# LABOUR FORCE MODELING BASED ON AGENT-BASED SIMULATION
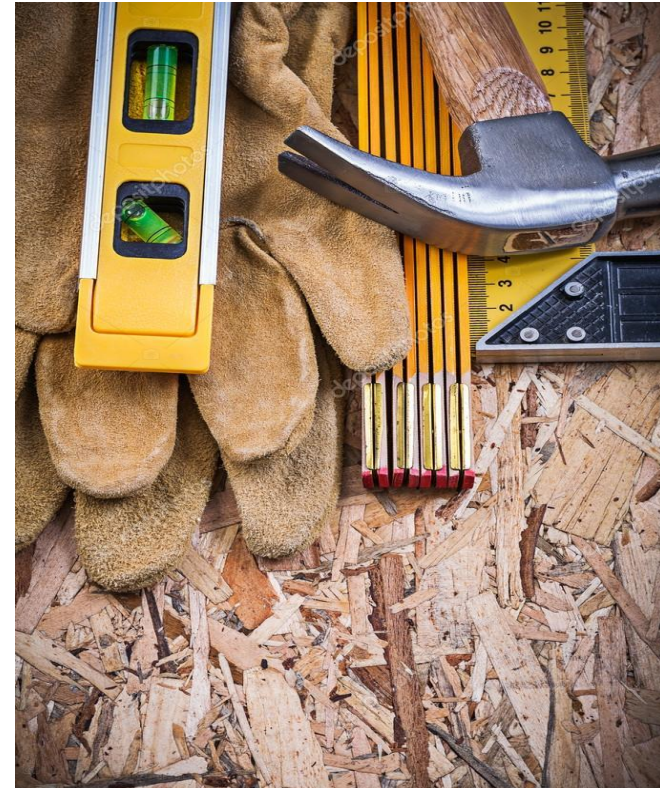
**Mustafa DİNÇ**
**Ph.D., Rtd. Captain (N)**

- **Project  Goal**
- **System Design**
- **Modeling  Approaches**
- **Agent-Based Simulation**
- **Simulation Tool**
- **Results**
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# Project Goal

\* Main objective is to simulate a production system and labor force modeling based on human factors (human behaviors, morale, motivation, experience, (un)expected brakes) using Anylogic simulation tool.

* Then

  – to make an efficiency analysis of the system,

  – increasing the number of material output,

  – explore the main effects of Human factors on performance and work efficiency

# Anylogic – A Simulation Tool



➡️ *http://www.anylogic.com/*

# What is Anylogic?

* is a simulation software tool

* runs in multi-platform

* 2D/3D animation and visualization

* Java functions

* Anylogic supports:

  - Agent-based simulation,

  - System dynamics,

  - Discrete event simulation techniques as a software program.

# System 3D Design
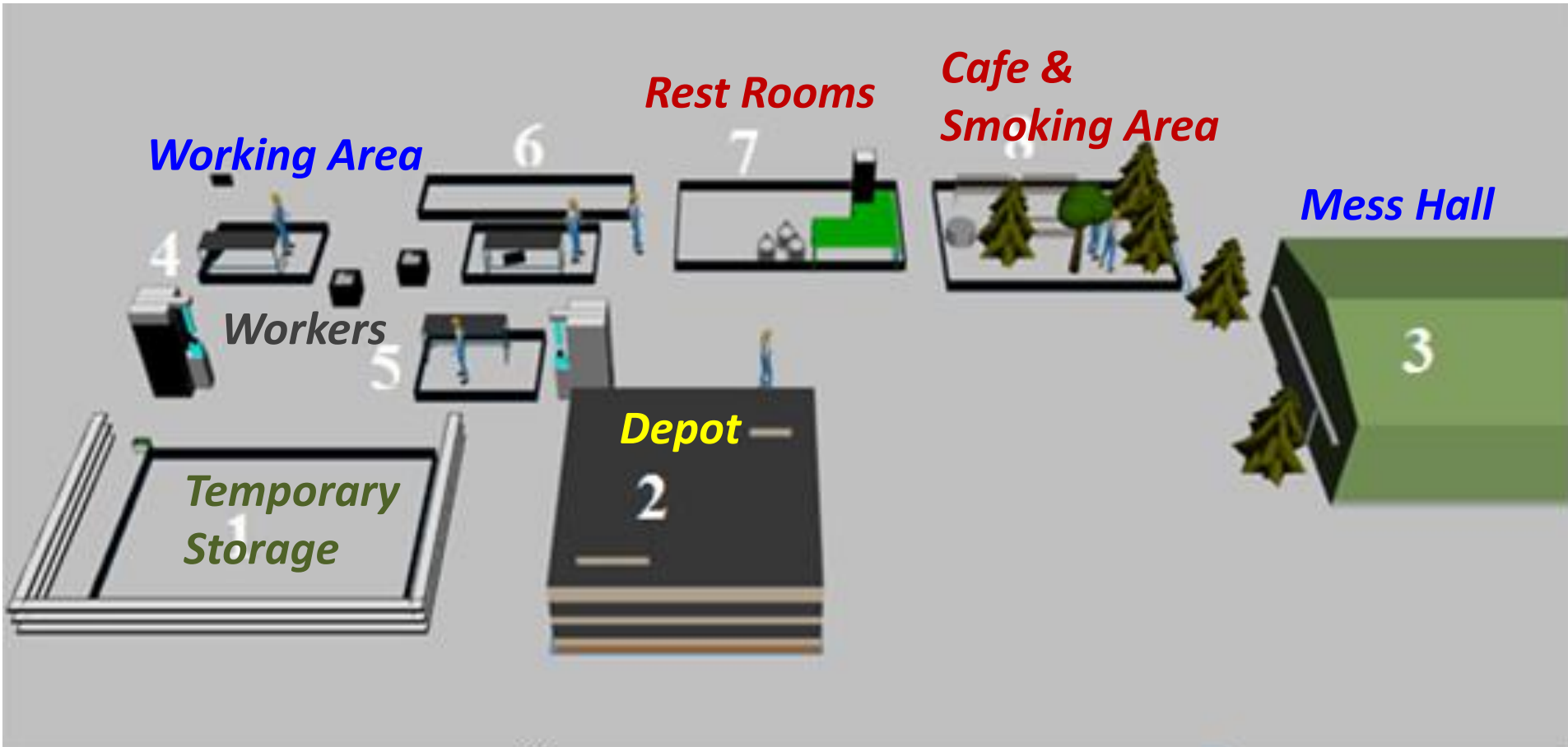
# **Modeling Approaches**

1- Discrete Event Simulation

2- Agent-based Simulation

# Discrete Event Simulation

*   **Identifying factor:**   State behavior

\* DES models the operation of a system as a discrete sequence of events in **time**.

\*   That is, time is broken up into small time slices and the system state is updated according to the set of activities happening in the time slice.

\*   Countable occurrences –discrete

\*   Focuses on system changes over time – dynamic

\*   can both have deterministic and probabilistic variables.

\*   Events occur according to a schedule.

# Agent Based Simulation
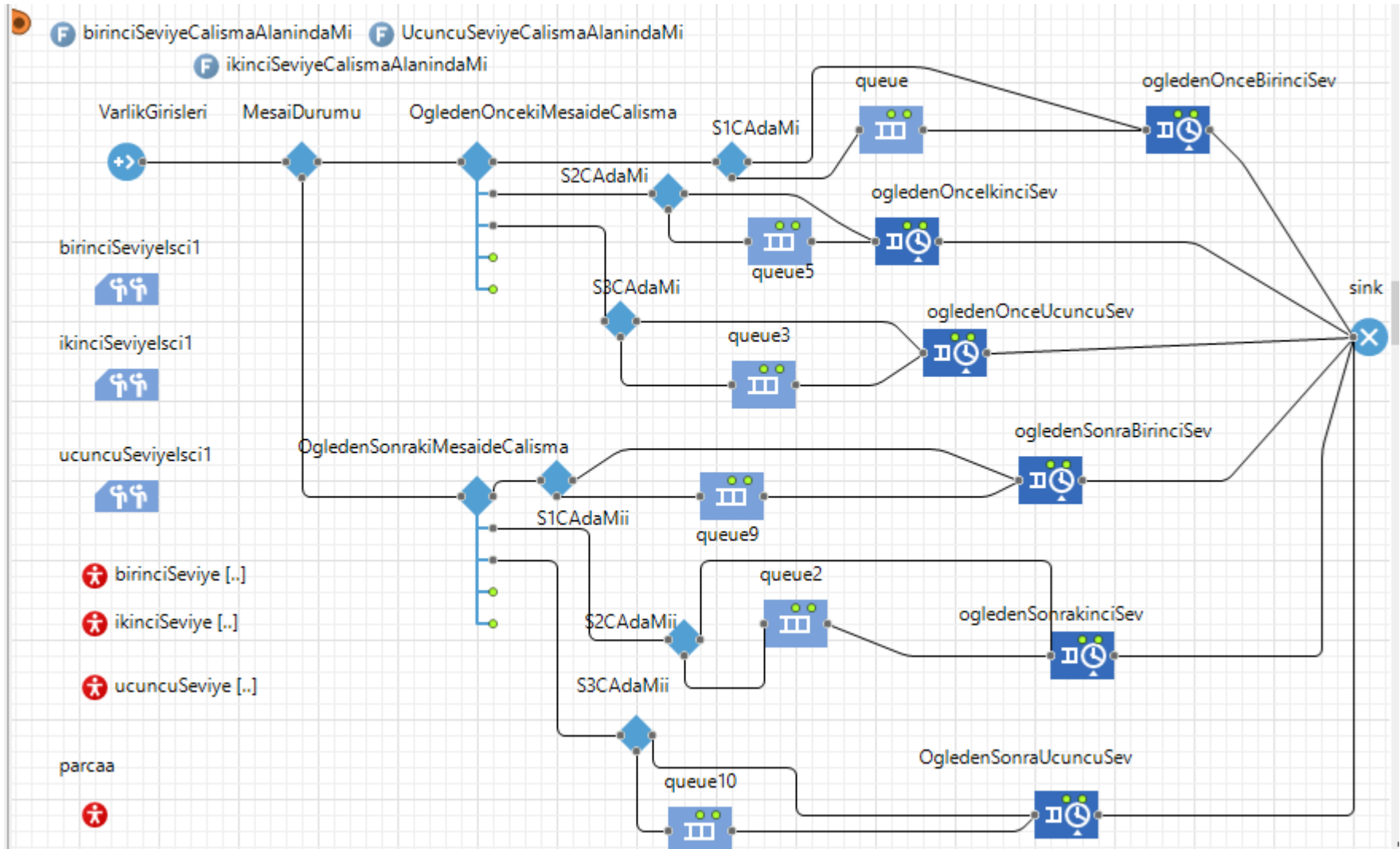
\* In ABS, active entities, known as agents, must be identified and their behavior defined.

\* They may be people, households, vehicles, equipment, products, or companies, whatever is relevant to the system.

# Agent Definition

"*Agents*" are autonomous, computational entities that can be viewed as perceiving their environment through sensors and acting upon their environment through effectors.

percepts

sensors

agent

effectors

actions

environment

We will build agents that act successfully on their environment.

# Main Features of An Agent

* **Action** —able to modify their environment and pro-active;

* **Communication** —signals, messages, or *interactions* – collaboration, coordination, negotiation, and competition;

* **Control/Autonomy** — autonomous; from each agent being a separate process (or thread) to one single process.

* **Adaptability** —learning with experience, adapt and modify its behaviors, their environment, evolution;

* **Resources** —where withal to do things;

* **Partial Knowledge** —point of view; each agent can have its own set of rules and beliefs;

* **Capability** — *behavior*, skills, intelligence, perceiving (sensor), mobility;

* **Feedback** —persistence, reproduction.

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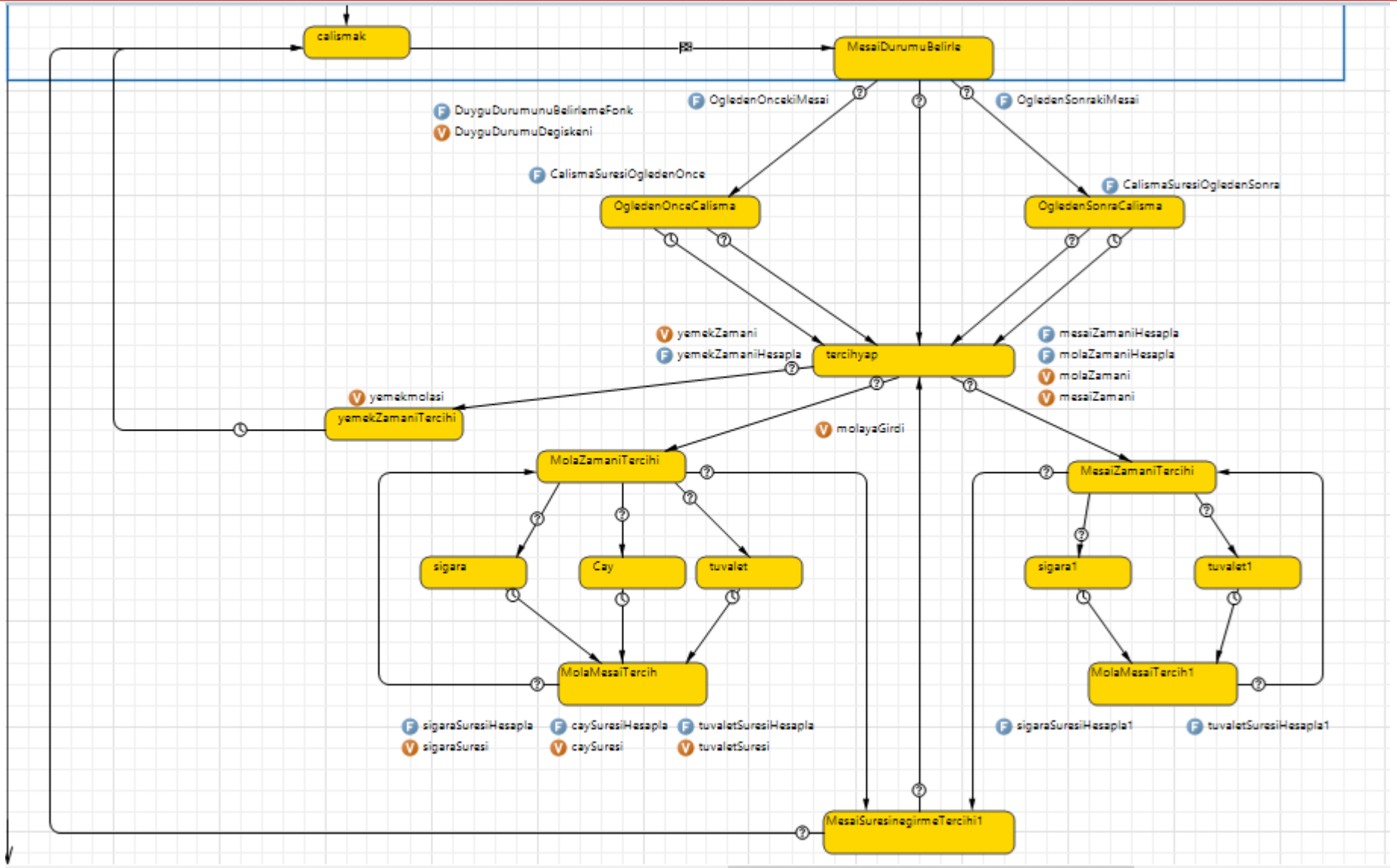
\*    Focuses on the correctness of the developed computer program or model.
"Building the model right" – Debugging and testing the simulation software.

\*    Focuses on determining whether a simulation model is an accurate representation of the system. "Building the right model" – Comparisons of simulation results with collected data from the real system ( 5 days observation)
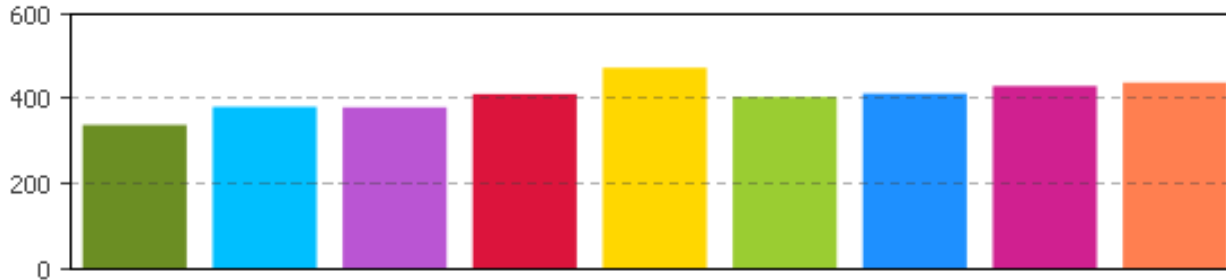
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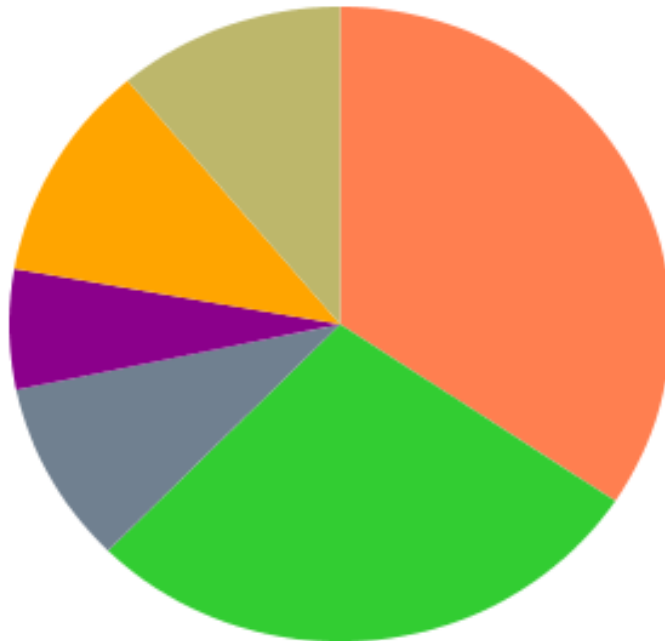
**Working  Times of one of 1$^{st}$ Level Experienced Worker in minute**

- 1.CalisaninOgledenOnceCalismaDurumu: 185.683 (34.4%)
- 1.CalisaninOgledenSonraCalismaDurumu: 151.111 (28.0%)
- 1.CalisaninMesaideikenverdiGiMolalar: 50.362 (9.3%)
- CalisaninResmiMolaKalmaSuresieksik: 32.932 (6.1%)
- yemekMolasii: 60 (11.1%)
- diger: 59.912 (11.1%)

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# Statistics

## Working Times of all workers in minute



■ birinci Seviyedeki 1. İşçinin Çalışma Süresi: 336.794
■ birinci Seviyedeki 2. İşçinin Çalışma Süresi: 379.391
■ birinci Seviyedeki 3. İşçinin Çalışma Süresi: 378.128
■ ikinci Seviyedeki 1. İşçinin Çalışma Süresi: 409.37
■ ikinci Seviyedeki 2. İşçinin Çalışma Süresi: 471.255
■ ikinci Seviyedeki 3. İşçinin Çalışma Süresi: 402.842
■ Ucuncu Seviyedeki 1. İşçinin Çalışma Süresi: 410.718
■ Ucuncu Seviyedeki 2. İşçinin Çalışma Süresi: 428.241
■ Ucuncu Seviyedeki 3. İşçinin Çalışma Süresi: 436.401

# Statistics

| Workers | Active Working Time Percentage Before noon | Active Working Time Percentage Afternoon |
|---|---|---|
| 1st Worker | 34.4% | 28.0% |
| 2nd Worker | 35.56% | 34.33% |
| 3rd Worker | 31.9% | 34.2% |
| 1st Worker | 35.3% | 29.8% |
| 2nd Worker | 39.7% | 33.5% |
| 3rd Worker | 38% | 30.3% |
| 1st Worker | 38.5% | 34.2% |
| 2nd Worker | 37.3% | 42.8% |
| 3rd Worker | 40.0% | 34.4% |

Without Human Factors:

Labor Force Efficiency:

1. Level Workers   =  ~ 11 products / person (hr)

2. Level Workers  =  ~ 8 products / person (hr)

3. Level Workers   =  ~ 5 products / person (hr)

Without Human Factors:

Labor Force Efficiency:

1. Level Workers   =  ~ 8 products / person (hr)

2.  Level Workers  =  ~ 5 products / person (hr)

3. Level Workers   =  ~ 3 products / person (hr)

# **Conclusion**

* Realistic Labor force modeling based on human factors

* Agent Based Simulation

* Analysis & Decision Making

# Questions & Comments