18th Workshop-School on Agents, Environments and Applications
Brasilia, DF, Brazil
August 14 - 16, 2024

# Simulation of IT Staff Turnover through a Multi-Agent System: Development and Applications

**Eduardo Ferreira** (CEFET/RJ)
Oscar Rete (UCES)

CEFET/RJ

UCES
UNIVERSIDAD DE CIENCIAS EMPRESARIALES Y SOCIALES

# Introduction

- Importance of efficient staff turnover management for organizational competitiveness.

The problem of staff turnover is already a problem global [Orozco et al. 2020].

- Challenges faced by IT companies due to **HIGH** turnover rates.

# Introduction

- Turnover is the frequency with which people change jobs in the economy.

Turnover is the result of employees leaving and others entering to replace them on the job. [Chiavenato, 2020].

# Introduction

**2.02**
million
professionals in the technology macro sector in Brazil

**117**
thousand
new IT jobs in 2022

**4%**
are IT jobs in Brazil

Source: Sectoral Report 2022 ICT Macrosector [BRASSCOM 2023]

# Objectives

- **Develop** a multi-agent simulation model to analyze IT staff turnover.

- **Identify** factors influencing employee decisions to stay or leave.

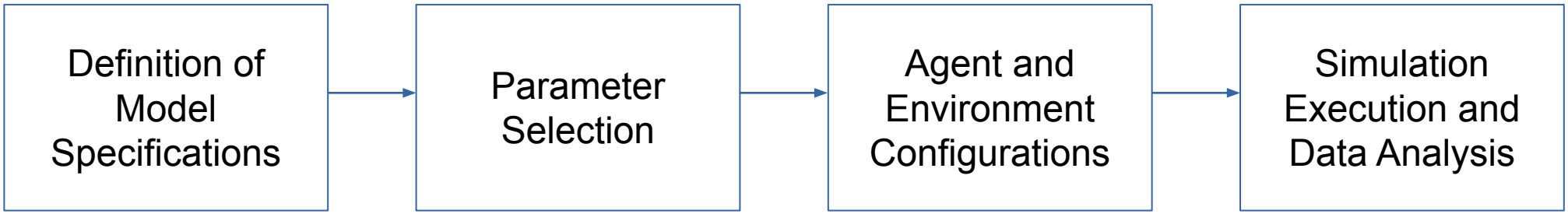
# Theoretical Foundation

## Literature Review

- Key theories on staff turnover (e.g., Organizational Commitment, Job Satisfaction).
- Previous studies using Multi-Agent Systems (MAS) in HR contexts.
- Advantages of using MAS for simulating complex social interactions.

Through simulation, individuals can receive feedback and rewards, thus optimizing your own behavior [Arshad and Yao 2024]

# Methodology




**GAMA Platform Implementation:**

- simulation environment setup.
- Agent behavior rules and interactions.

(GIS & Agent-based Modeling Architectures) [Drogoul et al. 2013]

# IT Staff Turnover Model

***Variables:***

- $s_i$: Job satisfaction of employee i.
- $e_i$: Engagement level of employee i with the company.
- $a_i$: Affinity of employee i with the team or company.
- $p_i$: Perception of HR strategies by employee i.
- $w_i$: Salary of employee i.
- $b_i$: Quality of the relationship between employee i and immediate management.

The probability of an employee leaving the company is modeled by the function:

$$P(\text{leave}_i) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 s_i + \beta_2 e_i + \beta_3 a_i + \beta_4 p_i + \beta_5 w_i + \beta_6 b_i)}}$$

where $\beta_0$, $\beta_1$, ..., $\beta_6$ are the model coefficients that reflect the impact of each variable on the employee's decision to leave the company.

**Global Turnover Rate Model (r)**

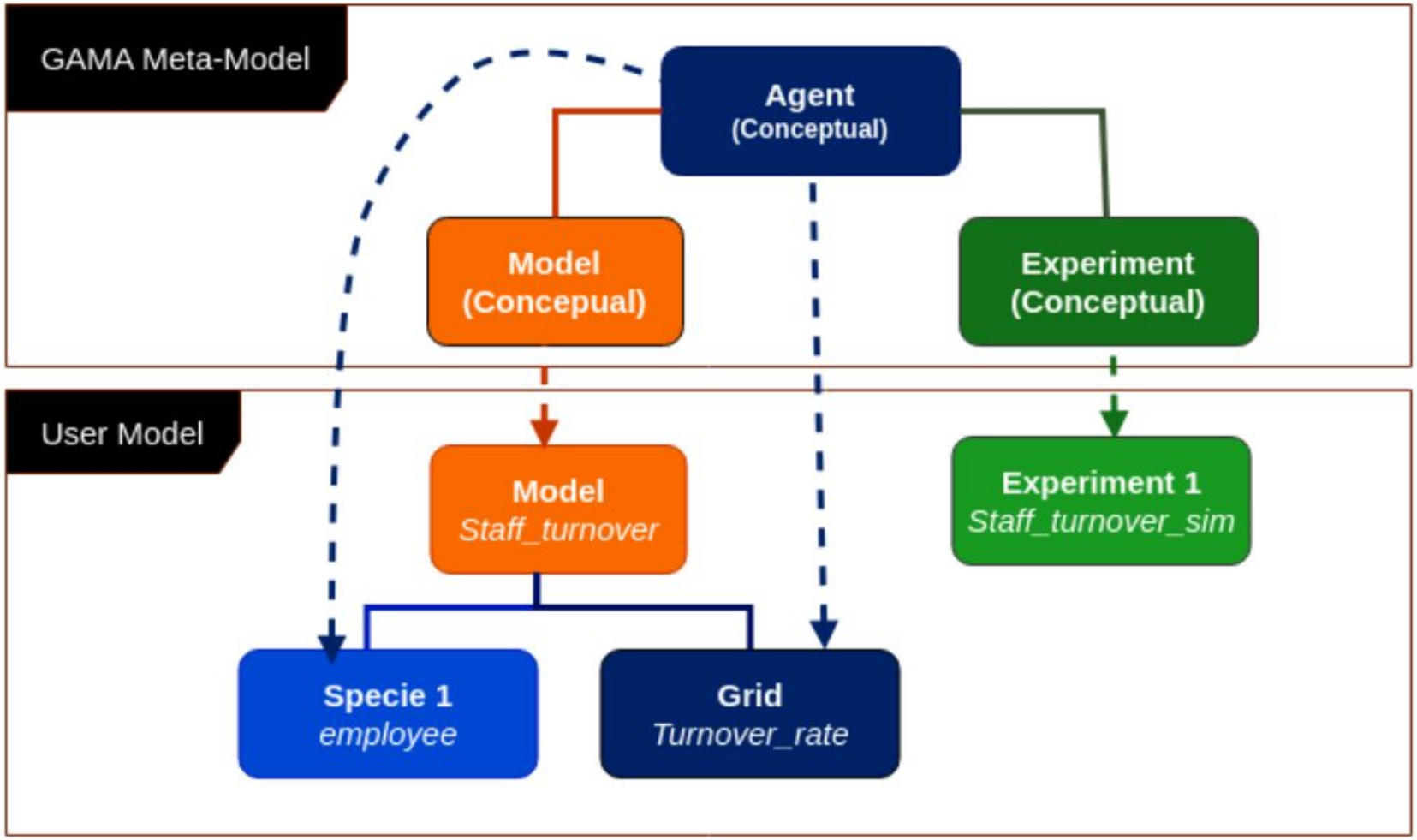
- The global turnover rate (**r**) for the company is calculated as the average of the exit probabilities adjusted by the average length of stay (**t**)
- Where **N** is the total number of employees in the company.

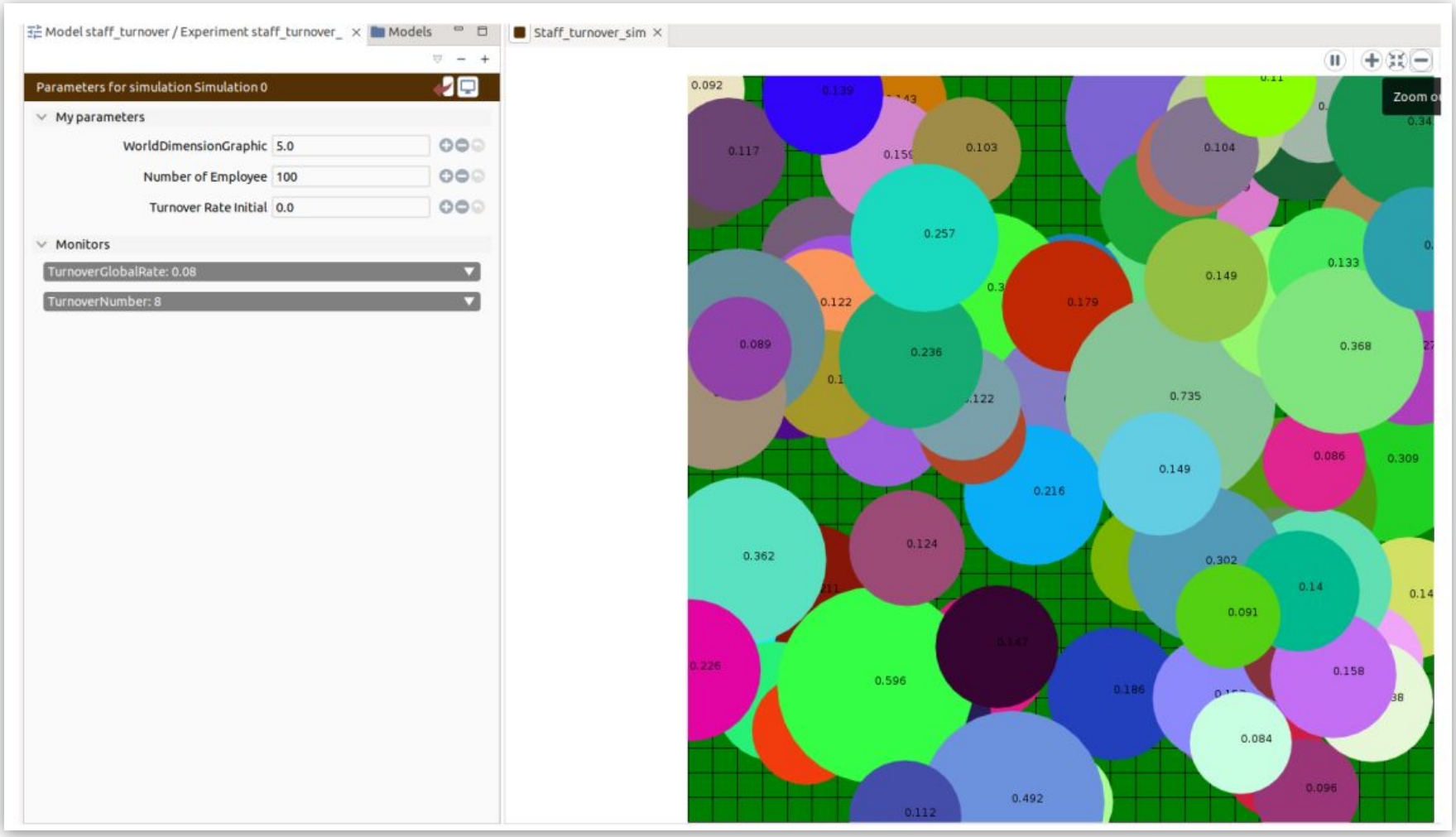
$$r = \frac{1}{N} \sum_{i=1}^{N} \frac{P(\text{leave}_i)}{t}$$

Wesaac 2024

18th Workshop-School on Agents, Environments and Applications
Brasilia, DF, Brazil

August 14 - 16, 2024


GAMA Meta-Model
Agent
(Conceptual)
Model
(Concepual)
Experiment
(Conceptual)
User Model
Model
Staff_turnover
Experiment 1
Staff_turnover_sim
Specie 1
employee
Grid
Turnover_rate





Wesaac 2024

# 18th Workshop-School on Agents, Environments and Applications Brasilia, DF, Brazil

August 14 - 16, 2024

# Simulations and Discussions

- **Understand** how different factors can influence employee turnover in an organization, allowing for the simulation and analysis of potential strategies to reduce turnover and improve employee retention.
- The analysis of the simulation cycles provides insights to interpret agent behavior, understand turnover dynamics, and evaluate the effectiveness of implemented HR policies.

# Conclusions

- **The value of MAS in understanding and addressing IT staff turnover**
  - Key findings on factors influencing turnover;
  - Effectiveness of HR strategies modeled in the simulation.
  - Decision-making tool for HR Managers;
  - Recommendations for improving retention strategies.
- **Limitations**
  - Potential challenges in real-world application not included in the model.
- **Future Work**
  - Integrating more complex external variables;
  - Exploring innovative HR strategies like remote work.

# Thank you!!!


**Eduardo Ferreira**

Professor in CEFET/RJ

Campus Maria da Graça

eduardo.ferreira@cefet-rj.br

https://linkedin.com/in/eafsilva


CEFET/RJ

INTEGRA
Portal da Inovação

Wesaac 2024

**18th Workshop-School on Agents, Environments and Applications**
**Brasilia, DF, Brazil**

August 14 - 16, 2024

# Bibliography


Albrieu, R., Basco, A., Brest López, C., De Azevedo, B., Peirano, F., Rapetti, F., and Vienni, G. (2019). Travesía 4.0: Hacia la transformación industrial Argentina. CIPPEC.

Aranibar Gutiérrez, M. F., Melendres Carlos, V. D., Ramírez Barón, M. C., and García Rivera, B. R. (2017). Los factores de la rotación de personal en las maquiladoras de exportación de ensenada, bc (factors of staff turnover in textile factories of ensenada city, bc). Revista Global de Negocios, 6(2):25–40.

Arshad, M. and Yao, W. (2024). Human resource management decision support system based on multi agent. pages 1–5.

Beccaria, L. A. and Maurizio, R. D. L. (2018). Un análisis dinámico de los flujos de entrada a la formalidad en américa latina.BRASSCOM (2023). Relatório setorial 2022 macrossetor de tic. Acessado em: 20 de
março de 2024.

Cardoso, R. C. and Ferrando, A. (2021). A review of agent-based programming for multiagent systems. In Computers, volume 10,4, page 16.

Chiavenato, I. (2020). Gestão de Pessoas - O Novo Papel da Gestão do Talento Humano. Grupo GEN, 5 edition.

Dornbusch, R., Fischer, S., and Startz, R. (2013). Macroeconomia, volume 1. AMGH, 13 edition.

Drogoul, A., Amouroux, E., Bommel, P., Gaudou, B., Grignard, A., Marilleau, N., Taillandier, P., Vavasseur, M., Vo, D. A., and Zucker, J.-D. (2013). Gama: A simulation platform that integrates geographical information data, agent-based modeling and
multi-scale control. In Principles and Practice of Multi-Agent Systems, pages 242–258. Springer.

ECLAC (2021). Policies to protect labour relations and hiring subsidies amid the covid-19 pandemic. Employment Situation in Latin America and the Caribbean. LC/TS.2021/163.

Frufrek, G. L. and Pansanato, L. (2017). Rotatividade de pessoal: Pesquisa com profissionais de empresas brasileiras de desenvolvimento de software. iSys - Brazilian Journal of Information Systems, 13:05–29.

Llamas, S., Lopez Torres, V., and Moreno Moreno, L. (2017). Impacto del clima organizacional en la rotación del personal: Evidencia en sector desarrollo de software. Revista Internacional Administración & Finanzas, 10:49–61.

Naciri, N. and Tkiouat, M. (2015). Multi-agent systems: theory and applications survey. Int. J. Intelligent Systems Technologies and Applications, 14(2):145–167.

Neto, A. C., de Amorim, W. A. C., and Fischer, A. L. (2016). Top human resources managers' views on trade union action in brazilian corporations. BAR - Brazilian Administration Review, 13(4):e160066.

- Orozco, D. G. A., Fernández, M. D., Arredondo, M., Manjarrez, N. I. R., and Ruiz, V.
(2020). ROTACIÓN DE PERSONAL ¿Qué es y cómo combatirla?

Porter, L. W., Steers, R. M., Mowday, R. T., and Boulian, P. V. (1974). Organizational commitment, job satisfaction, and turnover among psychiatric technicians. Journal of Applied Psychology, 59(5):603.

Soares, M. L., Capistrano, A. G. A., and Barbosa, M. B. A. (2015). A rotatividade de servidores pÚblicos na Área de ti: Um estudo de caso sobre a Ótica da gestão de pessoas. V COLÓQUIO INTERNACIONAL DE GESTÃO UNIVERSITÁRIA –CIGU.

Wooldridge, M. J. (2009). An Introduction to MultiAgent Systems. Wiley, 2 edition.

18th Workshop-School on Agents, Environments and Applications
Brasilia, DF, Brazil
August 14 - 16, 2024

# Simulation of IT Staff Turnover through a Multi-Agent System: Development and Applications

**Eduardo Ferreira** (CEFET/RJ)
Oscar Rete (UCES)

CEFET/RJ

UCES
UNIVERSIDAD DE CIENCIAS EMPRESARIALES Y SOCIALES

Wesaac 2024

# 18th Workshop-School on Agents, Environments, and Applications

## Brasilia, DF, Brazil

August 14 - 16, 2024

# Registration open

## Important Dates

**Call for papers**

Paper submission deadline: **June 3, 2024**

Notification to authors: **July 1, 2024**

Final version deadline: **July 15, 2024**

Author registration: **July 22, 2024**

Conference: **August 14 to 16, 2024**

UnB