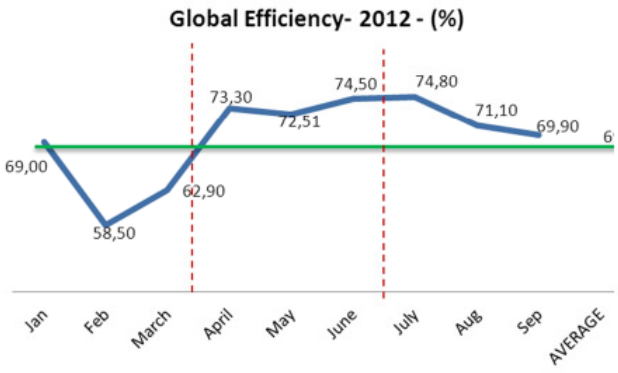

Chart 4: Line II – Global Efficiency.

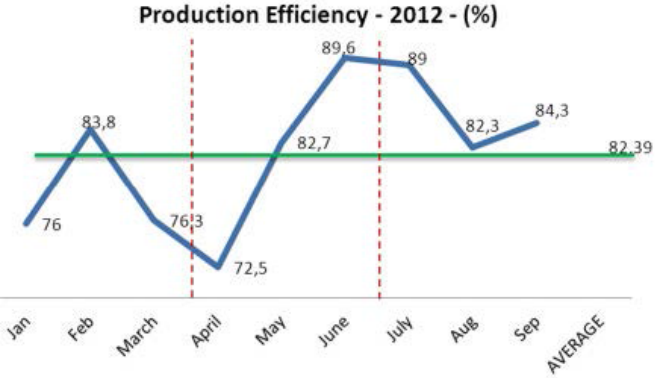

Chart 5: Line I – Production Efficiency.

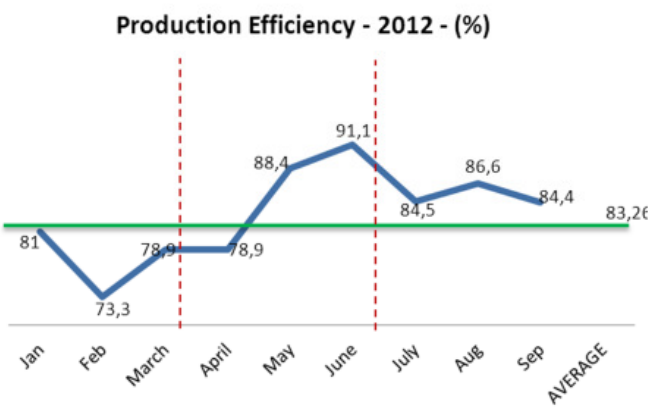

Chart 6: Line II – Production Efficiency.

In the chart 7 it can be seen, as perceived by employees, their performance after implementing the semi-autonomous management was significant, where only 3 of the 26 participants reported that their performance remained stable and increased performance in the opinion of 23 employees, which shows that after the implementation of the new format, the employees realized, significantly, an increase in their productivity and performance at work, proving one of the premises of the establishment of the semi- autonomous management.

It's important to be considered because before obtaining development team is necessary to have individual development, now perceived by them.

In Chart 8, when the question of the possibility of organizing work individually was made, was observed that 23 employees have the right perception of the semi-autonomous management, which prioritizes the division of tasks and responsibilities, answering that can never organize the work alone, however it is also possible to view 3 employees with opposite perception, each claiming that it is possible to organize work individually, however, each one reported the frequency that it can be done.

Despite of the divergence is low; this is an important point, because employees who do not have a clear understanding of teamwork, there could be possible to find some interference with the performance of the line.

In this case no indication that any indicator may have received negative influences.

Finishing the first questionnaire was observed that 100% of employees, as shown in chart 9, estimate that after the implementation

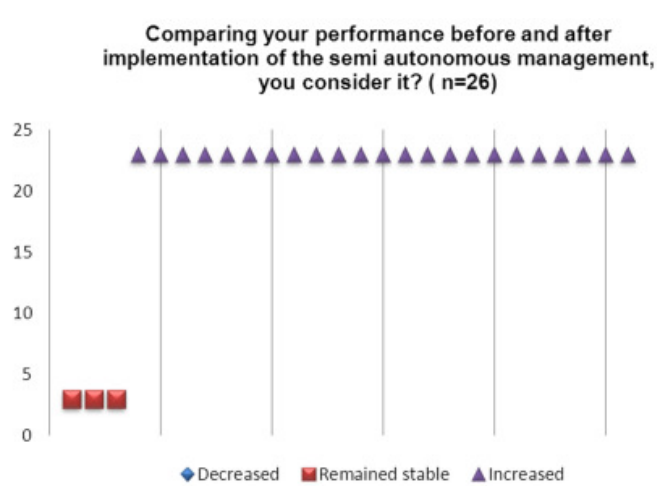

Chart 7: Comparison of individual performance before and after implementation of the semi- autonomous management.

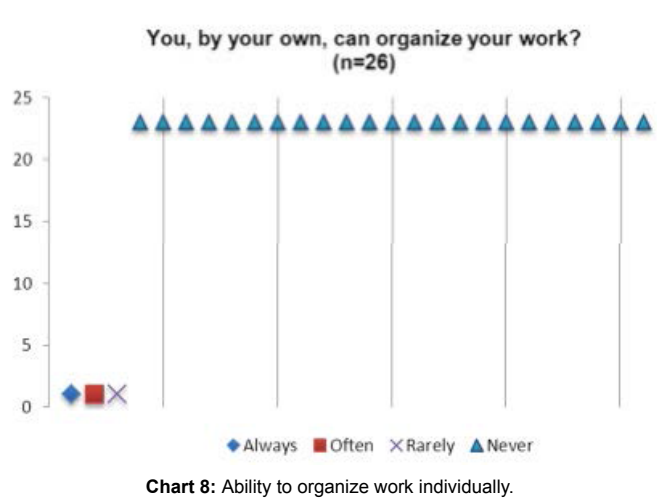

Chart 8: Ability to organize work individually.

of the semi-autonomous management, their opportunity to develop new skills was increased. Through this chart it is possible one better understanding of the indicators results presented above. Because of the increased rates of each indicator was the result of the action of the workers, who after receiving specific training on indicators, could acted more autonomously in search of solutions.

It is noteworthy that from the moment that employees become responsible for a particular indicator and / or interface, automatically, their search for more information on the subject becomes bigger.

Another important factor for the perception of the individual forward to opportunities to develop new skills, is due to the fact that at the beginning of the project there were basic trainings, which stimulated demand for more information with a focus on operational improvements.

The results of the second survey are even more impressive. It indicates positive developments of new skills and understanding of the goals and organizational relationships.

In chart 10 was obtained impressive results on productivity in teams, which indicates an understanding of the employees on the system, because productivity is an indicator of the line and not individual, so to achieve high levels of productivity is required group work, and this is one of the premises of the semi-autonomous management.

This process confirms the rates of overall efficiency and production increased during the year, thanks to the joint action team to detect possible faults and design the best solutions in order to maintain the productivity of the line.

When asked about what developmental stage they had with the new skills, 23 employees assessed as reaching a broad development of new skills. Only 3 colleagues evaluated development above standard but not enough to be considered extensive development.

Here may be noted that the perception of new skills is very solidified since, in general, employees have reported an increase in opportunities to develop new skills.

When asked about their development in relation to the understanding of organizational goals and their indicators, 20 employees answered that they possessed a broad development, it means, a total grasp of the subject, while 4 employees showed a significant development, however believe they are able to improve this relationship.

Only 2 employees indicated a standard development and had the maturity to appreciate that still need more information and studies of indicators and organizational goals.

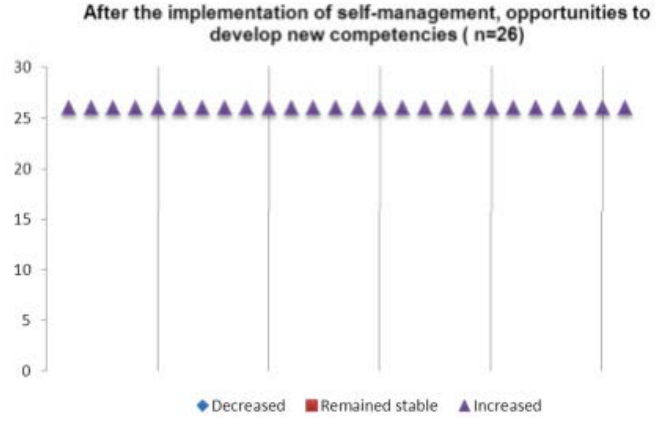

Chart 9: Opportunity to develop new skills after implantation of the semi-autonomous management.

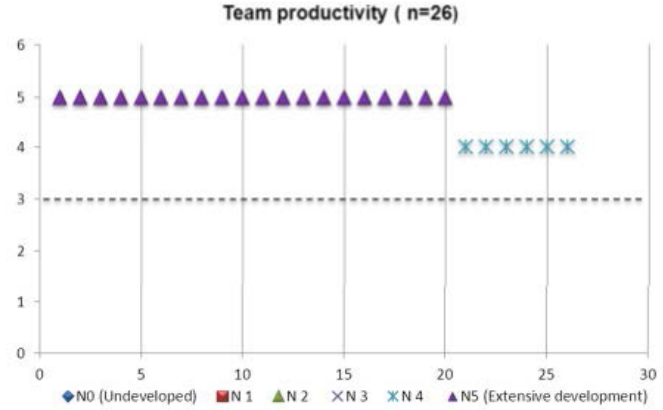

Chart 10: Degree of development team productivity.

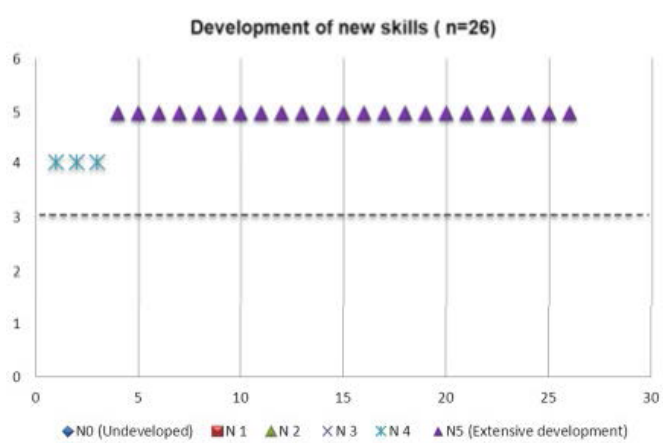

Chart 11: Degree of development of new skills.

Chart 12: Development of the understanding of organizational goals.

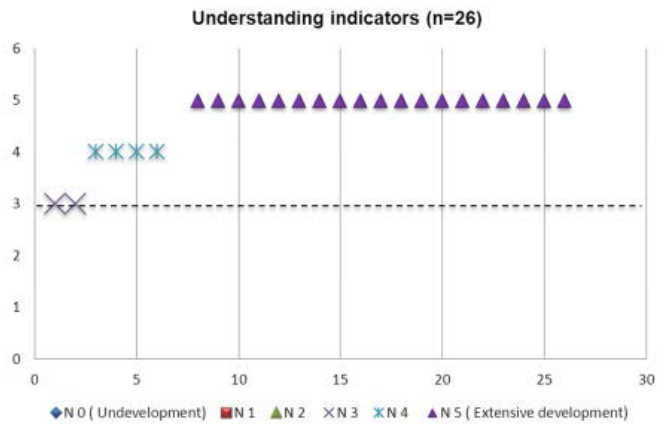

Chart 13: Development in understanding indicators.

Conclusions

The new approach, the semi-autonomous management requires a strong mental mobilization of the work understanding and all the variables and indicators that surround the collaborator. With this format the worker participates effectively in the decisions of their work, thus becoming an essential part of solving problems and recognizing their new skills.

All work involves the development of motor actions and cognitive mainly, which can be seen from the results presented.

According to several authors, such as Vidal, Luria and Abraham the development of new skills is a mental process that involves the processing of information, association with the experiences of the individual [4-6].

Leontiev, does not give the character static activity, on the contrary, he points out that the character comes dynamically, considering that the process is constantly changing and this will not be linearly because each event carries future actions and methods already acquired by the employee on past events [22]. Hence the importance of putting the employee at the center of the whole process. This way he will have greater autonomy and consequently a better development of cognitive skills and new competences.

According to Wisner work is an activity performed by any individual, regardless of sex, to supply what is not covered by the organization of work so it was observed that to the worker is not enough to only follow the prescriptions, it is also necessary interpret, fix, adapt, and even create new strategies for activities with super visioning of technical issues [7].

It is important to note that the cognitive ergonomics aims not to elaborate general theories of human cognition.

The results presented in the survey show that the lines analyzed had a mature deployment and consolidated management of the semi-autonomous, demonstrating that teams have able to conduct their work on a daily basis including the distance of the hierarchy.

According to Luria, the principle of autonomy advocates greater number of people involved in the process of making decision, which will be guided by their own judgment, which in time will be enriched through experiences [5]. Through the efficiencies of the research the reference studies can also be observed.

The survey also found through the questionnaire that new skills can be developed significantly from the time that the individual is in daily contact with the process in a way that you can put into practice all their perceptions and reactions .

This perception involves numerous psychological factors, physical, physiological, along with the cognitive processes required for each new demand, with exactly this intersection that the development potential arises. Its possible then to see the emergence of the results presented for the benefit to the company.

With the results of the questionnaires is possible to confirm the incremental skills responsible in developing strategies for problem solving and improvement for the entire team. Luria, further states that intelligence is manifested in the individual shortcomings of the process, where the individual, from his intelligence and skills developed will seek plausible solutions for certain situations [5].

Further studies are suggested to look across the enterprise and other levels of action seeking to confirm that the program implementation of the semi-autonomous management is effective also in other sectors, with different production processes, varied physical environment, organizational climate and maturity of the employees.

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