Operational strategies and repetitive work

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Abstract
In the last decades, it has occurred the local productive system consolidation of plated jewelry in Limeira, located at São Paulo State /Brazil, which it has created many jobs, opportunities and the city's economic development. In the jewelry's manufacture, manual work has been predominant, characterized as repetitive work, mainly attached to the processes of assembly and welding. This study analyzed the welder's activity plated jewelry industries with theoretical-methodological search Ergonomics in order to understand the operational strategies adopted against the repetitive work. The study verified the welder's perception that the physical demands prevail in work activities, but they works on the organization, a collective work and flexibility to change operating strategy, adjusting their work. Because of experience, expertise, collective work, breaks and the possibility of accelerate or decrease work's rhythm; the welders can stay keep working front repetitive work.

Keywords: 1. Repetitive work. 2. Ergonomics. 3. Plated jewelry

Introduction
The city of Limeira, State of São Paulo, in Brazil, observes the growth and consolidation of its productive system where manufacturing and assembly of plated jewelry (SAMPAIO, 2002). It is the predominant use of manual labor, noting the following processes: assembly, welding and electroplating with the foliation. According to Ferreira (2005), there are several occupational diseases related assemblies or welding processes in manufacturing industry of jewelry.

The study of Alves, Assunção & Luz (2002) in a jewelry factory shows that, in addition to repetitive tasks performed require skill and dexterity, firm and precise movements. The requirement for attention and responsibility can lead to an increased static muscle contraction, which can contribute to the overall muscle overload. The results show that the work despite repetitive is essentially no physical. It also requires concentration, attention and responsibility. All these requirements determine the postures, mainly to static. A question arises from this description: How is the health of these workers against the repetitive work? How does the actual work according to the requirements present in repetitive work?

There is a relationship between health and work. Firstly, because to achieve the desired results, employees reaffirm their self-esteem, develop their skills; express their emotions, as described in the study of Assunção e Luz (2001). Secondly, the work is one way to develop the character. Connecting with others through the material to be transformed, it becomes possible to constitute the collective bargaining, and workers gradually built its history and social identity. In short, Assunção (2003), workers constructed by mobilizing the health conscious or not the potential for adaptation of the human being, allowing you to interact with the working environment, fighting against diseases. According to Lima (1998), health occurs due to the expansion of the area of regulation of their workload. Therefore, one hypothesis is that health at work occurs in regulating individual that the individual makes during activity.

The standpoint of activity, aspects of the work situation can be known and investigated the way really happen, allowing the ergonomist intervenes in work situations and help to maintain the health of workers. This knowledge also allows corroborate skills development and at the same time ensure the economic goals set by the company (GUÉRIN et al, 2001). According to Abrahão and Pinho (2002), it is urgent; therefore, to carry out research to understand the worker, inserted in different work contexts, they are complex, creative, repetitive or monotonous.

Assunção and Lima (2002), all work asking repetitive movements, take place only thanks to the ability of workers to develop representations, operational methods, solve problems, anticipate them and make decisions during the execution of the work. Furthermore, the author states that the gestures can be repetitive, but the work is its variability, even when margins are narrow for regular workload. In a purely manual work, the operator must be careful to ensure production objectives. The work is considered from the repetitive activity analysis in a real situation with its entire organizational context. Therefore, despite the literature describing complaints about repetitive work; health maintenance can occur depending on the degree of freedom exists for the development of strategies, operational methods, problem solving and decision making. Studying the worker makes in this context to understand the work in its entirety and there is interaction with its components, tools, artifacts, organization of labor, materials and skills of workers.

Therefore, this study aimed to understand the operational strategies adopted by employees against the repetitive work for health maintenance, welding sector, in industries plated jewelry and trinkets in the city of Limeira. This study included also the verification from the point of view of workers, identifying the forms of regulation of the operative mode, the difference between prescribed and real work and verification aspects of the grading.

Search Methods

The study uses a research-based case study. This type of method is fit as a qualitative approach and is often used for data collection in the field of organizational studies, social, and political group, and other related phenomena (YIN, 2005). This in-depth analysis of one or more objects (cases), allowing for its broad and detailed knowledge (GIL, 1996; BERTO; NAKANO, 2000). The theoretical and methodological approach taken is Ergonomics Situated where applies to Ergonomic Work Analysis (EWA). When performing the first visits in the company, making a note open and working knowledge of

the company, there was a question that welders developed repetitive work, but did not have any musculoskeletal disorders. There was a welder with 18 years of business and emerged the following question: How can people be subjected to repetitive work and not complain? What do welders to keep working, even with complaints? From this, we conducted a literature search on these issues.

From this arose a research question: how these operators regulate their activities to maintain health, whereas the literature suggests this work as potentiate involvement of musculoskeletal disorders?

These first observations, hypotheses were formulated to explain the demand. The observations were made open by checking the company's operation and characteristics of workers through document analysis and interviews. It was observed aspects related to the company's founding date, description, environmental, work schedule, division of company sectors, production process, seasonality, payment for productivity, knowledge of all tasks of the company, etc..

In task analysis, was observed and described aspects of the workspace, and production of welding task of preparing asbestos and welding. Along with it, we performed the analysis of activity. To prove or disprove the hypothesis, systematic observations were made of the activity of workers welding industry, totaling 200 hours of observation, on different days of the week and the month, for a period of 10 months. The activity was observed over a period of time, to quantify actions and operations, were asked questions like "what," "how," "why" to understand the determinants of the activity and the activity was observed without intervention Ergonomist to understand the subjective aspects of existing work in this situation. The categories were observable communications, the postures, the observations in terms of actions taken or information, comments regarding the collective dimension and the technical system. From this, was watching all the gestures, the real difference-prescribed, variables and strategies to modify their work.

The record was made of the spontaneous verbalizations of workers during the observations and, in specific cases; interviews were conducted simultaneously to perform the tasks, in order to clarify any questions about work activity. This context, the principle of observation of real work situation, verbalizations record and interviews with the subjects was indispensable in the analysis of the activity. The validation with the worker, the analysis of the data collected was important for the explanation of unobservable activity, which refers to the representations. Finally, we arrived at a diagnosis, based on the factors identified in the analysis process, demand, and operation of the company, data interpretation and systematic analysis of clarifications provided by the operators. Therefore, from the standpoint of activity, aspects of the work situation can be known and investigated the way really happen, allowing the ergonomist understands the actual work. This knowledge allows the development of skills and at the same time ensuring economic objectives determined by the company (GUÉRIN et al, 2001).

The State of Working Studied

The study population refers to women known as welders. In this sector there are 7 workers in the task of preparing one for welding and asbestos, and all women. When necessary, there are 2 workers who stay in the weld preparation. The age ranges from 20 to 43 years. The tenure is 1 month to 18 years.

Each pellet has a length of solder. According to the charge, for example, the ball 7 has a daily production of 1150 pieces and the ball 13 has the daily production of 650 pieces. In the case of stamping parts (all parts that are not balls), productivity / day is 1150 pieces. Moreover, there are some jobs that are performed cold solder according to customer demand, where the goal is for productivity of 850 Kg /day.

The work is individual, but they share parts between them, so that all may gain more productivity in relation to this. There is a cooperation of collective bargaining, so that all may have a fixed salary and keep an extra salary. This happens as follows: a request arrives for welding and they share that request, so that there is service "good" for them all. The service is one that good to perform welding, yields and production cycle time is less than 10 seconds. This is the case of balls called "marbles Marina" spheres with diameters less than 7 mm and pin placement in stamping parts. However, there are also services "bad", where the cycle welders have over 10 seconds and happens when welding rings, chains, cold solder, etc., representation of welders in relation to their work is linked to productivity, cycle work and collective work.

There are two types of jobs in the welding industry. The first is to prepare the asbestos and second, welding parts. In preparing asbestos, plays container upon asbestos, a tray positioning ball and other parts. This asbestos is a refractory material, does not let heat, is fireproof, does not leave deform the work piece and is a lightweight material. There are two types of asbestos: ones that are full of holes and others are smooth. When the holes are filled with asbestos are used to position the balls are smooth and when, positions the stamping parts. The stamping parts are brass plates used to make earrings and pendants. The beads are used to make earrings, pendants and bracelets. After placing the balls in asbestos, get tweezers and places the ball into each hole of asbestos with the "front" side up. The sphere has a "front" which features a hole and some spaces, which runs the solder to secure the necessary accessories such as pins. When finished asbestos, they positione in the cabinets to grab the welders to accomplish their task. Carefully observes the ball so that there is needed and that the holes are preserved. A note on the work order is the order that regulates its operative mode so that selects the right amount to put the ball in asbestos. Memorize and be attentive to see how much is needed in each ball asbestos.

It stay seated and makes movements of wrist flexion. The complete cycle of assembly of asbestos ranges from 5 to 6 min, settling 100-200 spheres in asbestos. It takes on average 2 seconds to put each ball on asbestos. There is variation in the size of the asbestos and the parts to be placed. When stamping, can is put the pieces in asbestos or not. But with the ball, you must put in asbestos. In stamping, welding their own place on asbestos smooth. Because there is only one person to prepare asbestos, so they self-organize so that there is always in production relay welding and stamping parts ball. When the balls are smaller, 3, 4 or 5 mm, grabs the container plays in asbestos and balls already positioned themselves in the holes of asbestos. The holes are large and it facilitates the positioning of the spheres. She stirs asbestos and balls already accomodating. *"... give a shakeup in the balls ... gain in time smaller balls..."*

She looks, listens and inspects to see if the balls are "face forward". Otherwise, grab the tweezers and position the ball so that it is facing upwards. Despite the spheres are made at the company, they exhibit irregularities in shape, having a variety of aperture of the spheres. When preparing asbestos when the ball has its very open hole she uses

tweezers to close it. It's a way to solve the problem and take the ball. This is not prescribed. Also, inspect the parts defects hour putting balls in asbestos. If you do not detect the welding defects may or may not detect, and the quality inspection in the process.

There is a strategy to use their time so that it is integrated with the welding time for rest and work. Pauses and speeds up work to get organize your time and pace appropriately. Organize your work rate according to the work of welders. However, there may be delayed for the preparation of asbestos. Need adapt their pace of work to prepare asbestos in coordination with seven welders.

"... have to position them straight to ... otherwise they lose time ... "

"... if you very quickly end up the asbestos and I get no service ... if they are too early to have ... they are going slower delayed ... I cannot slow down at all ... "

Talk with colleagues at work or stops the cycle at times to talk with colleagues about matters unrelated to work. It is a way to coordinate their work and use their time according to the need of welders. She will self-accelerate or slow as the welders are performing their task. You used to have work rate, his pauses and puts more pieces, the bigger your reward for productivity. *"... go slow because I've done enough ... if I delay the girls and cannot wait ... cannot waste time ... "*

When is the ball called "Marble Marina" to be produced asbestos begin to prepare in advance because welding is faster than preparing. It is anticipated the worker to perform the preparation and not compromising production. If the welders have already done the work, take another piece to weld until you have prepared for all asbestos solder ball. *"... Marina is when, not enough to prepare while we solder ... Welding is quickly ... welding is faster than preparing ... "* The second task is to be performed welding. Grab the pin / hook / loop with the tongs that is in the right hand, put some solder (micro cut into squares) on pin passes torch that is in his left hand. The torch heats the solder and the pin sticks within the "front" of the sphere. The solder flows in risk. For each sphere, there is a type of welding and pin type. It has been found that it is important to have accuracy and attention to develop this work. Developed ability to use these tools in this way to accomplish the task of welding. Must have the memory of each of the type to be used, but they communicate among themselves and verify the type of welding required for the ball. The most experienced in memory know what type of solder used in the field to be produced. Sometimes even experienced welder knows what type of welding, but confirms with the most experienced, generating this interaction between them. For a sphere of 9 mm pin 80 and need solder 11. *"... no problem ... then put the pin 80 ... (Pin 8/10 11 thickness and length) ... ta with which you weld? ... (L) ... with 11 to ... (E) "*

There are several types of balls and larger ball has to be warmed, exposing it in the longest torch. Thus, increases the cycle time when compared to the smaller spheres. Furthermore, holding the caliper pressure larger in time, keeping the handle in static posture. *"... bad solder ball more ... has to be very hot ... "*

The smaller the ball, the less time leaves the torch to heat it and drain the solder. If the ball is very open with his hole needs to put more solder there. Depending on how the ball is positioned welder has to turn it up to the front to put the solder ball in the hole. The more "soldarão" fastest solder flows through the spaces.

In relation to the working cycle, which influence is the diameter of the sphere, the sphere size of the hole, positioning the ball on asbestos, the amount of "soldarão" around

the ball. The "soldarão" is a chemical used in conjunction with boiling water to carry the ball. Each ball has a type of weld. From the ball 13:15 second solders places because one is not sufficient to close it. This type of ball has a cycle time of approximately 17 seconds when placing pin therein. However, the sphere 11 has a cycle time that varies from 14 to 16 sec. Table 02 shows the systematic observation held in the company by checking cycle times of each size ball.

The total cycle filling of asbestos varies around 30 minutes. By producing a "ball Marina", takes a solder wire with the tweezers in his right hand and his left hand is the torch. By melting the tip of the welding wire, placed on top of the sphere with circular movements, so that the solder ball drain spaces. There is a coordination in the work, so that they can divide between production pieces not to miss any of them. When asbestos grab choose the most part that has thus far do not raise and earn bigger prize for production. According to them, it's advantage, since the production of Marina is a "good service" cycle that has less than 5 seconds and leads to increase your productivity goals. *"... when does marina is because the application is great because it usually goes to the street* ... On average there are 120 pieces in each asbestos and take 10 minutes to complete one asbestos, and the cycle varies from 2 to 4 seconds. Divide production marina *"... Asbestos is six for each ... ".*

After ending production of the marina, takes the ball from a box with his hands and does a visual inspection to see if a ball stuck in another. The experienced welder recognizes the ball stuck by noise. Stir in the box and passes torch to unglue them balls. The other worker, more than the other newcomer, prefer for a ball in a box to see if it stuck. *"... ta seeing that sound thin ... stuck ta ... ".* A piece stamping which is held welding, and was ball is not a part that was divided between two welders to carry out the welding. *"... facilitates the work ... it becomes easier to divide the pieces ... ".*

A worker welds newcomer randomly while the experienced welding in an order. Besides it has the exact measurement on the torch, because the torch newcomer gets more time in the play. The newcomer does not look for the earring, if it was not bent or parts, unlike experienced looking after the end of the weld. She does not talk to the other and sits at a table alone. Unlike others, who sit in pairs. *"... I am still ... 'm new ... I need to see what to do ... "*

One strategy adopted by working to prevent efforts into fists and drop the pieces quickly stamping parts is put in a tin with a lid, shake and remove the parts, playing in a colander. Remove excess soldarão to put in colander and put in a box. This makes the parts come loose and the worker makes no effort to unglue the parts. Do not have to use your time to unglue piece by piece. Detaches all at once. *"... ta see ... is easy ... all loose pieces ... "*

An important question to be raised are the breaks taken during the workday. The importance of the pause is related to muscle recovery time and switching positions to minimize the effects of repetitive work on this task of preparing asbestos and welding. Most of them performs breaks in a time of 5 minutes or less. Besides this pause reported by welding, there is the pause inserted in activity, where each prepared asbestos or each welding bead asbestos complete (30 minutes on average). Leave your job, alternating sitting posture for standing and will pick new asbestos in the closet, moving about 3 meters.

Conclusion

It was found that there is a procedure for individual and group, where welders act on the organization, collective work and has flexibility to change operating mode, adjusting their work. The specific knowledge, developed by welders, enabled them could adjust the procedure according to their cognitive and physiological resources, favoring the construction of health. The relationship between repetitive work and the possibility of planning the activity generated by the freedom given to welders work organization, contributing to the health and avoiding the occurrence of musculoskeletal disorders.

The work of welding cycles was characterized with less than 30 seconds, according to the view biomechanical / kinesiological reported by Silverstein, Fine and Armstrong (1986). For Lima (1998), time is not determined in a manner so simple, since there variability present in the work situation and a very dynamic work activity. The variability was present, mainly linked to the pieces. In relation to the working cycle, it ranged from approximately 2 to 20 seconds. This occurred due to the ball diameter (2.5 to 24 mm) hole size of the "front" of the sphere, the position of the ball on asbestos (with "forward" upward), the amount of "soldarão" in around the ball (chemical used in conjunction with boiling water to accomplish the sphere). Thus, there is a relationship which Coutarel, Daniellou, Dugue (2001) describe therefore highly repetitive in situations with short cycles, there exists a variability of raw material, the type of application, the condition of the machinery, etc.. That lead workers to change their method of operation, thus requiring action planning.

The welder performs repetitive movements in welding and preparation of asbestos with short cycles, but also develops representations, operational methods, anticipation, problem solving and decision making during execution of work. As regards Wisner (2004), every time you store information for action (activity) and action (seeking a goal) will be building skills and creating representations. It is through the representations that the individual selects relevant information more assertive and procedures to accomplish a task. Every work situation the individual creates differentiated responsibilities for action.

This work, as well as repetitive, holds a unique character accuracy, and manual. For Lima e Silva (2002), the manual activity is important due to the richness of behavior, characterized by flexibility, adaptability, development and improvement of forms of regulation. The task of manual precision in the case of welders, showed skill and manual dexterity and objectification of practical knowledge, with an exclusive, because there is no way to eliminate human labor in welding jewelry. Colombini, Occhipinti and Fanti (2008), the lack of recovery periods can lead to biomechanical overload movements and / or repetitive upper limb. For Maciel (2000), there must be a recovery time sufficient breaks. For the author, the effects of repetitive movements are more pronounced when they are performed by applying forces. In the case of welding, no application of force, but there are periods of muscle recovery because perform micro-pauses when she plays the part inspection tasks, breaks every 30 minutes when changing asbestos and breaks to go to the bathroom, coffee , among others. These breaks are forms of regulation to prevent any illness from the welder.

According Kuorinka and Forcier (1995), complaints are accumulating load exceeding the adaptive capacity of a tissue, appearing a warning sign. The situations that potentially has a degradation of work activity, leading to a risk factor, with reduced capacity for work. Despite welders work with pain, yet there was no decrease in the ability to work, according to this form of regulation that collective installed through

breaks. The welder defects of parts inspected and removed the solder pelotes. That was the moment she alternated the position of wrists and hands, regulating the work since developed a different activity soldering. When preparing the asbestos, the experience contained in memory, attention to irregularities in shape and opening of the spheres, the spheres were examples of use in existing activity that alternated with manual tasks, creating another regulatory space where there used to hold the posture and movement of forceps. When the operator prepares to put the ball asbestos in it, started from the top and was left a space at the bottom where you could catch balls remaining (left over on top of asbestos) and play in the box, not having to remove the balls one by excess one with forceps. Succeeded with that, use your wrist movements only for the ball and do not remove the excess. It's a new form of regulation.

The smaller spheres, 3, 4 or 5 mm, grabbed the container, asbestos and threw the balls into the holes already positioned themselves asbestos. The holes were big and has facilitated the placement of the ball. She fiddled with asbestos and balls already settled, regulating the work, not having to use tweezers and gripping movements to put the ball in asbestos. The piece called helmet, welder had to be careful because she needed solder two very similar and accessories needed to store and apply on the part. Used the strategy of leaving an accessory on your left side and the other on the right side, near its range. The experienced now could differentiate which was every accessory, positioning close together.

The operator prepares asbestos that had a strategy to use their time in order to be integrated into the welding time for rest and work. Did breaks and accelerated the work arrange to get your rhythm and timing appropriately regulating its work. Organized his work rate according to the work of welders. In "Marina ball", to be produced, began preparing asbestos in advance because welding is faster than preparing. It was an anticipation to accomplish the preparation of asbestos and not compromising production. If the welders have already finished the job would take another piece for soldering until all asbestos was prepared to weld the "ball marina".

The welder had freedom, increasing regulation of this space, managing the maintenance of health, even with complaints. It was noticed that there was no burden on your internal state, obtaining flexibility in its operative mode. For Assunção (2003), the strategies of individuals built with work experience can serve as an argument for extending the margins of work organization. Thus, the implementation of these strategies and the development of others, can compensate for the decline in activity and prevent the emergence of risk factors for the health of those who have not got sick, despite finding themselves overwhelmed.

Dejours (2000) states that a repetitive task can generate mixed feelings at the thought. When there is no acceleration of the work, there is room for creative thinking to create mental representations, emotional and affective, avoiding the monotony of work. The work of the welder was not characterized as monotonous. The concept of monotony and repetitiveness had an important relationship because to perform the activity, the welder increases the duty cycle through the work of "good" and "bad", leaving much creative thinking to create representations, solve problems and make decisions. .

Carayon (2000) describes that in an organization based on teamwork, there are high levels of participation, generating positive psychosocial work environment. Furthermore, if some breaks may reduce exposure to physical, which occur in the work of

a welder. According Dejours (2000), from the measurement that the thought is removed, the body becomes more fragile and, in case of overload, the symptoms expressed in a somatic. This occurs in repetitive work under time constraint where the symptomatology is oriented toward the body and not the mind. In the case of welders is no such constraint on the basis of award for productivity. Means there is acceleration in the pace of work, may intensify their work in a planned manner, generating cost and wear a welder. Thus, complaints arise because they increase the pace, so surgery is fast and can lead to work overload.

Carayon (2000) demands quota production can lead to pressure and tension between team members. There was this work a production target for the welders, controlled by the charge. If a worker begin their work in this fledgling company cannot make that minimum production initially, it has difficulties in handling the torch in his left hand, so you need to take care not to put the torch torch near or close to your body parts not melt them. Also, need to learn to handle the forceps in the right hand, with movements gripping and wrist flexion, coordinated with the torch, to perform welding. Can only achieve minimal amount of parts at about three months. But not to compromise the production usually hire welders with experience another factory jewelry. One newcomer joins the company and is trained by more experienced operator. This showed a concept of craftsmanship.

According to the welders, the welding work is stimulated by the award for productivity, favoring the increase of additional salary. Not reported anything negative like physical effort to achieve the goal. It's a dilemma existing in this research, because the regulation is at work to promote health, but welders gain by intensifying production work. With experience, operators increasingly adapt their strategies according to their physical cost in terms of effort and time to provide for the carrying out tasks. This is a specific knowledge worker about their own skills in a particular field or in a given situation (ASSUNÇÃO, 2003).

Affective relations also interfere with the construction of collective bargaining. The work was featured as individual, but they shared parts between them, so that all could gain more productivity in relation to that, being a form of regulation that intensified work. However, the cooperation of that collective bargaining has created a form of regulation alternating cycles. A cycle of 2 seconds to produce "marbles Marina" is worse than a cycle of 17 seconds to produce spheres 15. There was a division order, serving "good" and "bad" for all. The one that was good service to perform the welding, and rendered on production cycle times less than 10 seconds. It was a case of "balls Marina", spheres with a diameter less than 7 mm and pin placement in stamping parts. However, there was also the services 'bad', where the welding cycle were over 10 seconds and happened to weld rings, chains, cold solder, etc. As the study showed the Assunção (2003), also happened with the welders where one of the rules of the collective is to not let the fellow in a difficult situation, a situation where their means and capabilities are fragile to answer requirements of the tasks.

Finally, we found that further studies are needed to understand every step of the manufacturing process of jewelry, with the completion of Ergonomic Work Analysis. It is important to analyze different products and different sizes of companies, as well as vertical companies and horizontal to understand the context of the global jewelry companies.

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