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IMPORTANCE OF THE PROCESS OF DEMAND CONSTRUCTION IN THE ACTIVITY OF CIRCULAR LINE DRIVER IN A FEDERAL UNIVERSITY

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Abstract

This article describes the work of bus drivers on the Circular Line of a Federal University, demonstrating the inadequate working conditions to which they are subject, regarding the condition of the vehicles, the rules established by the company related to the organization of work and the repercussions directly linked to the health of these workers. It aims to demonstrate how important the process of building demand is to carry out the survey of existing demands in the workplace of these professionals and supported by social construction. The process of building demand was carried out based on theoretical research in order to obtain demand hypotheses. After having knowledge, the social construction and the global analysis of the driver's activity were carried out. The workers' demands were confronted with the demands provoked, resulting in the negotiated ergonomic demand related to the established route times.

Keywords: Drivers; Circular Line; Demand Construction; Social Construction.

1. INTRODUCTION

Among the professionals who work in traffic, urban public transport drivers stand out. The work of these professionals consists of making continuous displacements, taking and bringing people to predetermined destinations. They have a "macro" workplace, which is traffic, and a "micro" one, which is the bus. Due to this peculiar characteristic, no other professional suffers as much from the pressures of the road environment as bus drivers (BATTISTON, CRUZ and HOFFMAN, 2006).

This article consists of a case study carried out with the drivers of the Circular line bus of a Federal University, aiming to demonstrate the importance of the construction of demand sustained by a social construction in the process of defining negotiated ergonomic demands (ROCHA et al., 2022). The methodology used was based on the Ergonomic Analysis of Work

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(WISNER, 1987; VIDAL, 2008; GUÉRIN, 2001). For the process of demand construction (SALDANHA, 2004) a theoretical research was carried out to support the hypotheses of demands that were later confronted with the situated demands, resulting in the selected ergonomic demands.

Studying and understanding the representations of existing problems from different points of view and the particularities existing in the activity of these professionals becomes extremely important, since the drivers, who perform their activities on the bus route of the University's Circular line, are subject to inadequate working conditions regarding the conditions of the vehicles, the rules established by the company related to the organization of work, having a direct impact on the health of the worker, on the execution of a safe activity and on the quality of the service that is being offered.

The survey of the demands in this work environment will allow the understanding of the current difficulties of bus drivers, providing information that can be applied in the elaboration of proposals that can contribute to a positive transformation at work that has repercussions in terms of comfort, health, safety and efficiency.

2. THEORETICAL FRAMEWORK

2.1. Drivers' activity

The bus driver's task is to drive passengers to a certain location. The driver performs the task of transporting passengers with the means available to him (the vehicle being the means of driving) and within the conditions established not only by the conformation of the physical space of the command post, but also by the rules imposed by the company (GORNI, 1997).

The work of the urban public transport driver is directly related to the environment in which it is carried out. Unlike people who perform their professional activities in closed environments such as rooms or stores, sometimes air-conditioned and relatively comfortable, this professional performs their activities in a public environment, traffic. Therefore, it does not have a restricted and well-defined place to carry out its tasks; on the contrary, he works outside the company's gates, being subject to inclement weather such as climate, traffic conditions and the route of the roads (BATTISTON, CRUZ AND HOFFMAN, 2006).

A study conducted by Suter (2001) states that noise is one of the most common occupational risk factors, and noise levels are easily identifiable to health. However, there is a lack of preventive programs, which, for the author, is due to the fact that noise is usually accepted as a "necessary evil" and, although it is capable of causing damage to health, it is not

literally visible, it does not cause injury and, when the worker is able to endure the first weeks of work exposed to noise, he has the feeling of having "gotten used to it". As a result of this "necessary evil", Cavalcanti (1996) states that the location of the engine exposes drivers to a potential risk of occupational deafness, since the noise of the engine in decibels is higher than the limit established to avoid such risk. In other words, front-engine buses cause greater discomfort since the source of the noise is exactly next to the driver, and the noise of the engine is added to that of the traffic and the passengers themselves.

High temperature is another aspect that can interfere with drivers' activity, which can alter their emotional state. According to the DETRAN of the state of Pernambuco (undated) (2007), the temperature inside a crowded bus, in the summer, can reach 50°C, which can occur in other states with similar annual temperature averages. This high temperature can cause discomfort (making the driver restless), mood swings (irritability and aggressiveness) and interfere with performance when performing their driving task (inattention and drowsiness).

Vibrations are also present in the drivers' work environment. Griffin (2001) points out that vibrations can be whole-body or transmitted by the hands. Full-body tests occur when the body is resting on a vibrating surface (for example, when sitting on a vibrating seat, stepping on it, or lying on a vibrating surface). For Silva and Mendes (2005), who studied the whole-body vibration to which the driver is exposed, they concluded that the values reveal a risk situation, as they far exceed the limit established by ISO-2631 for eight hours a day.

The high workload is a constant in the lives of these traffic professionals. According to Frankenhaeuser (2001), it is also necessary to distinguish the quantitative from the qualitative workload. The first is related to the excessive amount of work that must be performed in a given time, and the second concerns repetitive tasks that need variety and difficulty. Battiston, Cruz and Hoffman (2006) point out that under aversive conditions, the demands of this work tend to generate overloads on the physical and psychological systems.

Grandjean (1998) points out, in relation to the high mental load, that the profession of bus drivers requires prolonged attention and alertness that after 4 hours of work the first limitations of production capacity arrive, and that after 7 to 8 hours these same limitations increase strongly. The author also states that these limitations are indicators of a state of fatigue.

In the activity of urban bus driver, forced postures and excessive repetitive movements of the upper limb often occur. The Public Health Commission of Spain (2000) states that repetitive movement is a group of continuous movements, maintained during work, which imply a musculoskeletal set, causing muscle fatigue, overload, pain or injury. According to its

chronicity, contractures, pain and injury appear, forming a vicious cycle of pain. The diagnoses are very varied: tendinitis, peritendinitis, tenosynovitis, myalgias, among others (BATTISTON, CRUZ AND HOFFMAN, 2006).

According to Battiston, Cruz and Hoffman (2006), there are conflicts between bus drivers and passengers, and also with inspectors. Some statements suggested the existence of difficulties in relation to passengers: "We are just employees, sometimes we have to reveal what passengers say"; "There are passengers who complain about the driver, as if it was our fault for having a traffic jam or for someone having braked in front of us" (Drivers interviewed).

These relationship difficulties were also detected in a study carried out by Machado and Levenstein (2002) and are aggravated by the dissatisfaction of users with the service offered, whether in the mismatch between supply and demand, which can lead to overcrowding of the bus, or in the waiting time in places without shelter or in the time lost in traffic jams. There is a considerable lack of support facilities for adequate comfort and hygiene for the workers under study, and this is confirmed in the research carried out by Battiston, Cruz and Hoffman (2006), who highlight that the terminals had few toilets, the hygiene conditions were precarious and there was proximity to bars, which favored the consumption of alcoholic beverages by drivers.

Ergonomics, a science that focuses on work activity, can contribute positively to the transformation of the work activity of bus drivers in order to provide conditions of comfort, safety, efficiency and health at work. Based on the methodology of Ergonomic Analysis of Work, which requires knowledge of the work (task), the worker (user) and the organization (socio-technical environment), it is intended to elucidate the effects on the health of these workers and the results of their work (BATTISTON, CRUZ AND HOFFMAN, 2006).

3. METHODOLOGY

3.1. Social construction

One of the main questions when working on the survey of ergonomic demands is: how to start this survey, and what methods should be used to achieve success? According to Vidal (2008): "The effective functioning of an ergonomic action requires a structure of action, of a participatory, technical and managerial nature". Therefore, it is necessary that there be articulations on the part of researchers with various groups of different nature. Thus, social construction deals with the organization of a device for the instruction of ergonomic action in the company that will help in the survey of demands. The groups that should be taken as references throughout the intervention are: the ergonomic action group (GAE), support group

(GS), follow-up group (GA), focus groups (FG). The function of each of these groups, adapted to the present research, will be described below:

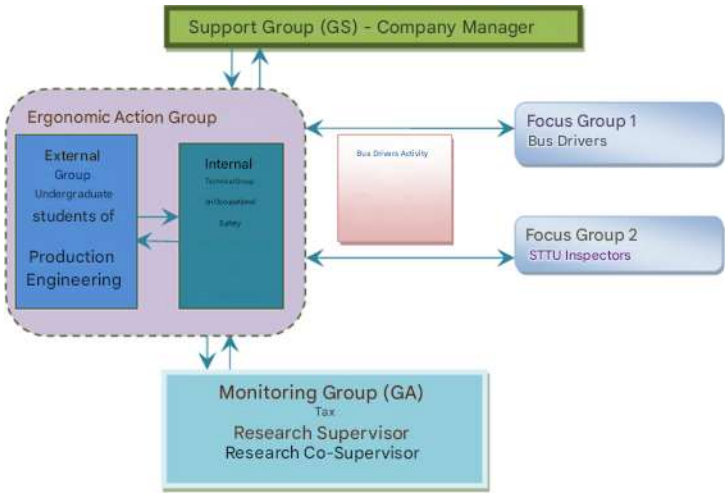


Figure 01: Social Construction

GROUPS	FEATURES
Ergonomic Action Group (GAE)	Constituted by the articulation of the Ergonomics team with the interest group, formed by the people who are responsible for Ergonomics in the company. In this case study, the GAE was divided into sub-groups: *External Group:* composed of three undergraduate students in Production Engineering, responsible for the survey of the information collected and *Internal Group:* composed of an occupational safety technician.
Monitoring group (GA)	Formed by people who have the technical authority to make decisions related to the driver's activity, especially in terms of schedules and inspection, that is, it is formed by inspectors from the Municipal Department of Transport and Urban Traffic (STTU). The research advisor and co-advisor were also part of this group.
Focus groups (GF's)	Composed of people who participated in the data collection: drivers and STTU inspectors, who contributed to the surveys and validations of information on the activity.
Support Group (GS)	Composed of people who hold the decision-making power in the company, that is, the manager of the company under study and the STTU inspectors.

Table 01: Social construction device

3.2. Global analysis of the activity of bus drivers on the ring line of a federal university

3.2.1. Performance of the circular bus line at the university

The city where the research was carried out is the capital of a state in the Northeast Region of Brazil, which has an estimated population of 800 thousand inhabitants. The University has more than 27,000 students, 3,062 technical-administrative staff and 1,638 professors.

The Circular bus was implemented about 10 years ago, with the participation of two companies that had the University Campus as their route. These companies had a concession to operate in the city's urban system, with the Municipal Department of Transport and Urban Traffic (STTU) being the regulator of this procedure. After Law 8,666, which establishes

general rules on bids and administrative contracts pertinent to works, services, including advertising, purchases, disposals and leases within the scope of the Powers of the Union, the States, the Federal District and the Municipalities, is sanctioned, the STTU (granting authority) only delivers the concession if the company gets a bid. Currently, the University Campus has two companies doing this service of transporting people in 4 buses in total, 2 from each company.

The University's bus services are paid for by everyone who uses the city's public transport. This payment is made indirectly through the calculation of the city's bus fare that is passed on to the services of the Circulars.

The Circular line is free and has the intention and capacity to serve students, servers and teachers in the capital. This service is also used by the non-university population that lives in the vicinity of the University, taking into account that there is no identification for University students.

The Circular buses that travel through the University are organized in two shifts: day and night, from Monday to Saturday. The first shift operates from 6:30 am to 2:25 pm and the second from 2:25 pm to 10:20 pm, with each driver having a 1h05min break for food and a 5-minute break after each trip. When a driver is on a break for food, only 3 (three) buses are running, which happens mainly at the busiest times at the University, so that the buses that circulate are overcrowded.

The itinerary of the Circular (see table 02) is prepared by STTU, which currently runs through the University in two directions, one direct (direction I) and the other reverse (direction II) according to the map of the University Campus (see figure 01). The definition of the timetable is defined by the STTU, which states that the entire route must last a maximum of the pre-established time of 20 minutes. The agency states that four buses would be enough for transport if only the student population, which lives in the capital, used them. However, University students who live in other municipalities also use this service, for this reason, the buses work with overcrowding.

The bus used by the driver of the Circular line has precarious conditions of conservation and maintenance. Added to this is the fact that the bus used has a long time of use, contributing to the appearance of mechanical defects. It was observed that the intensity of the noise and vibrations produced by the bus is high and that some drivers' chairs are not adjusted, making it difficult to adopt an adequate posture during the activity in order to avoid discomfort at their workstation.

Figure 02: Map of the University Campus

IDA ***DIRECTION I***	***RETURN*** ***DIRECTION I***
University Restaurant (Terminal)	Campus Ring Road (Rectory)
Campus Ring Road (swimming pools)	University Restaurant
Santos Dumont Street	
Passeio das Rosas Street	
Coronel João Medeiros Street	
SENSE II	***SENSE II***
University Restaurant (Terminal)	Campus Ring Road (Biosciences)
Campus Ring Road (Rectory)	Campus Ring Road (Return of CAERN)
Santos Dumont Street	University Restaurant (Terminal)
Passeio das Rosas Street	
Coronel João Medeiros Street	

Table 02: Route of the Circular line

The existence of the Circular as a means of transport of "integration" is essential for students to be able to travel from one sector to another within the Campus itself and also externally, when students go to the University or when they move from there to their respective residences.

3.2.2. Characterization of the working population

The participants of this research were 04 (four) bus drivers, which correspond to 50% of the population of drivers of the Circular line that are part of this fleet of the Federal University in question, being 02 (two) of the day shift and 02 (two) of the night shift, whose working day corresponds to 7h 20 min. The investigation on these transport professionals was directed more specifically to the drivers of one of the companies that provide this service at the University. Table 1 shows the characteristics of the work population analyzed:

Table 01: Characterization of the working population of drivers of the University Circular

Motorista	Sex	Age (years)	Schooling	Length of profession (years)	Time on line (years)	Salary (base sal. Min.)	Marital status	No. of children	Own home
M1	M	40	Complete high school	12	2.5 years	1 to 3	Married	3	Yes
M2	M	60	Incomplete elementary school	39	3 years	1 to 3	Married	3	Yes
M3	M	55	Elementary school incomplete	22	2 years	1 to 3	Married	3	Yes
M4	M	58	Incomplete high school	22	5 months	1 to 3	Married	3	Yes

3.2.3. The task and activity of the circular line driver

In the company studied, it is up to the urban bus driver, when taking over the service and receiving the key to the bus, to inspect it in relation to crashes, tire conditions, springs, seat belts, lighting, seats, radiator water, as well as to know the route of the line to be executed. Any abnormality found, the driver must inform the company's inspection before moving the car. The driver must drive the bus in accordance with the traffic rules in force in the city, obeying the signs, maximum speed allowed and also stopping only at specific stops for boarding and disembarking passengers.

The time to carry out the task of the Circular bus driver is 20 minutes regardless of the time and route. In the day shift, drivers must take the same route 15 times, while drivers in the night shift must take the same route 16 times. Drivers are granted a break of 1h05min for a break for food and rest, with the break time of one of the drivers being close to lunch and in the case of the night shift, one of them has his break close to dinner time at the University Restaurant, and a 5min break after each trip. This break time is a little incoherent, because at the busiest times at the University, when most students are arriving for classes or leaving them, there is a greater need for all the buses on the line to be circulating, and it happens exactly that there is a vehicle stopped.

In the analysis of the drivers' activity, it was observed that the itinerary requires a combination of visual, auditory, psychomotor coordination and quick thinking during the mobilization of a large vehicle on the University's route. After a certain time, as a result of internal and external factors (tiredness, pain, high temperature, vibrations, noise, traffic, stress, irritation), the driver abandons his correct posture, adopting the most varied adjustments in his

spine. The speed of the movements made by the driver increases when he is late at the times of stops, at the stops and at the bus terminal (University Restaurant). This occurs at the busiest times (peak hours) at the University, which are at 7 am when students arrive at the University; between 12:30 p.m. and 1 p.m., a break that corresponds to the end of morning classes and the beginning of afternoon classes; between 6:30 pm and 7 pm, which corresponds to the end of classes in the afternoon shift and the beginning of the night shift and at 10 pm when students leave the University.

The Municipal Department of Transport and Urban Traffic (STTU) determines the schedules and lines on which drivers will work. This scale is strictly controlled by STTU inspectors who circulate through the terminal. At times of high passenger flow, the delays, resulting from this increase in service request, must be recovered on a next trip, by determination of the STTU inspectors, leaving drivers without the 5-minute interval, to which they are entitled.

Repetitive movements are quite typical in this activity and were widely witnessed in the monitoring of this itinerary. The most noticeable were in the head-neck region, upper and lower limbs, in addition to great movement of the trunk.

As a result of factors related to the working conditions in their activity, the workers presented some changes in their health, such as herniated discs, generalized discopathy and serious back problems, and these work-related diseases were reported as the main managerial demand.

It can be highlighted, through the reports of the drivers, that these are professionals who experience moments of great emotional and physical exhaustion as a result of the crowding at peak hours and the pressure exerted by the inspectors due to non-compliance with the timetable and also by the students, who demand that this worker stop at improper stops or travel faster. The tasks to be fulfilled, the physical demands at times of greater traffic movement and administrative pressures, are situations that are part of the driver's routine and are directly linked to his obligations to the company.

The activities of the bus drivers that carry out the route of the University Circular are characterized by:

i. Lack of autonomy as to the form of work organization, with working hours and places, which are determined by STTU inspectors;

ii. Intense supervision of the work used as a surveillance system through STTU inspectors who supervise compliance with the timetable;

iii. Pressure on the work by the inspectors with regard to compliance with the travel time. According to the workers interviewed, when they arrive late at the terminal, they must leave immediately to cover the delay.

During the activity of the Circular bus drivers, several variabilities and regulations were detected. At busy times at the University, there is an overcrowding of passengers on the Circular buses. Consequently, drivers need to adopt inappropriate postures in an attempt to view the mirrors for greater safety in the transport of passengers.

Other variabilities that occur frequently are: delays due to external conditions (slow traffic and delays in boarding/disembarking passengers) and the request to stop in an inappropriate place (outside the bus stop). These factors lead to a delay in arrival at the terminal. As a form of regulation, drivers fail to make their entire itinerary and end up "cutting" the path to be able to adapt to the rules of the work, or make the journey at high speed, compromising the safety of passengers and the driver himself in an attempt to make up for lost time.

Several factors contribute to this demand, the most notorious is related to the time of boarding/disembarking due to the high number of people at the stops at peak times, the duration of the route in this environment reaches approximately 30 minutes. The overcrowding of the vehicle arises as a result of this factor, and this fact is very worrying, because the overcrowding of the bus brings undesirable consequences both for the users and for the driver. One of the biggest risks, reported by a driver, is leaving the stop with the bus doors open and the impossibility of closing them due to passengers traveling hanging from the doors.

It can be observed that the delay of the bus generates another obstacle for the driver: they have the right to an interval of an average of 5 minutes between one trip and another. When they arrive late, they lose those 5 minutes that are intended for a short break. This generates a physical overload, irritability and repetitive movements for the driver, generating health problems and increasing the probability of accidents occurring. The pressure that is exerted by the inspectors, who demand that the schedule of the table be met, reflects directly on the performance of these professionals. Another conflict present is between the driver and the passengers, when the former does not stop at the stop when he is late or when the bus is overcrowded.

In other cases, variabilities occur incidentally. The most common is related to your work object, the bus, with defects/breakdown of the equipment. Climatic variations (heavy rains at

certain times and very hot days); traffic jam resulting from a collision or the large flow of cars; A ditch on roads or streets are external factors that completely break with the established timetable.

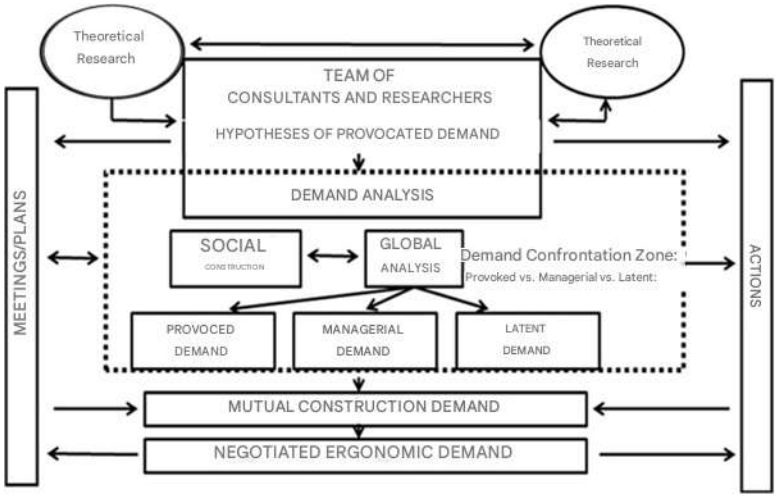
Human variability is also present in this activity. The adequacy of their job position and the length of time in the profession are interindividual characteristics: some are performing their function in the circular more time than others and there is a difference between tall and short people. Tiredness, fatigue, increased workload, stress, irritability, and decreased productivity are intra-individual variabilities.

3.3. Construction of demand

The method used to conduct the study of bus drivers was based on the approach of Ergonomic Work Analysis (AET), proposed by WISNER, 1987; VIDAL, 2008 and GUÉRIN, 2001.

The process of constructing the demand for this work was carried out through a provoked demand, according to which the researchers sought the organization, proposing to help it in a possible problem, if it was manifesting a problem and was in need of help, or proposing to develop a study that could identify problems that would become demands (CARVALHO AND SALDANHA, 2001). The process of constructing the provoked demand is shown in Figure 03.

Figure 03: Construction of the Ergonomic Demand.



Source: CARVALHO and SALDANHA, 2001 adapted from VIDAL, GOMES and BENCHEKROUN, 1997

For the survey of ergonomic demands, first, a theoretical framework on the subject was carried out, which served as the basis for the formulation of hypotheses of the demands. The

theoretical framework and the demand hypotheses helped in the elaboration of the research instruments to be used in the global analysis of the activity, described above, which allowed, in addition to confirming or not the hypotheses, to identify the latent and managerial demands. The instruments used in data collection were observational methods and interactional methods, which are: dynamic scripts; extended listening and conversational action and questionnaires. Photographic and video records were also made for a greater understanding of the activity. The questionnaire had the following objectives: to survey the profile of the workers, the socioeconomic aspects.

With the information regarding the hypotheses of demand and the managerial demands, the inspectors and the drivers, an analysis and confrontation of the demands was carried out, resulting in the negotiated ergonomic demand.

To instruct the demand in the company under study, it was initially sought to identify problems that could be found in the situation studied through the elaboration of a set of demand hypotheses established from a theoretical research. From the analysis of the theoretical framework and the information collected in the work environment studied, it was possible to elaborate the following hypotheses of the demand provoked and the demands situated, according to the table below:

Table 02: Demands of the Activity of drivers: hypotheses of the demand provoked and demands situated.

DEMANDS	**SOURCE OF DEMANDS**	
	Chance	**Located**
Excessive noise (SUTER, 2001; CAVALCANTI, 1996)	X	
High temperature (DETRAN-PE, 2007)	X	X
Excessive vibrations (GRIFFIN, 2001; SILVA AND MENDES, 2005)	X	X
High workload (FRANKENHAEUSER, 2001; BATTISTON, CRUZ AND HOFFMAN, 2006; GRANDJEAN, 1998)	X	X
Forced posture and excessive repetitive movements of the upper limb (THE PUBLIC HEALTH COMMISSION OF SPAIN, 2000; BATTISTON, CRUZ AND HOFFMAN, 2006)	X	X
Conflict between: drivers X passengers and inspectors (BATTISTON, CRUZ AND HOFFMAN, 2006; MACHADO AND LEVENSTEIN, 2002)	X	X
Lack of support facilities for adequate comfort and hygiene (BATTISTON, CRUZ, AND HOFFMAN, 2006)	X	X
High mental load		X
Work-related illnesses		X
Lack of infrastructure for moments of rest and meals		X
High pressure from STTU inspectors		X

4. FINAL CONSIDERATIONS

Accompanying the drivers in their activities on the Circular bus, surveying the ergonomic demands, through the process of constructing the demand sustained by social construction, allowed the research group to open new perspectives, as well as to outline considerations for improving the working conditions of the drivers and the service provided to users.

These improvements in the working conditions of these professionals of the Circular line are essential to have a satisfactory service for the population of students and employees of the institution, as well as to maintain the physical and mental integrity of the drivers. In this sense, the redefinition of travel times on each specific line, considering the variabilities is fundamental. The development of an ELA will allow the knowledge of the work reality of these professionals, allowing, according to Guérin (2001), the understanding of the variabilities, both in terms of their occurrence and the mechanisms used by the operators to face the diversity of situations and their consequences. From this understanding it is possible to delineate the part of reducible variability, the part of controlled variability to be considered in the organization of work, and the means to be provided to operators to face unavoidable variability.

Changes in the working conditions of drivers are the responsibility of the various actors involved in the process, involving the companies, the Municipal Department of Transport and Urban Traffic (STTU), inspectors, drivers and users. Improving working conditions can have a positive and multiplying effect on the performance of the activity with repercussions for drivers, users and companies.

It is not possible to understand the demands of the Circular driver without first analyzing the production system as a whole: the people, the technologies, the organization and the social, political and economic context in which it is inserted. Ergonomics as an area of knowledge that is concerned with analyzing real work situations has, therefore, an important contribution to make in this context through the methodology of ergonomic analysis of work.

Production Engineering, as a field of knowledge, enables the use of resources from various areas of knowledge, and can contribute to the search for appropriate solutions for each specific work situation, contributing to the improvement of quality and productivity, to the safety and health of workers and users and to the economic effectiveness of the production system.

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