

# Activities performed by passengers in an aircraft cabin: contributions for comfort study and recommendations for cabin project

## Authors

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# PRESENTATION

- This study is part of the research developed by EMBRAER - FAPESP - PICTA “**Comfort and Design of Aircraft Cabins**”. Besides these institutions, the **National Agency of Civil Aviation (ANAC)** contributed to the research offering logistical support that enabled the data collection.



# Introduction

- Brazilian aviation presents a significant growth in the transport of **domestic passengers**, primary activity of the airlines in the country (ANAC, 2005 – 2007);
- The total flow of passengers in the country went from round about **45 million** in 2007 to **50 million** in 2008;
- Competition among airline companies: comfort is a differentiation factor
- Challenge: to project cabins in which comfort, health and performance are integrated with requirements such as resistance, safety and economical viability.



# Introduction

## 1. Concept of comfort

- ❖ Vink (2005): “Convenience experienced by the end user during or just after working with the product”
- ❖ Quehl (2001): “Comfort is the sensation of well-being, pleasure and satisfaction perceived by individuals in the interaction with the environment and artifacts”
- ❖ In the scientific literature the definition is under debate

### **Issues that are generally accepted (Looze et al, 2003 apud Vink, 2005):**

- ❖ Comfort is affected by various factors (physical, physiological and psychological)
- ❖ Comfort is a reaction to the environment/product
- ❖ Comfort is a subjective concept



# ***What interferes in the passengers comfort during a flight?***

**According to the review of the literature:**

## **2.1 Seat:**

- Space for the legs
- Health (deep vein thrombosis )
- Height, width and length (depth) (postures, mobility level)
- Seat Cushioning
- Adjustments and integrated features to accommodate occupants' needs (inclination level, adjustable height, lumbar support)
- Support (adjustable support, support for arms, neck and head)
- Integration of the seat with the In-flight Entertainment (IFE)
- Activities performed by the passenger (resting/sleeping, feeding, watching a movie, ingress/egress)



# ***What interferes in the passengers comfort during a flight?***

**According to the review of the literature:**

## **2.2 Physical environmental factors:**

- Temperature
- Humidity
- Acoustic conditions
- Vibration
- Lighting
- Vibrations/shock

## **2.3 Cabin size and layout**



# ***What interferes in the passengers comfort during a flight?***

**According to the review of the literature:**

## **2.4 Operational aspects:**

- Delays and flight cancellation
- Lost luggage
- Cabin service (flight attend)
- Safety

## **2.5 Individual aspects:**

- Expectations concerning the trip
- Reason for the trip (business, leisure)
- Gender, age, stature, and weight
- Health, fear and anxiety



# ***How to use activity analysis to evaluate and improve passenger comfort?***

- ❖ **The aspects of a task** performed by the individual may have an important perception of the user's comfort/discomfort (GROENESTEIJN *et al* 2009).
- ❖ Passenger comfort: Not only does it not depend on the seat and the space between them, but also on the possibility of performing activities during the flight (Han et al, 1998).
- ❖ Understanding passengers needs and expectations
- ❖ Using objective and subjective methodology to evaluate passenger comfort during the flight





## Objectives of the study

- To analyze the activities performed by passengers during a flight, to identify the positive aspects that cause well-being, and the negative ones that cause constraints in each activity
- To establish relations between the constraints and dimensional aspects of the cabin

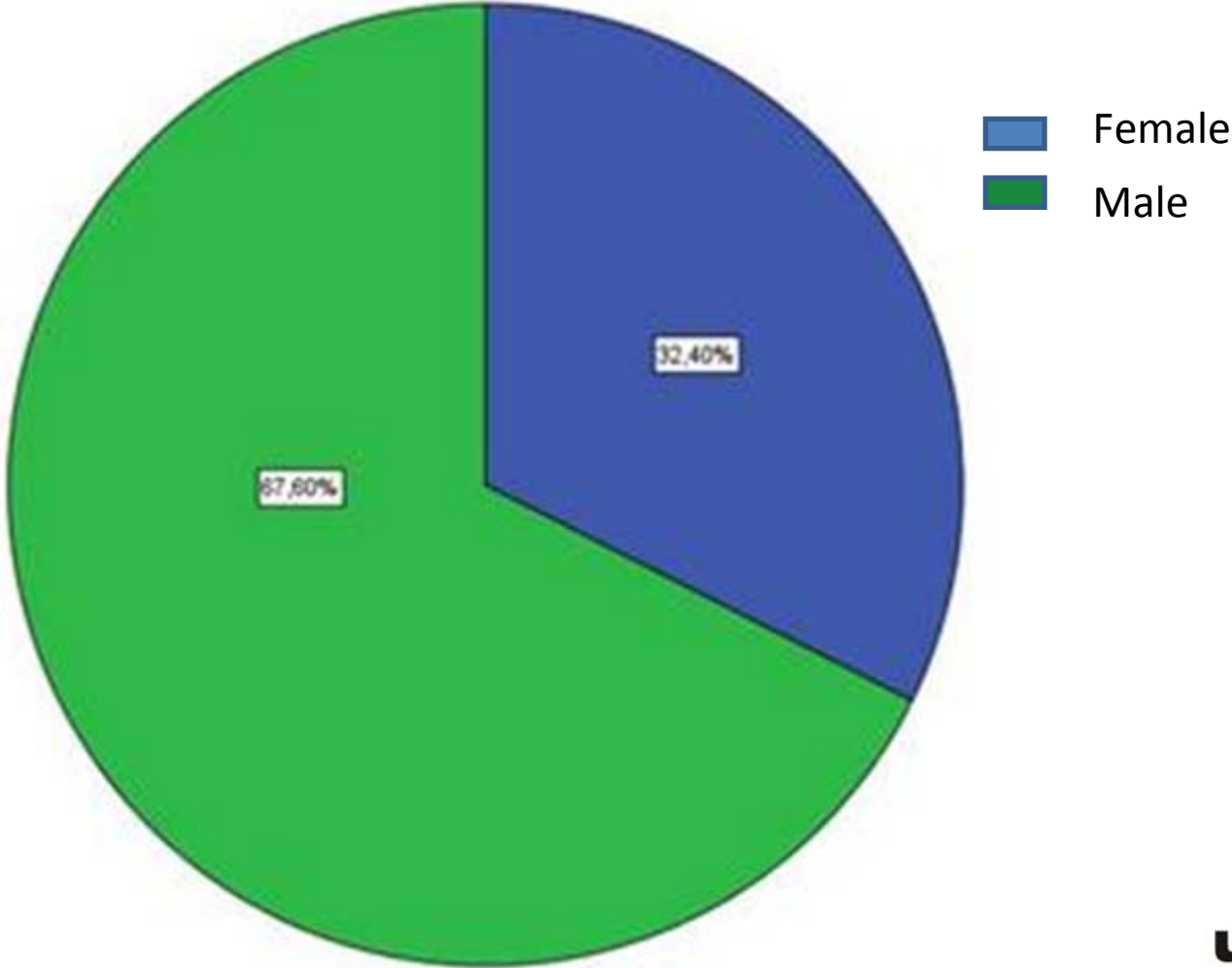


## Field research during the flights

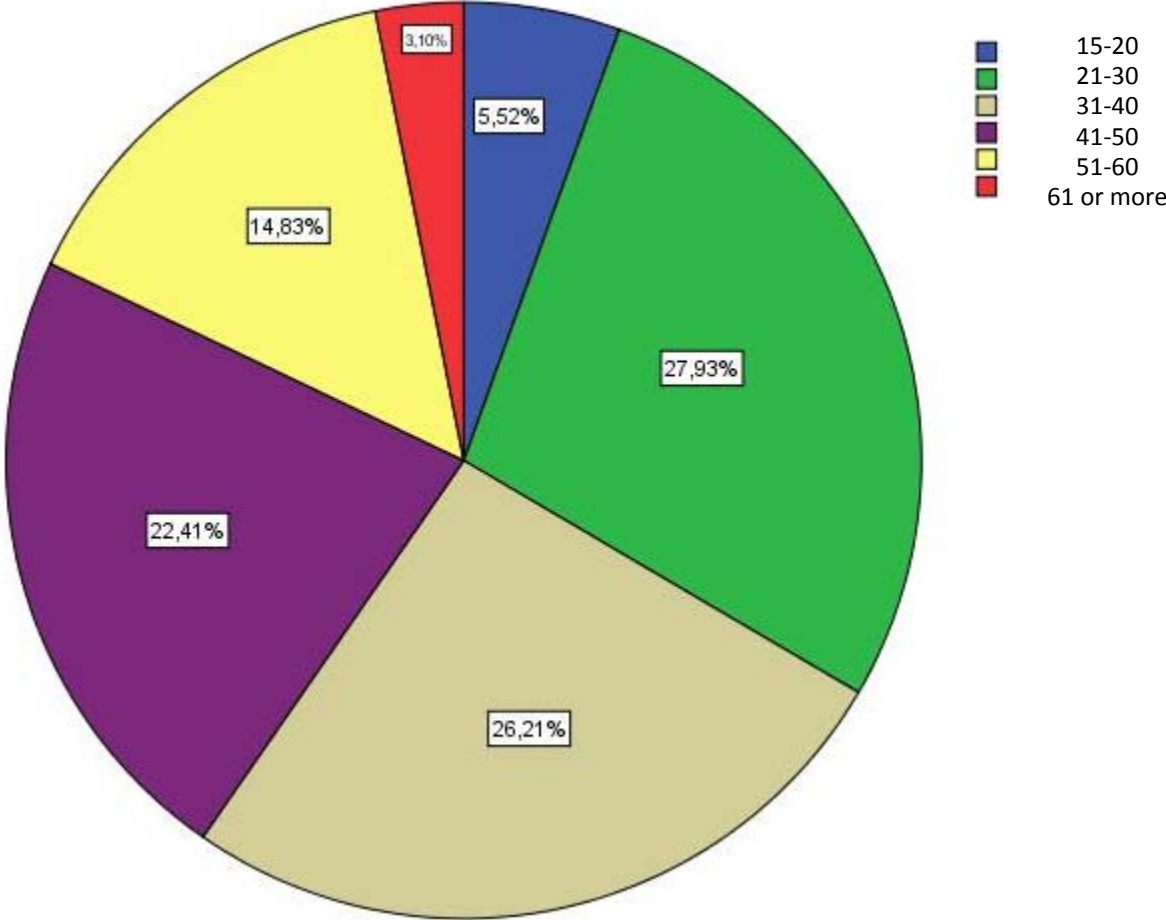
- ❖ 40 flight segments at up to 5 hour duration. Variety of aircraft models, destinations, timetable, and flight durations.
- ❖ **Performed procedures:**
- ❖ 287 questionnaires were applied (time of response: 15-20 minutes);
- ❖ 46 shootings



# Questionnaires Sample Characterization: Gender



# Questionnaires Sample Characterization: Age



## **RESULTS DISCUSSION:** Activities perceived by passengers as the most important ones for comfortable conditions

- Activities cited as being the most important to their well being over a flight cycle were: embarkation (Med=9) and accommodation (Med=9).
- Activities such as: finding seat, organizing the hand luggage, reading ; feeding, relaxing and sleeping, removing hand luggage from bin, and disembarkation were also mentioned as important (Med= 8).
- Medium importance to the informational activity: *To pay attention to crew information about safety (Med=7).*



# RESULTS DISCUSSION: Activities with great difficulty level and main discomfort factors

Activities	% of realization	% of difficulty	Main difficulties
Feeding	91,10%)	46,06%	<ul style="list-style-type: none"> <li>•The passenger in the row in the front leans the seat restricting space (Med:9);</li> <li>•Lack of garbage baskets (Med: 8)</li> <li>•Lack of elbow room (Med: 7).</li> <li>•The cup holder is too shallow, the cup slides and does not fit well (Med: 6)</li> <li>•The tray table does not offer enough space (Med: 5,5)</li> <li>•The passenger on the seat in the row in the back has difficulties to fold the tray table (Med: 5)</li> </ul>
Relaxing and sleeping	82,37%)	74,68%	<ul style="list-style-type: none"> <li>•Weak backrest seat inclination (Med: 10)</li> <li>•Seat width (Med: 9)</li> <li>•Single armrest (Med: 9)</li> <li>•Lack of headrests (Med: 9)</li> <li>•Little space to body move (Med:9)</li> <li>•Lack of legroom (Med: 9)</li> <li>•Inadequate foot support (Med: 8)</li> <li>•Lack of foot support (Med: 8)</li> <li>•Inadequate headrests (Med: 8)</li> <li>•The passenger in the row in the front leans the seat restricting space (Med: 8)</li> <li>•Lack of lumber support (Med: 7)</li> <li>•Lack of fold down armrest on the aisle seat (Med: 7)</li> </ul>
Going to the lavatory	54,87%	40,63%	<ul style="list-style-type: none"> <li>•Ingress and egress the seat, when the seat in the front is reclined (Med: 9);</li> <li>•Ingress and egress the seat, especially the middle and the window seat (Med: 8);</li> <li>•Lack of space to wait for the lavatory to be free (Med 7);</li> <li>•Request the passenger to egress/ingress the seat (Med: 7).</li> <li>•The armrests that do not fold down make it difficult to leave the seat (Med:6)</li> <li>•Restrict space in the lavatory making it difficult to move (Med: 6)</li> <li>•Aisle width (Med: 5)</li> <li>•Lack of space to dress up kids (Med:5)</li> <li>•Problems to visualize if the lavatory is free (Med: 5)</li> </ul>



Related to the seat

# Field research during the flight

## Conclusion

- ❖ Main discomfortable activity: relaxing and sleep (74,68%).
- ❖ Variables related to the seat and aspects of the cabin: the main causes for discomfort
- ❖ Regarding relaxing and sleep, 14 awkward situations with medians equal or more than 5 refer to the seat
- ❖ Intentions to improve the aircraft cabins: the relationship among the factors should be taken into consideration, and changing one of them may affect the passenger's perceptions.



## Field research during the flights

### Shooting

- ❖ 46 passengers: 20 business passengers, 4 leisure passengers, 4 students passengers, 10 passengers visiting friends and family, 6 have not answered and 2 mentioned other reasons (training and contests).
- ❖ The shooting was performed during the boarding/debarking and cruising
- ❖ 30 passengers were man and 16 were women.
- ❖ 11 passengers were sitting on the window seats, 31 on the aisle seats, and 4 on the middle seats.



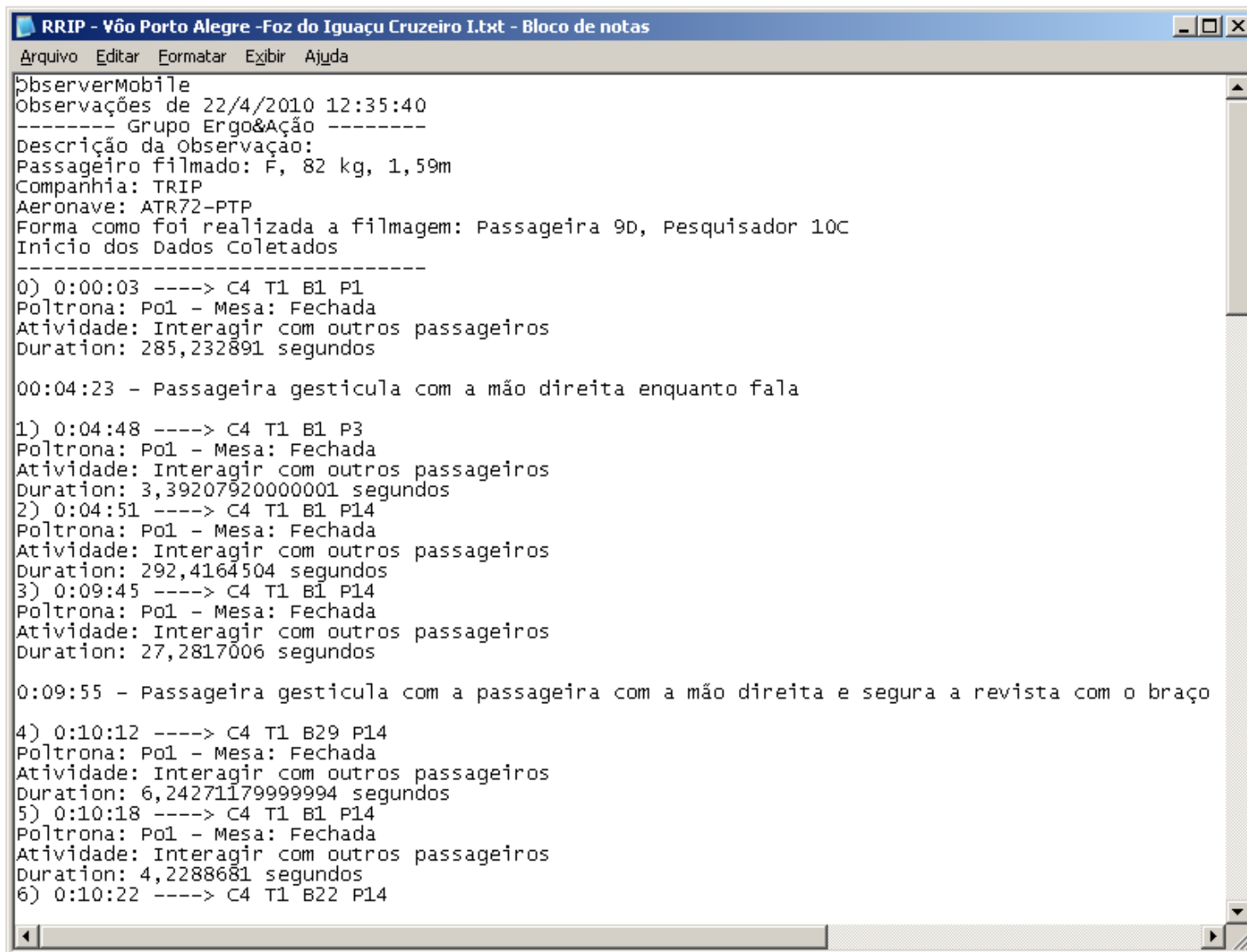


# Preliminary Results from the Shooting

The screenshot displays the 'Iliso Pose - Desktop' software interface. The main window is titled 'SimuCAD - Ergo&Ação' and features a menu bar with 'Arquivos', 'Gráficos', and 'Reconstruir'. The central area is divided into two main sections: a video player on the left and a 3D model grid on the right. The video player shows a person sitting in a chair, with a progress bar at the bottom indicating 'Em pausa' (Paused) and a duration of '03:10'. The 3D model grid is organized into a 3x5 grid of views, with tabs above labeled 'Cab\*', 'Tro\*', 'Bra\*', 'Pe\*', 'Pol\*', 'Not\*', and 'Rel'. The grid contains various views of a 3D human model, including front, side, and back views. Below the grid is a control panel with 'Controle de Vídeo' (Video Control) and 'Controles do Gráfico' (Graphic Controls) sections. The 'Controle de Vídeo' section includes buttons for 'Taxa' (Rate), 'Tempo (s)' (Time (s)), 'Marcar Vídeo' (Mark Video), 'Observações' (Observations), 'Continuar' (Continue), 'Desfazer' (Undo), and a 'Contador' (Counter) set to 0. The 'Controles do Gráfico' section includes a 'Filtro' (Filter) input field and a 'Zoom' control with '+' and '-' buttons.

## Preliminary Results from the Shooting

### ❖ Analysis example



The screenshot shows a Notepad window titled "RRIP - Vôo Porto Alegre -Foz do Iguaçu Cruzeiro I.txt - Bloco de notas". The text content is as follows:

```
ObserverMobile
Observações de 22/4/2010 12:35:40
----- Grupo Ergo&Ação -----
Descrição da Observação:
Passageiro filmado: F, 82 kg, 1,59m
Companhia: TRIP
Aeronave: ATR72-PTP
Forma como foi realizada a filmagem: Passageira 9D, Pesquisador 10C
Início dos Dados Coletados
-----
0) 0:00:03 ----> C4 T1 B1 P1
Poltrona: P01 - Mesa: Fechada
Atividade: Interagir com outros passageiros
Duration: 285,232891 segundos

00:04:23 - Passageira gesticula com a mão direita enquanto fala

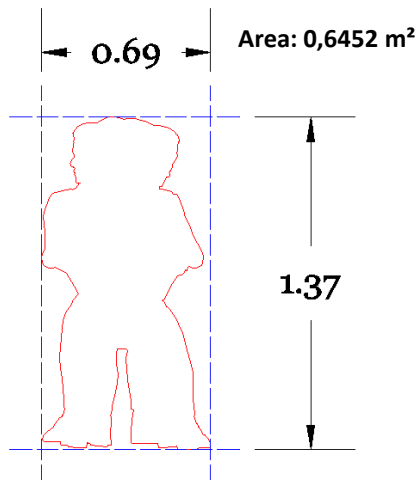
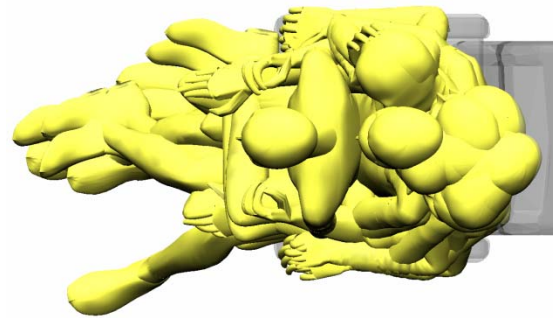
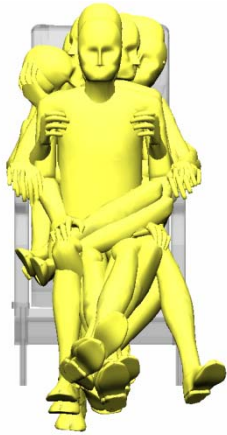
1) 0:04:48 ----> C4 T1 B1 P3
Poltrona: P01 - Mesa: Fechada
Atividade: Interagir com outros passageiros
Duration: 3,39207920000001 segundos
2) 0:04:51 ----> C4 T1 B1 P14
Poltrona: P01 - Mesa: Fechada
Atividade: Interagir com outros passageiros
Duration: 292,4164504 segundos
3) 0:09:45 ----> C4 T1 B1 P14
Poltrona: P01 - Mesa: Fechada
Atividade: Interagir com outros passageiros
Duration: 27,2817006 segundos

0:09:55 - Passageira gesticula com a passageira com a mão direita e segura a revista com o braço

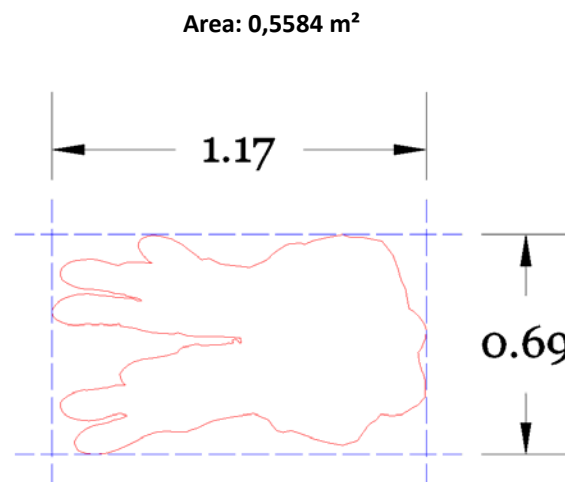
4) 0:10:12 ----> C4 T1 B29 P14
Poltrona: P01 - Mesa: Fechada
Atividade: Interagir com outros passageiros
Duration: 6,242711799999994 segundos
5) 0:10:18 ----> C4 T1 B1 P14
Poltrona: P01 - Mesa: Fechada
Atividade: Interagir com outros passageiros
Duration: 4,2288681 segundos
6) 0:10:22 ----> C4 T1 B22 P14
```

# An Analysis Example : Dynamic Variables of the activity

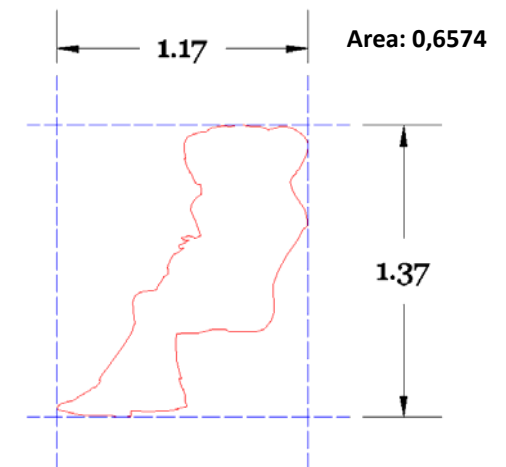
❖ Analysis of the areas taken by the passengers during the performance of the activity during the flight.



Frontal View



Superior View



Transversal View

# Initial conclusions of the shooting

- ❖ Analysis of the shootings: it enables the identification of the main problems and adopted strategies by each one of the passenger`s performing different activities during a real flight.
- ❖ Envelopes of postures will be created and measures will be calculated concerning them, such as:
  - ✓ Calculation of the area of the envelope projections in frontal, sagittal and transversal planes;
- ❖ The calculation of the area will be compared to the aircraft dimensional measures to verify if there is a possibility of action.
- ❖ The envelopes will also be able to be used in simulations in cabins with different dimensional characteristics.
- ❖ The main difference between this model and the traditional simulation models is that it enables a dynamic analysis of the adopted postures by the passengers during the performance of the activities in real situations of use.



# General Conclusions of the Study

- ❖ The comfort perception is determined by different variables, related to the seat, the airplane, the operation and individual factors.
- ❖ The analysis of the shooting and the data obtained from the questionnaires will provide information on the constraints faced by the passengers with different anthropometric profile. These data linked to the simulations of the different dimensional measures cited above will give the basis for the discussion about sizing aircraft cabins.



# Future Steps/Phases of the Study

- ❖ Simulation of the users action (with real capture of movements) of different anthropometric profiles in aircrafts with different dimensional measures;
- ❖ Simulation of different scenarios (what if);
- ❖ Presentation of solutions to minimize constraints based on preferences and necessities of the passengers during a flight, for a further development of recommendations regarding cabin projects, involving safety, operational aspects and in-cabin facilities.

