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Work Experience: Participation or Creation?

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Abstract

Where does the successful performance of businesses and organizations mostly stem from? Is it from engagement in work or an effort undergoing imposed expectations? The latter has been a matter of much controversy. Proposals for participation in the workplace were a target of much criticism by Castoriadis and Tragtemberg. Without intending to answer such a predicament, this paper discusses points that seek to contribute to the debate. It analyzes the experience of air traffic controllers, which may be approached not as much as an effort in itself, but as the result of a collective creative process. It is based on research data collected from the past fifteen years from aviation workers, above all from air traffic control centers in São Paulo and Rio de Janeiro.

Keywords

Work, Participation, Collective Creation, Air Traffic Controller, Aviation

1. Introduction

The idea of participation appeared in Brazilian organizations in the 1970s, which contradictorily was the time when the country was governed by a dictatorship. Companies at the time were looking for ways of countering the mobilization of workers, who were on strike for better salaries and working conditions. New ideas in management strategies, such as quality control circles, participative management and what was considered to be the Japanese model, were introduced by a new class of executives, in the face of the advances workers were making on the political scene.

These participative proposals in organizations were the object of criticism, particularly by Castoriadis & Tragtenberg. In the 1950s, Castoriadis (1950, 1974) questioned proposals for worker councils and the worker management of plants, considering that power over production requires other forms of collective life. He considered, however, that no organization could function without the organization of work by worker collectives, in-

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dependently of management and their production rules, given the unpredictability of the production process. Tragtemberg (1980) was one of the great critics of organizations and of ideas of co-management, participative management and plant committees. He always pointed out the patrimonial and authoritarian heritage of the Brazilian business class and claimed that these proposals would not result in structural changes in management policies. They would not result in a participative democracy, since decisions, the dividing up of profit or the different ways of disposal were not included.

If the question of worker participation in the management of organizations or in the results of the production of companies is always controversial, how can we understand production systems that are developed as a result of worker action? The experience of workers on the Sao Paulo subway was analyzed within the context of its introduction between 1970 and 1990. This relied on the effective action of the workers and resulted in the undertaking being successfully introduced. In this case it was an innovative, automated technology within a social and industrial fabric that was still developing. But it cannot be simply understood as the result of the effectiveness of management strategies. Political action spaces were occupied by way of the various possibilities present at that moment. It was also understood as an effort by a collective of workers to involve themselves in a new universe of codes and systems and to create a new professional condition, that of the "subway worker". This goes beyond a simple analysis of an intended participation, submitted to control by the production process.

In fact, it cannot be stated that there is total control on the part of organizations over work groups. The production process, as established by the rules, is unable to deal with the failings and uncertainties of the systems and the unpredictable events that occur everyday in the work environment. This also involves the incoherent aspects of the forms that organizations take and their management policies.

It is a fact that workers in a production process do not dominate the whole process and have to submit to the rules of the organization and the systems established for controlling them. However, this does not reduce them to being simple machines. Not recognizing the other relationships that are established in production relationships is moving from a belief in scientific systems over labor relations to reducing the individual to a simple "doer", which was the criticism raised by Castoriadis (1974) and Habermas (1973). Rational systems do not always result in a mere duality between domination and servitude. There is no way of denying the conscience. Even in more rigid systems, the subjectivity of the worker makes itself felt. As social and historical beings, individuals think and mobilize their deeds to take account of their functions and what they do, and they know what to do and how to do it.

The objective of this paper is to analyse the experience of air traffic controllers. It is based on research data collected from the São Paulo and Rio de Janeiro control centers at different times and on different days of the week. In order to carry out this analysis daily observations were made in the workplaces over a six-month period. Each one of the activities carried out by the controllers was monitored and their actions and how they understand them were noted down. The study started from the hypothesis that air traffic controllers bring their attention to bear and make a big effort to take account of the work density and the strict rules that apply to their working conditions. Air traffic control, as it is developed on a day-by-day basis, results in a work of collective creation. This is why two main points are analyzed: content and effort; and density and creation. The study is based on data taken from research carried out over the last fifteen years.

2. Air Traffic Control

The Brazilian air traffic control system was conceived and structured within a military defense system. It was introduced and managed by and comes under the responsibility of the Ministry of Defense, Aeronautical Command. With responsibility for defining the circulation and traffic policies for Brazilian air space, this authority also has the public function of air traffic security and control. The current system, Sisdacta, [Integrated air defense and air traffic control system] was introduced in the 1970s. The control system comprises the circulation routes in the air space, approach control in cities and regional centers with a large amount of traffic and control of airport traffic. To control the air space of a territory covering 22 million sq. km., as well as areas of the sea, the system is organized by a national control center, with regional control centers in the country's main regions. The control towers of the main city airports are linked to these regional centers.

In 2012, the Brazilian air transportation industry carried more than 107 million passengers, 83% of whom travelled on domestic flights (ANAC, 2013). Air traffic controllers monitored more than 1 million flights that circulated in the country, an increase of 84 % in ten years (ANAC, 2013). Over the last two years, there has been a slow-down, following growth of 24% between 2009 and 2010. Even so, the number of passengers almost tripled over the ten years between 2003 and 2012. Passengers are concentrated in the Southeast region, with 43% of the total in 2012. This region also has the biggest concentration of air traffic, split between the airports of Rio de Janeiro and São Paulo.

The airport infrastructure has not accompanied the pace of growth in air traffic. In the 1990s, the number of flights doubled in ten years and over the last decade the number has grown by 84%. But it cannot be said that the number of people in air traffic control has doubled in each of these periods. What happened were changes in the airport management process, which has had an effect on the work of the control towers at airports.

This growth in the number of flights is added to the increase in the speed of systems and equipment, notably from the 1970s with the introduction of jet aircraft, which represent an increase in the amount of work and a acceleration in the pace of work. To these two factors are added the number of passengers per flight. Each flight can carry as many as 500 passengers, as is the case with some Boeing equipment. This increase in the number of passengers also translates into an increase in responsibility for safety in each flight. This triple increase—in the speed of equipment and systems, in flight traffic and in the number of passengers or amount of cargo per flight in the same number of working hours per day—justifies what is considered to be an increase in work density. This density has effects on the pace of the workplace.

3. Work Content and Effort

Work in the traffic control room is organized in sectors, which correspond to areas of the region controlled and the type of control, as is the case with flights that are in visual contact, which are organized into one sector. Each sector is coordinated by two controllers. For this control there is a console with various monitors and data equipment. On one of these pieces of equipment is a map of the air space, representing the delimited area of specific air space under the responsibility of that particular team. On another piece of equipment there is an image of the region's air space. On the monitor with a bigger screen the specific air space is identified, blown up, and the flights en route in movement are shown. Also alongside the monitors are communication systems, like a radio and telephone.

The control room is organized as a large circle. The supervisor can see all the teams of each of the sectors. The supervisor also has the regional data center under his supervision. The room has no natural ventilation or light source. The room remains in semi-darkness, which is justified by the incidence of light on the visualization screens; it would make it difficult to visualize them properly if it were not arranged like this.

A simple and rapid observation shows the controllers concentrating in front of their monitors the whole day long. The working day starts with a briefing, a report from colleagues about the development of the day's traffic and advice for the day. To monitor a flight a controller carries out a series of activities and takes a large number of decisions in a short time-cycle. Among these activities the eight most important are as follows.

The first consists in looking at the program schedule and seeing what flights are programmed for their working day. They also check the flights that appear on the monitors, as represented by icons: numbers and letters. The act of seeing is not simply looking at the symbols that appear, but also observing the movement and remembering it. The second consists in decodifying or deciphering the symbols, differentiating the colors and numbers with the corresponding letters, composing them into a set in order to transform them into comprehensible information. The third activity consists in analyzing the possible routes existing in the sector's space and assessing them with regard to other flights en route.

The fourth activity is to decide the route to be allocated, ensuring beforehand that no other flight is planned for that route at that time and checking that there is a minimum horizontal distance, or nine kilometers, between flights. Some strategies may be put into practice in emergency situations. One of them is placing flights in a vertical position, one on top of the other, at a distance of between 300 and 800 meters, in accordance with the type of equipment. The fifth activity consists in identifying the pilot who calls in by radio in order to check the flight data, which are also on the visualization screen of their monitor. The sixth activity is recodifying the information to conform with air traffic codes. The seventh activity is to transmit the route to the pilot by radio and the eighth is to input the route allocated, once the pilot has confirmed it, and then to insert it in the program. Many controllers also carry out a ninth activity, which is to write the route down on paper, called a strip. This activity, which used to be compulsory, was discarded with the introduction of new equipment and systems. However, many do not feel secure and maintain the activity, because during the observation period it becomes necessary to use them, above all in case of an emergency situation, like a breakdown in the data transmission system.

What is stressed is that all these activities are undertaken under severe time restraints. The situations experienced in the control area show the need for absolute dominance over the sector's traffic information. It is obvious that each of these sectors feels responsible for the safety of the passengers in flight, and because of this for the aircraft en route to their destination and for the crews. They have in mind the international aviation rules and they keep up-to-date with regard to the weather information in the region and neighboring regions and the take-off and landing conditions at the airports under their control. They do this because they are risk situations and they try and have control over the smallest details, even those that change. According to the controllers, unforeseen and unexpected situations occur, even though all precautionary measures are taken to ensure greater control.

Among all these activities, there are four that require a lot of concentration and attention. They are data collection; the treatment of these data; data codification, and decodification for processing information that is not clearly presented. There are data that appear on the monitor by way of symbols, like numbers and letters and in different colors. Some blocks of color move constantly on the screen and others not. It is also necessary to look for other data that are needed and that are not on the monitor. For example, based on the location of the point on the monitor, a cursor is used to open a window situated in the upper corner of the monitor to open up these other data. This is route information and the sequence of flights that will move very shortly. They require representation work at different levels and these levels must be seen, identified and deciphered in order to understand the state of traffic in their sector.

These data are those that, above all, demand identification, analysis and data treatment activities in order to prepare information. Such tasks need to be done quickly. As flights move at speeds of between 1000 km and 1600 km an hour, they are moving at between 3 and 4 kilometers per second. Although the speed of movement in the air does not correspond to the same speed on the ground, it follows the same logic of speed and movement. Each controller is responsible for six flights simultaneously. At peak times, between 6 am and 9:30 am and 6 pm and 9 pm when the traffic is more intense, each one is responsible for as many as twelve flights. In some cases a controller is looking after as many as twenty flights simultaneously. At times like these an already tense atmosphere becomes even heavier.

As the data of the support system are transmitted at the speed at which the flights are moving, when the number of simultaneous flights increases the controller needs to be able to handle the speed at which these data are being transmitted as well as the amount of data corresponding to each flight. The monitor shows data on the screen, which changes every three to four seconds. This demands that the data are quickly visualized in order to identify and memorize them. The controller also has to deal with the different types of equipment that are on each of the flights and their different capacities and speeds. This requires knowledge of the capacities and possibilities of each one and how they are operated by each of the companies.

In fact, some aspects of the content of this work that the controller needs to look after result from an organization and management of the process as it is developed in practice. Seven aspects of this organization can be mentioned. The first refers to the composition of the teams and the working hours. In the control room in São Paulo, for example, the number of flights for each sector increases because of a lack of personnel. There are five teams, each comprising 14 controllers, who are distributed into three shifts a day. There are also teams for covering vacations and days-off. There is a certain idea that working days, rest periods and days off are managed by the teams. However, what may appear as a certain notion of self-management of the hours worked masks the responsibility that is attributed to them of ensuring the three shifts per 24-hour day have a full complement of personnel. What is implied in the work allocation decision is that if there are insufficient people to make up the teams of the day, many controllers feel they are being called upon to double their working day.

The justification for the shortage of people is that there is a full complement of staff and there is no possibility of justifying hiring new people. But this is much more a management accounting problem. In the control room in Rio de Janeiro, for example, the permanent staff complement is 80 controllers, with 50 controllers in the control tower at Galeão Airport. But, according to one of the supervisors, of the 80 controllers, only 46 are working in the normal shift system. This represents almost half the staff. The other 34 are on leave from the function, whether because they have been sent to look after emerging situations, such as systems maintenance and administrative services, or because they have been summoned to look after investigations. Some controllers are also on medical leave, and nine of them are on vacation. So the 46 are distributed among 6 teams, with at least 8 controllers in each. In each team there are one or two interns in training who need to be monitored, which is done mainly by the most experienced people.

A second aspect that is emphasized arises from the deficiency of the organization as a whole, which has an effect on the work of the controllers; this is what they call something "being left up to the controllers" to sort out. There are failings and problems with the infrastructure of the airports, as is the case with São Paulo and Rio de Janeiro, which have a greater amount of traffic. These dimensions and functioning conditions are disassociated from the growth and number of landing and take-off operations that take place and the circulation of passengers. As a result the length of time during which flights need to be controlled increases, with an increase in the number of flights for each controller and a longer time the controller is responsible for being vigilant and providing guidance during the approach stage. Problems of visibility are also frequent in these airports, particularly at certain times in the winter when there are thick fogs and during rainy periods and when there are storms. The third aspect refers to the fragility of the support system vis-à-vis a complex activity. The breakdowns in the systems, which occur frequently, leave the controller without information and this is incompatible with the level of responsibility he has for flight safety. As the controllers say, the system goes down, blocks, stops or shuts down. In these cases, the controller resorts to old control strategies, when there were no data visualization support systems. However, as the controllers stress, this was used when the amount of air traffic was different, because the clock had "other markings".

The fourth aspect is the slowness in making decisions for coming up with a solution to the problems caused by the defects that affect the functioning of the support systems. It is expected that these solutions be effective and fast, and function at the exact time they are required in the control activity. But this slowness takes on another dimension, since they are decisions that are outside the competence of the control room to take and require action from other sectors—and they have another time for doing things. There is another time, which has to do with the decision about buying or exchanging parts or equipment, which for the controllers is incompatible with the requirements of the activity, or with the demands to which they were submitted, given the speed of the systems and the amount of flight traffic. Once in this pace it is impossible to understand the distinctions between the demands that exist and the responses of management to them. When assuming this function, controllers assume responsibility for ensuring the safety of flights in order not to put into practice rules and norms that may compromise the accuracy of their vigilance and the guidance they give to flights en route or approaching the airport. The fifth aspect has to do with the difference between the work content and responsibility and the salary earned. This is an activity in which each controller may have under his responsibility around 3000 passengers at any one time, without counting the other corresponding impacts. But this work density is not reflected in their salaries. The sixth aspect has to do with the action the controllers take for correcting or managing the risks caused by problems they cannot change. They are responsible for coordinating the air traffic of a sector and for being watchful so that the anomalies that can affect air traffic do not occur. In this growth, in traffic what there is no lack of, according to the controllers, are the errors they have to live within the air traffic function. There are problems in the programming, just as there are problems arising from the actions of the airlines that are increasingly seeking to obtain greater productivity from their flights. In doing so, they produce problems for the rest that must be managed when this affects the functioning of air traffic, since the controllers do not have the power to correct the decision at the source.

The seventh aspect is the incompatibility that exists between the responsibility of controllers and their authority to decide. They cannot decide about flight programming, but the programming is increasing and traffic control does not even have the possibility of expressing their opinion about managing this increase. Air traffic control management is also unable to intervene in the decision that may contribute to improvements, and there is no lack of suggestions, proposals and sometimes appeals for improvement from the controllers. However, if there are accidents, the controllers are blamed for them. In some of the cases that have been monitored the controller needs to "sort it out himself" when it comes to defending himself from a blame for which they have no responsibility. Currently we see that there is a very obvious distance between the responsibility attributed to them and the power to intervene in the decision process. The content, therefore, becomes complex and dense, given the increase in risks they experience as part of their work. This is not included in the equation and has an influence, above all, on their capacity to work and the effort of each one in their daily work routine.

4. Work Density and Collective Creation

What we see is that the worker cannot be evaluated only by the activities that are carried out in the functions as they are established. On the contrary, to perform their functions correctly, or even just to keep on top of them, places in practice all their working capacity. They assume the responsibility that is attributed to them and the conditions they have so the process can function.

A part of the complexity of these control functions is to make all the communication systems work and to be able to rely on the visual information that is transmitted to them on their monitors by the systems. In fact, we see that air traffic control work involves being responsible for all the risks associated with the malfunctioning of systems, quite apart from the problems they face on a daily basis from management policies, the issues surrounding the organization of the structure of air traffic and the failures in the infrastructure, which are present in this process. There are unforeseen risks, for example, associated with a breakdown in one or various systems, and weather uncertainties, such as rain, storms, fog, clouds and wind, which also make the work of the pilots tense. There are also risks arising from the various changes in schedules and problems related to the functioning of on-board teams, which affect leaving, take-off and landing times, as has been previously analyzed (1998, 2009).

The educational qualifications of controllers is always considered as being simply second grade of middle school. This is the requirement at the time of selection and the civil service entry exam. But this does not correspond to the knowledge needed for responding to the demands of this work. The contradiction lies in the fact that to assume the position of traffic controller requires experience of at least seven years in the function, from airport towers to control rooms. This is what is required to satisfactorily exercise the functions attributed to controllers and for them to be made a permanent employee in the function. In fact, the requirements for obtaining permission to work begin with selection and the training period, which takes between at least five and seven years. Demands also extend to include health, which is assessed at the time of selection, and that includes a long and complex battery of information required for obtaining the license to exercise the function after selection. The state of health is also periodically assessed, either every six months or every year, after the vacation period. This health certificate is compulsory.

But one of the risks the controller runs is that of losing this certificate; without the certificate they cannot exercise the function. The risks are very marked in aviation, above all by the fact that the quality required in the state of health, contradicts the working conditions they experience. We see controllers being made available to assume other functions or relieved of their controller functions for psychological reasons. We also saw other causes, like heart attacks and other health-related issues. But these cases did not result in a prevention program, or a program for improving working conditions. Neither did the results of the medical examinations or the illnesses identified form part of the care and treatment or improvements in the state of health of the workplace.

In view of the fact that the organism is constantly in movement, the physical, mental and social well-being of controllers depend on care and permanent attention. This care is part of a dynamic process of searching for an equilibrium in the regulatory mechanism of the organism. Health is not a piece of information, a static state; worker health is much more the result of a process that develops in the social space and depends on the quality of the living and working conditions. Above all the state of health of the worker reveals use experience, as was analyzed by Fassin (1996), which is an experience in the conditions lived and specific to each work relationship. But the worker is responsible for managing the risks of not getting sick, of not becoming stressed and even of not losing their health certificate.

The experience of controllers, like that of pilots (1998), runs the risk of living an error, of suffering an accident and of being held responsible for it. Accidents in aviation are a fact of life, but they are managed by a safety management system at two points in time. The first is management of the accident data and the second is control of the security for investigating the accident. Air accident rates have always been kept quiet. It is a fact that there has been a drop in the number of accidents over the last few years, but it is data relating to previous decades that show this drop, as we can see from the reports; neither do accident analyses take into consideration the content or degree of fatality of accidents.

Attention to risk is always necessary, and it must be in favor of society. Investigations into the cause of accidents must contribute to identifying the failings, defects and dangers that could be eliminated for improving the safety conditions of air transportation. But controllers and pilots live under risk, given the fact that most of the investigations serve to lay the blame on them. The worker as a private individual has to respond for all the errors of a group of industries in the air transportation system, which involves high technology, comprising control systems, basic services and the control policies of the structured air space, which is under State control.

In fact, the activities of air traffic controllers cannot be visualized from the tasks they carry out. If we take into consideration the activities of the cognitive process we might also consider manifestations of fatigue, which are always common among controllers after hours of work. These are manifestations of the organism that signal the effects of the demands of the effort put into these activities. The symptoms of fatigue, which are manifest and seen above all after two or four hours of work, are accompanied by mood changes, which may be signs of the demand on the cognitive system. These are activities that demand a lot of the nervous system.

Important studies were carried out by Luria (1973, 1983, 1986) and Vygostky (1962) into the work of language-articulated cognitive processing, which might contribute to an understanding of this work. In these traffic control functions people work with data and the understanding of a piece of data cannot be wrong. A call over the radio needs to be well understood. The attention required for controlling the sound and the visualization monitor is multiple and necessary for correctly identifying the data seen and heard, in order to be able to prepare the information and take a decision. The actions involved in seeing and hearing are basic. They comprise data treatment activities, which mainly need sight. But sight needs to get used to a dim light when working on the monitors, for example, when the cells of the retina receive images in the form of luminous data. These data are transmitted to the brain by way of physical-chemical mechanisms, cone-like cells that are concentrated in the central part of the retina and used for seeing and recognizing colors.

In this activity, the act of seeing is not just looking, but seeing well; seeing in order to be able to read the data correctly. This means looking, reading and understanding the data. The visualized data come from the support system of the visualization monitors and this can present a large amount of information to the controller. These are data about air traffic, namely the movement of the aircraft on the runways, as transmitted by the control systems of the control towers. These are data about the planned program schedule and data that are being carried out. They are also data about the movement of aircraft in the air space. The data are picked up by radar, treated and transmitted by the support system, from which the controller must identify those that are important, select them and prepare them.

Studies carried out with blind people were important for understanding that the act of seeing in itself is not enough. Sacks (1995), for example, shows cases where it is necessary to see by making use of the eyes, of sight. The world as we see it is given to us, because it is in a continuous and cumulative construction process. The world around us is constructed from experience. We need to identify and classify it in a never-ending process of visual memory that produces a network of representations and recognition. The visual memory is an instrument that serves as support for visual perception, which allows us to perceive the world as we see it in a coherent way. This sensation becomes a perception that is relative to our visual behavior. This is why seeing requires the construction of a framework, an orientation structure that is developed by learning space, time, image and sound through simultaneous visual perception. These data are recognized and reconstructed by the treatment activities that are carried out by the brain and that result from a capacity we have for analysis, synthesis and hierarchization. Our sight captures the data that are treated to transform them into information in its multiple pathways and transported under different aspects by the visual cortex, as was analyzed by Meyer (2002).

This orientation structure is constantly referred to in order to look at and understand what is seen and to produce new representations and associations. These are neural connections using visual memory. That is why it is possible to construct what might be called a knowledge network on this structure. The use of this orientation structure and of knowledge networks can also be compared with what Fayol (1992) called situation models. These are activities of the visual cortex that are continually transformed. In this sense an object we see must be recognized by the representation activity, the memory, and by the construction of an integrated representation model, by way of the interaction, identification, data treatment and preparation of the information in the existing knowledge networks.

There are cognitive treatment activities that are carried out in environments with different noise levels. The demand of the act of seeing applies also to the act of understanding. It is necessary to listen well and understand well in this space. This is learning that is carried out by the simultaneous perception of the image and sound and the construction of the representations of the sound in time and space. The act of hearing develops on this orientation structure with help from the never-ending experience of sounds and their meanings. The act of understanding requires the identification and processing of data for the preparation of information so that a solution may be understood and also prepared and acted upon.

Noise is a problem in the case of the control room in São Paulo. One of the questions raised was sensitivity to noise after a period of hours of work. An assessment was carried out of the level of sound pollution in the control room, which followed the work of the controllers. Measurements were made at different times of the day and night and on different days of the week and month. The result showed that noise level came within the legal requirement of 75 dB (A), considered to be a tolerable limit. However, based on the discourse of traffic controller fatigue, a new study was carried out to analyze living with noise.

In fact the sound in this workplace is not a simple noise, and it cannot be analyzed in isolation. Exposure to constant and intermittent noise has effects on the organism as well as on work performance. A study into exposure of the hearing apparatus was carried out by a team of specialists in noise in confined work spaces. Such exposure produces disorders, which can be translated by the fatigue discourse accompanied by mood changes, and which can be noted after one and a half hours working at the same pace. Sound is also codified communication. The word that comes from a sound is an enunciation, with information or a fact that is introduced into a system of relationships in a semantic field. When Luria (1982, 1986) analyzed the communication process, he found that there is work involved in deciphering the system of sounds. It is not just a question of listening. This process comprises three stages, like perception of the sound system by a system of verbal codes; deciphering these codes or decodifying them, and understanding the general meaning of the information.

To do their work, air traffic controllers need to start with the data in order to prepare the information they need to decide about the guidance to be given. These data are transmitted by words that have meanings and these meanings are developed in their daily experience with work situations. Sound is an integral part of the work content, which is why controllers are alert to the calls from pilots over the radio and telephone. The ear captures the sounds and then selects those that are priorities and those that are not. There is no selective listening, a priori. In this listening all the sounds present in the room are intercepted and the listening experience is permanent. In these cases it is not the hearing apparatus that becomes overloaded, but the cognitive system. The volume of sound may be considered tolerable in a general measurement, like the reference value for the standard tolerance of the level of sound pressure the organism can support. But it is, above all, the large volume of data that the ear transmits to the cognitive system from the sounds it hears and that the latter needs to process, which translates into a large volume of information being processed. The ear captures and retransmits the signals, as codified sounds, as words that represent data.

We can analyze two different situations experienced by controllers during the period of observation. In the first situation the number of flights that are controlled is considered acceptable, at between one and four, and they manage to accompany the scheduled program of flights.

This program appears on the monitor of each controller, divided by sector. The flights can be visualized by means of icons that appear on the monitor, indicated by a code, two letters and a number. This code indicates the flight number and its altitude. The controller is watchful and monitors each of the flights, calling the pilot to provide him with guidance on the route. In a second situation, each controller is faced with a large number of flights, of between six and twelve. The controller is unable to control everything and accompany the program, as is necessary. But this number of flights can reach twenty, as occurred on several occasions. At this moment it is always the pilot who calls first to inform his position and request guidance.

In these situations, the traffic controller pays attention to all the information coming from the pilot by radio communication. He compares it with the data that are shown on his monitor and then with the scheduled program. The controller checks all the data, assesses them and certifies them. This assessment means analyzing the data that arrive and the various pieces of information he has and comparing them with existing data. Then he checks the route possibilities in the air space, as represented on the monitor, the distribution of the flights in the space and the flights programmed to follow. To do so he needs to assess the time needed for a flight to pass through a particular air space by calculating it in seconds and minutes. He also confirms the calculation to be certain of a position that is to be allocated to a flight on a specific route.

The entire assessment process is carried out with data represented on the monitor. The controller identifies them and the data relating to routes and the distribution of flights in the space, analyzing them with the flights that are programmed to follow subsequently on that route. The controller does not allocate a route to a pilot until he is certain of and has mastered all these facts. He decides and transmits the route within an available space when he is certain of the seconds and minutes available for this flight on this route. In this second situation the controller feels that he is not always in control of the whole situation. In fact, the norms and rules are put to one side and "he rolls up his sleeves and prays to God". This is when he "chases after things", as controllers always put this. The term used of "chasing after", which was also created in the daily language of control, means to undertake activities at a fast pace, in fractions of a second, seeking to handle the situation and "race against the clock", against the chronometer. All this effort is to avoid more serious problems.

Situations are unpredictable and uncertain in these activities. They demand multiple attentions on a permanent basis in order to control the risks of collision, of accidents. In this process, the cognitive activities are engaged and function permanently to solve problems and incorporate the construction of the mental representation of the situations to the new data that must be composed to prepare the information. This action also requires analytical activities of anticipation to control situations that may be conflicting. The controller needs to mentally assess a situation in the subsequent scenario, to face an imminent future moment in time. He prepares himself for this. At the time this occurs the action needs to be correct and timely. For this assessment, he uses his memory of the recorded data, from among those presented on the monitor's screen. Both the scheduled program and the data that are printed on the strip are data that change, that move every four seconds.

When an unforeseen situation arises, the controller has recourse to his memory to review similar situations he has experienced in the past, as well as the established strategies. He also discusses it with his colleagues to check out solutions and alternatives. Every time conflicting route and flight situations occur the controller discusses them with his colleagues and with his bosses. In fact, special or unforeseen decisions are always discussed to ensure the best alternatives. These unforeseen situations, which are not established in the rules, are frequent, and the team develops strategies for facing up to the different problems that occur. That is why elaborate work is put into practice, like collective creation in order to respond simultaneously to the demands.

Final Considerations

The work of air traffic controllers is an experience that does not tolerate misunderstanding or misinterpretation. Air traffic controllers do not hesitate in their activities. They are always in position. They do not feel at ease asking for information to be repeated that they did not hear well, or that they may not have understood. They need to decide immediately what is being requested. All activities demand the cognitive treatment of a set of sounds, numbers, letters and those that represent the pilots' words, the flights and routes in the air space that appear on the monitor's visualization screen. Controllers do not see objects, but work with the auditory and visual representation of a set prepared from a knowledge network, which demands an effort on the part of their neuro-cognitive systems.

That is why to understand this work of air traffic control we need to analyze the content that is carried out in the number of hours of a working day and under the conditions in which the controllers live in their day-to-day routine. This is work in which the chronometer is implacable. The number of activities undertaken is infinitely greater than what is established. It is impossible to comprehend the degree of responsibility these controllers have for flights, safety, and passengers, unless we extensively monitor them.

It is, therefore, a work experience with high risk content. The risk of accidents and incidents is impressive, given the degree of unpredictability and uncertainty in the automated systems. The number of uncertainties and unforeseen situations is incalculable, since they come from different points, systems, equipment, on-flight teams, the weather and problems arising from the airport infrastructure. These are associated with difficulties resulting from the incongruence of the air traffic organization systems, notably as far as the infrastructure and maintenance programs are concerned, and the functioning of the on-board equipment and systems and systems on the ground. These are facts that controllers face and consider as being common in their daily work. Finally, they also face other risks, above all those arising from the forms of organization and the management policies that are established in this workplace.

In this sense, in analyzing this work in the control center we see content that is dense. This density is always submerged under a capacity for work, but one that encourages the creation of a set of strategies that are developed and put in place by the controller in order to be able to "get by" in this activity. It is the creation of knowledge that is diluted by a vague concept of qualification. Guidance schemes are created and developed to carry out the activity. It is capacity for work that is put into action and that demands to be analyzed from another perspective, one that is interwoven with different meanings, provided it is based on the daily routine of a work collective. Among these strategies we find those for defending themselves from over-work, above all to protect themselves from risks and avoid the damage to their health to which they are exposed.

So, even considering that we are dealing with work that is controlled by the military and that has rigid rules from a military perspective, we see knowledge being developed and strategies created by these work collectives for making the systems they operate function. The functioning of this control would be impossible without these structures, which are created and developed for carrying out the traffic control function better.

However, other methodologies are also needed to understand this work density better under the conditions experienced in different situations. In the same way, the lack of specific rules for assessing conditions in this activity makes it difficult to assess the effects of exposure to noise and the effects of other motor and cognitive efforts in these workplaces, which are marked by work that is carried out at such an intense pace and speed.

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