HAIR STYLING TEAM

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Our Agenda

01 Introduction & project goals

02 Business model & concept

03 Simulation Model and Live Demo

04 Simulation, Experiment, Analysis

05 Conclusion and Recommendation

Introduction

A hair cutting shop offers three services:

1. Shampooing (washing)
2. Cutting
3. Coloring hair

The percentage of customers service request is randomly distributed.

- But if a customer asks for washing one or two additional services are required.
- But if the hair should be coloured then it should be washed before.

Exactly one employee is responsible for washing only. This employee is not allowed to cut or colour.

All other employees are allowed to process all services. But they will wash only when the hair washer is busy.

The shop's employees work 4.5 hours. They should take a 30-min break preferable in the middle of their shift

Assumption: Customers will decide whether they wait depending on the current waiting queue. A distinct percentage of the customers will return to the shop after a random distributed time period.

Customers who can't wait are to refer to as lost customers resulting in a loss in the business.

Project goal:

The shop manager wants to have a tool to optimize the hairdessers' schedule from an economic point of view:

- Maximize profit
- Minimize loss
- Minimize wait time for the customers

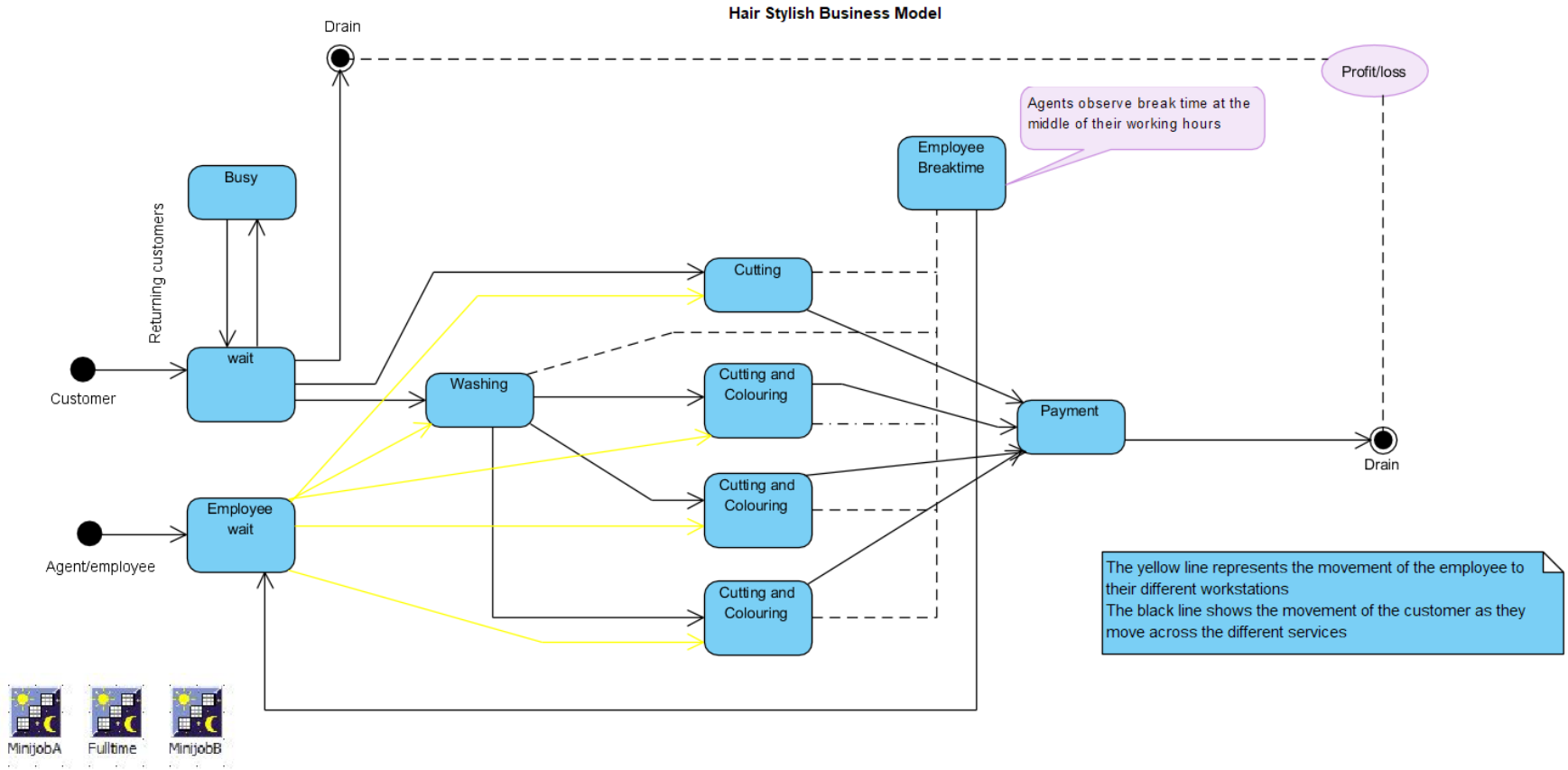
Needed Data

Before moving into the project implementation, it is important we talk about the data available and the assumed data in order to accomplish this project.

Available Data	Assumed Data
Period length (p=1 hour=3600 seconds)	Number of customers in each period 10
Working hours for employee = 4.5 hours	Number of agents in each period 3
Break and refreshment time = 30 minutes	Traffic Intensity 0.83
Number of Stations= 5 Stations/Seats	Service duration(5min) & Average Service duration
	Price for cutting, coloring and washing (10 Euro)
	Target Answer time

Business Model

Before moving further into the details of the project, it is important we understand the business and give a description of the project overview in lame man term.



Plant building boxes used for the simulation

Material Flow


Connector


Source


Drain


SingleProc


Buffer


EventController

User Interface


Chart

Information Flow


Method

Variable


TableFile

Resources


ShiftCalendar

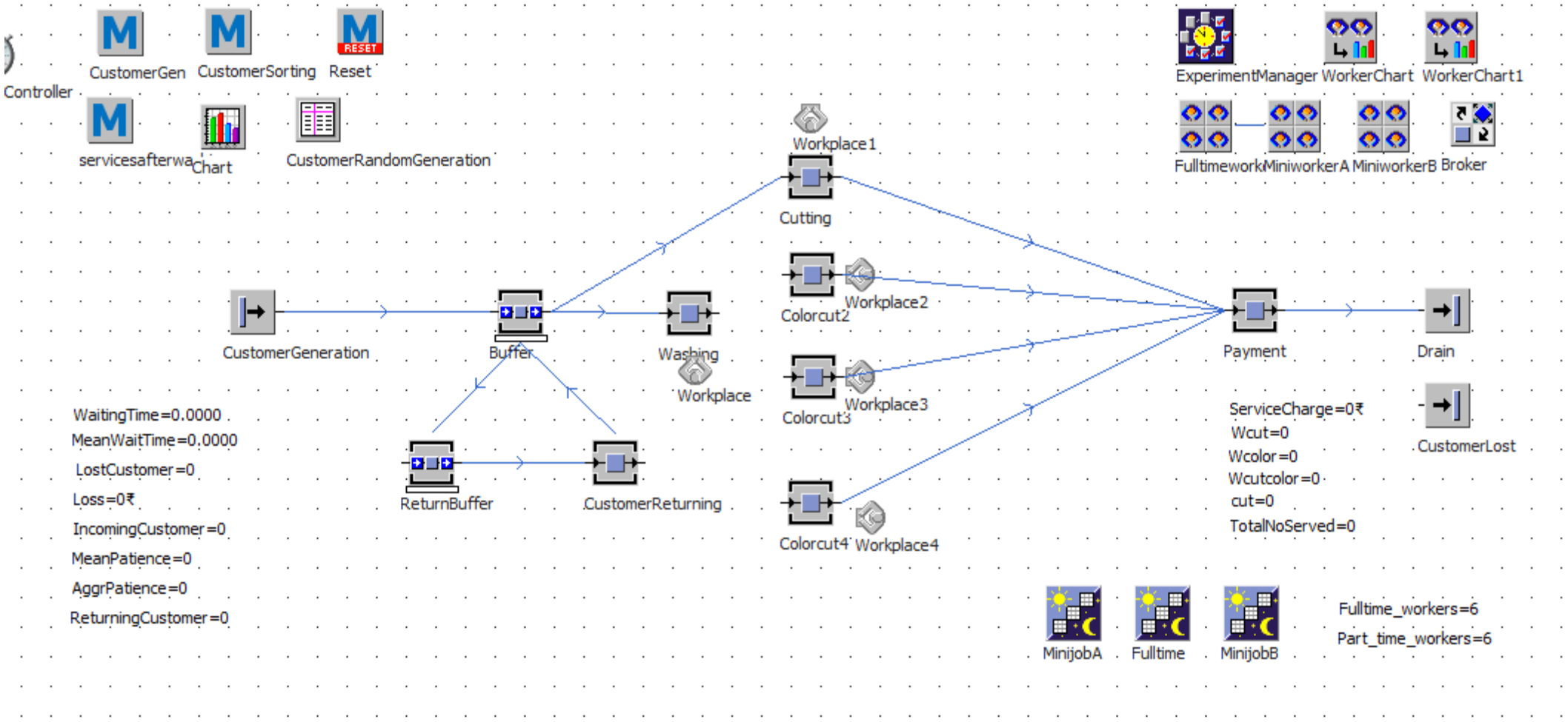

WorkerPool

Tools


ExperimentManager


WorkerChart

Plant Simulation Model



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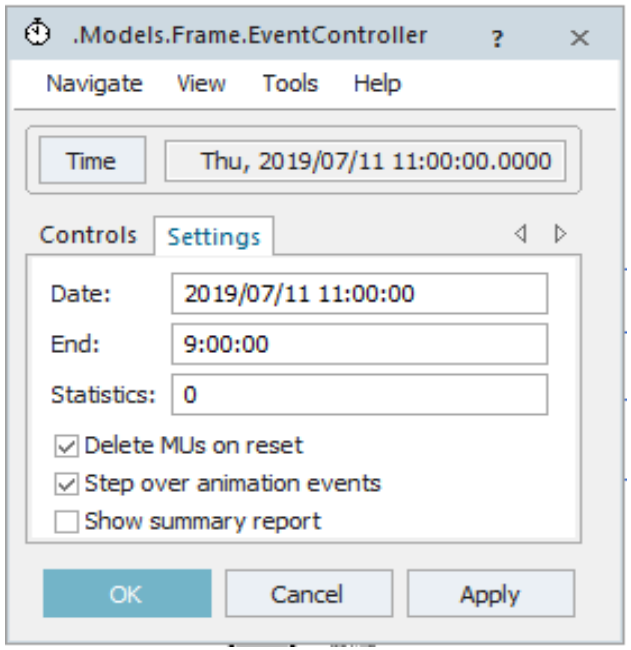
TEST CONCEPT

The event controller is used to keep track of the simulation time. We set our simulation time to 9 hours, since our saloon opens from 11:00 to 20:00.

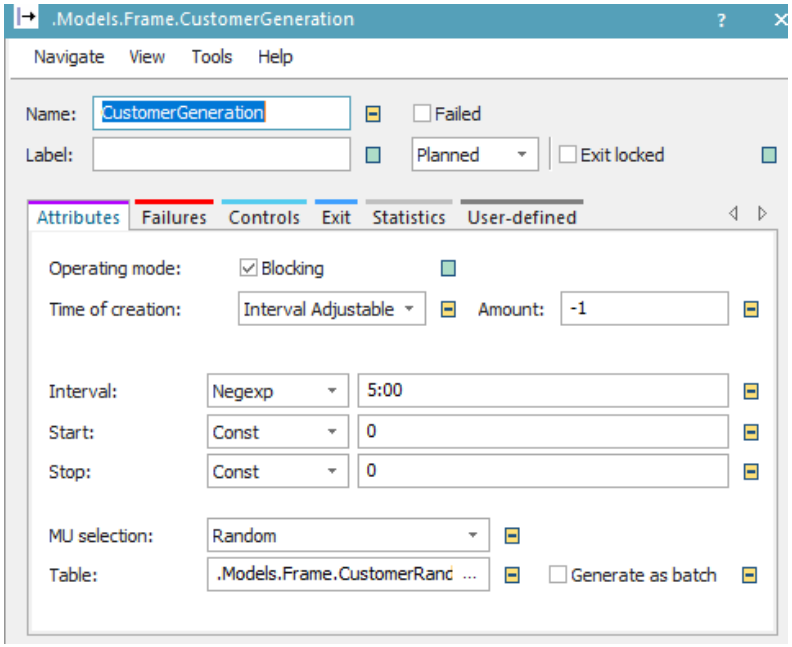


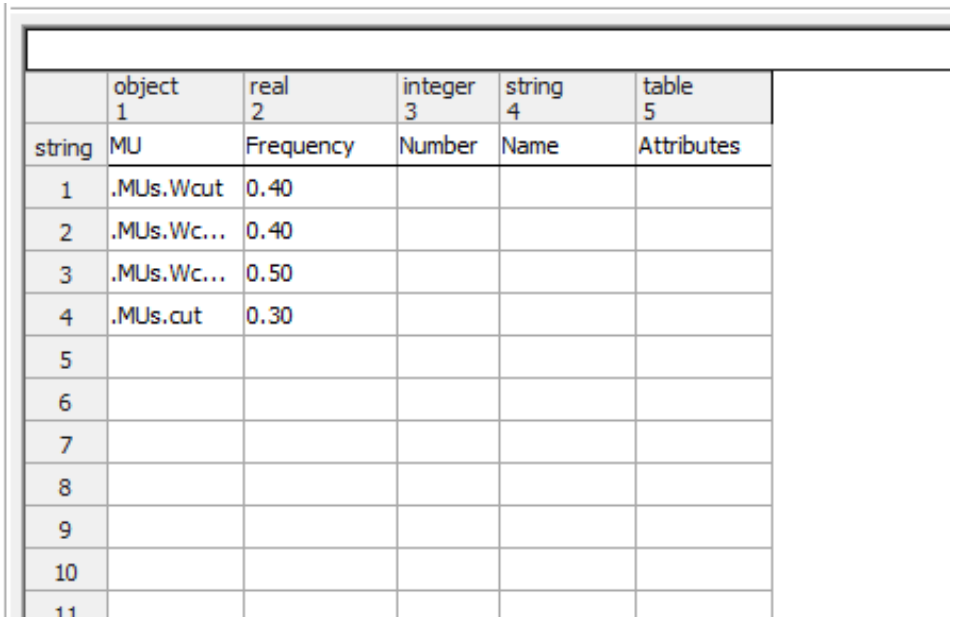
Event Controller

TEST CONCEPT

Customer Generation

Customers are randomly generated at interval at the source. This is done using a probability function (Negexp) and a Table.





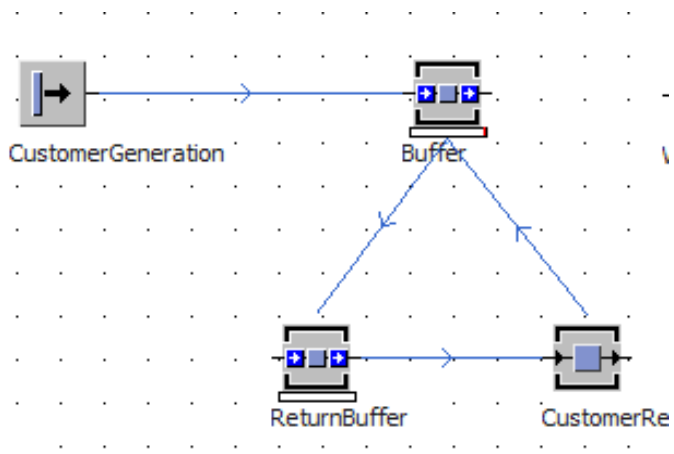
	object 1	real 2	integer 3	string 4	table 5
string	MU	Frequency	Number	Name	Attributes
1	.MUs.Wcut	0.40			
2	.MUs.Wc...	0.40			
3	.MUs.Wc...	0.50			
4	.MUs.cut	0.30			
5					
6					
7					
8					
9					
10					
11					

Fig 1.2: Probability distribution for Customer generation

TEST CONCEPT

Customer Wait or Return

Customers will decide whether they wait depending on the current waiting queue. A distinct percentage of the customers will return to the shop after a random distributed time period. Some of the customers who are not willing to wait are recorded lost as customers




```
// Customer Patience and Tolerance attributed

    var zval1 := z_uniform(1,0,1);
    var zval2 := z_triangle(1,20,0,160);
    if zval1 > 0.5 then -- 50% tolerate waiting

        @.WaitingTolerance := TRUE;
        @.Patience := zval2;
        print "Values zval1: ",zval1," zval2: ", zval2;

    else @.WaitingTolerance := FALSE;


    end;
```

```
if Buffer.NumMU >= 4 AND @.WaitingTolerance = FALSE then
var CustomerReturn := z_uniform(1,0,1);
    if CustomerReturn  < 0.5 then
        @.move(CustomerLost)
        LostCustomer:= LostCustomer + 1
    else
        @.move(ReturnBuffer)
    end
    end
```

```
// Returning Customers joins Queue or Leave based on Queue length
if Buffer.NumMU < 4 then
    @.move(Buffer)
    ReturningCustomer:= ReturningCustomer + 1
else @.move(CustomerLost)
    end
```

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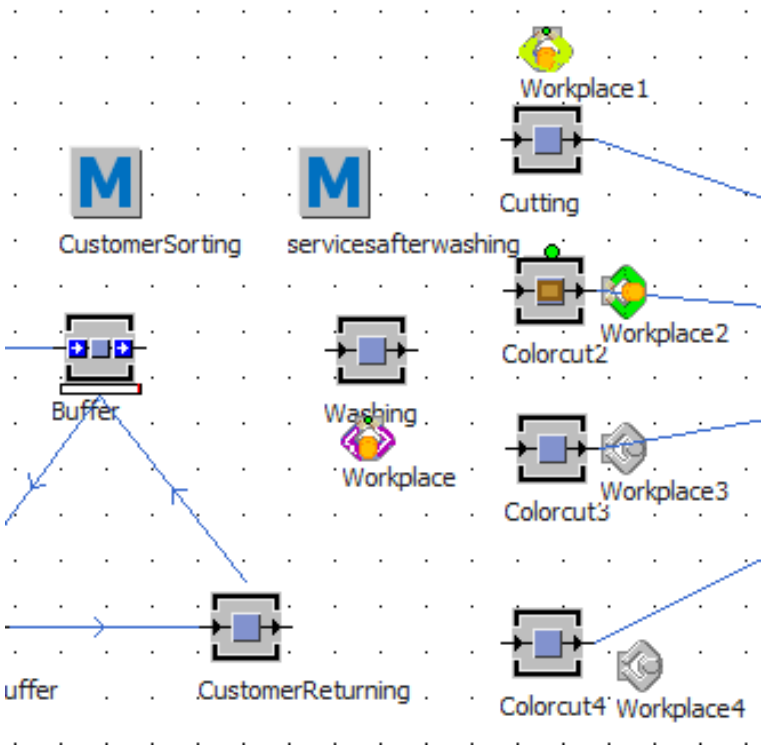
TEST CONCEPT

Routing and Processing Time




```
-- Direct customers based on their the service request


var ar: object[]
ar :=makeARray(Cutting,Colorcut2,Colorcut3,Colorcut4)


switch @.Name
case "Wcut"
    @.move(Washing)
case "Wcolor"
    @.move(Washing)
case "Wcutcolor"
    @.move(Washing)
case "cut"
    @.move(ar)

end
```

```
-- Direct cutomers based on their the service request

var ar: object[]
ar :=makeARray(Colorcut2,Colorcut3,Colorcut4)


if @.Name = "Wcut"
    @.move(ar)
elseif  @.Name = "Wcolor"
    @.move(ar)
elseif @.Name = "Wcutcolor"
    @.move(ar)
end
```

```
--if  @.Name = "Wcutcolor" spend twice the processing time

if @.Name = "Wcutcolor"
Colorcut2.ProcTime := 10:00.0000
else
Colorcut2.ProcTime := 5:00.0000
end
```

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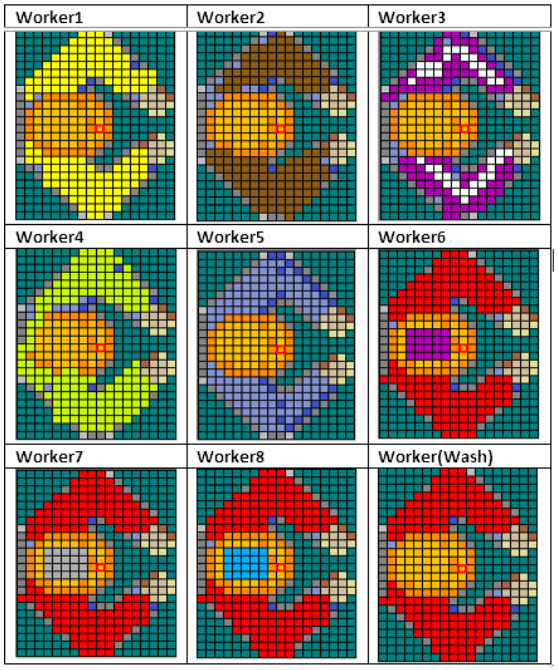
TEST CONCEPT

Employee Shift Implementation



Workers in all shifts:

Shift 1: Worker, Worker1, Worker2,

Shift2: Worker3, Worker4, Worker5,

ShiftA, ShiftB: These employees are available for both shifts to do mini job in case of break. Worker6, Worker7, Worker8

Conditions:

Worker- This agent is only for Washing, He cannot perform cutting or coloring job, If he goes on break, other worker comes and serve his place

We have three shift calendars in our Simulation

1. FullTime: Shift Calendar
2. Mini Job AShift calendar
3. Mini Job BShift calendar

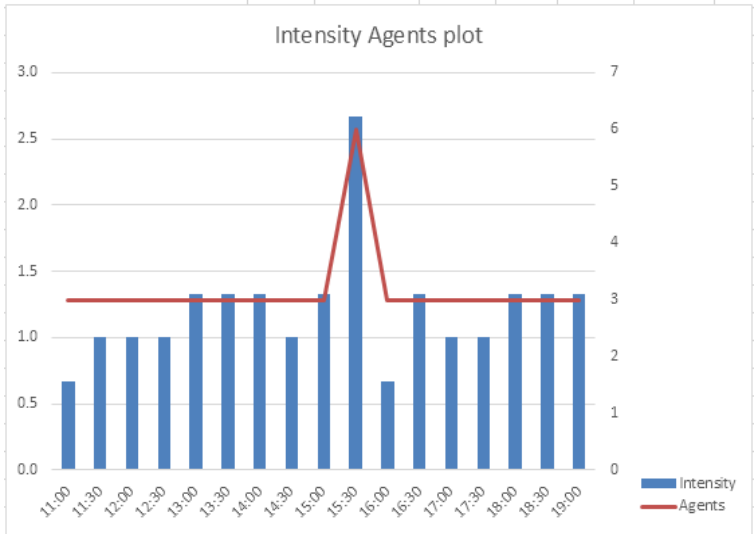
TEST CONCEPT

Employee Shift Implementation

We obtained above graph in which it shows intensity of customers versus time and showing how agents provides services to agents according to time schedule.

We have three shift calendars in our Simulation, for FullTime(Shift Calendar) following settings are implemented

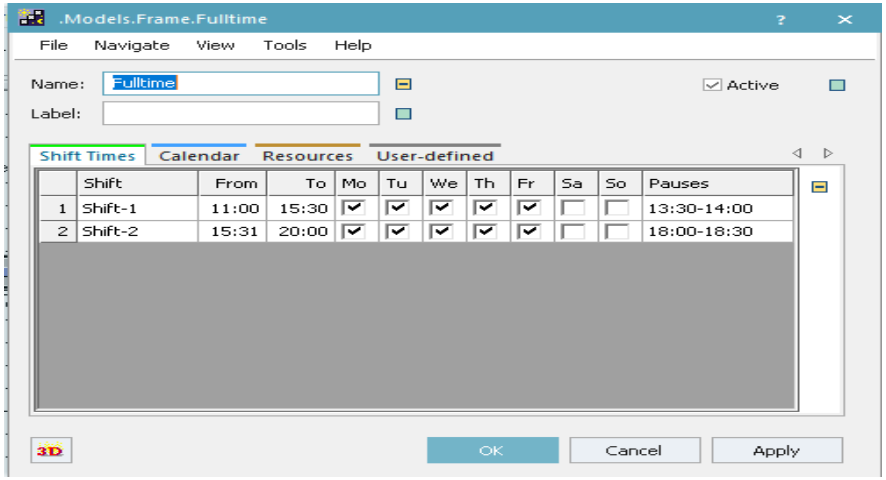
Time	Customers	Intensity	Agents	Occup.		Worker	Worker1	Worker 2	Worker 3	Worker 4	Worker 5	worker6	worker 7	worker 8
11:00	2	0.7	3	22%		1	1	1						
11:30	3	1.0	3	33%		1	1	1						
12:00	3	1.0	3	33%		1	1	1						
12:30	3	1.0	3	33%		1	1	1						
13:00	4	1.3	3	44%		1	1	1						
13:30	4	1.3	3	44%		0	0	0				1	1	1
14:00	4	1.3	3	44%		1	1	1						
14:30	3	1.0	3	33%		1	1	1						
15:00	4	1.3	3	44%		1	1	1						
15:30	8	2.7	6	44%		1	1	1	1	1	1			
16:00	2	0.7	3	22%					1	1	1			
16:30	4	1.3	3	44%					1	1	1			
17:00	3	1.0	3	33%					1	1	1			
17:30	3	1.0	3	33%					1	1	1			
18:00	4	1.3	3	44%					0	0	0	1	1	1
18:30	4	1.3	3	44%					1	1	1			
19:00	4	1.3	3	44%					1	1	1			
19:30	3	1.0	3	33%					1	1	1			
20:00	3	1.0	3	33%					1	1	1			

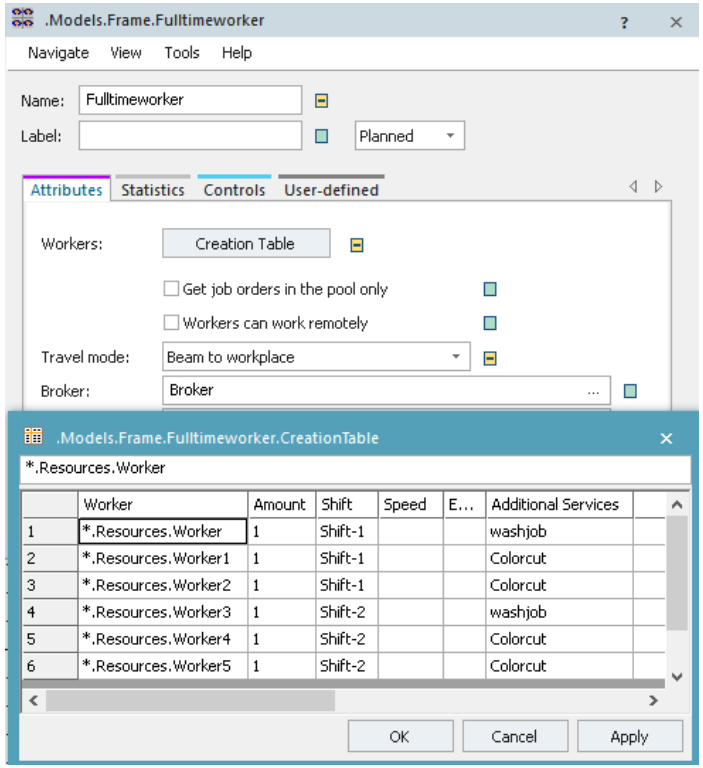


TEST CONCEPT

Employee Shift Implementation

1. Full time shift calender:



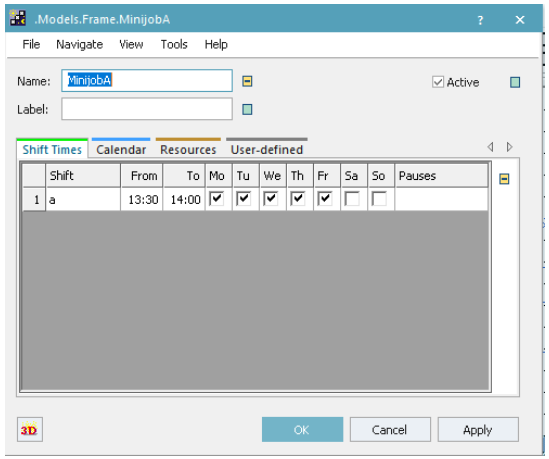


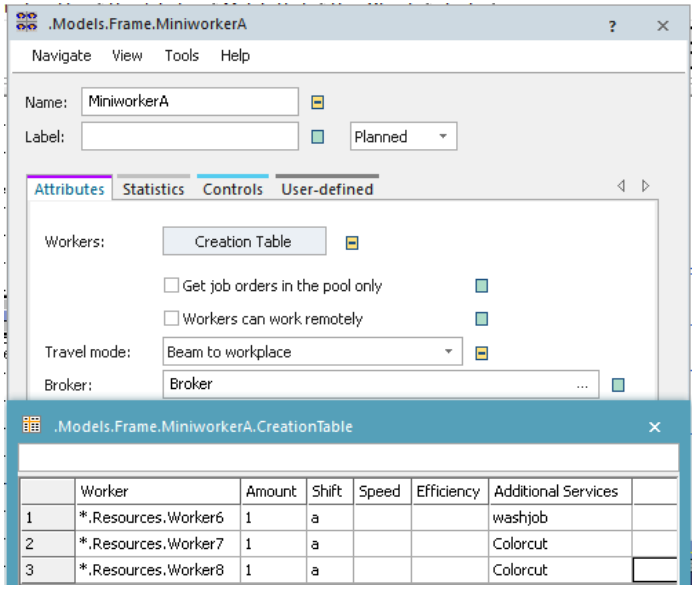
Fulltime Worker pool

TEST CONCEPT

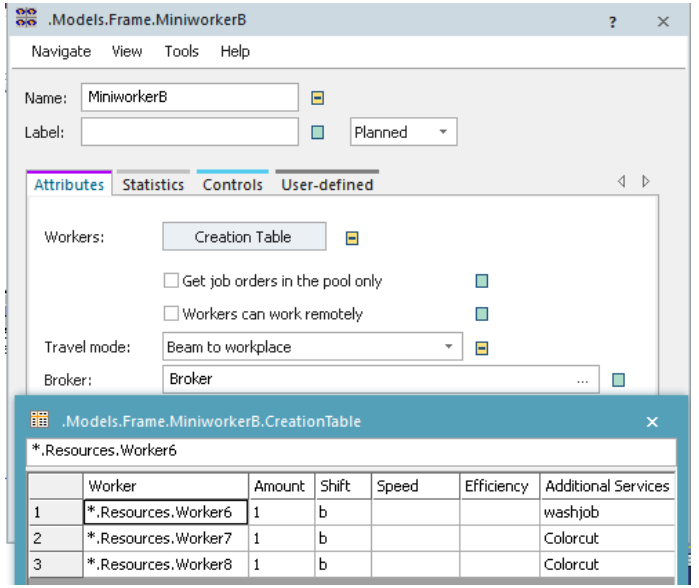
Employee Shift Implementation

2. Mini Job A Shift calendar:





MinijobA Worker pool



MinijobB Worker pool

TEST CONCEPT

Payment implementation

Total service charge is computed and also total money lost due to lost customers.

```
// Servicecharge for all service Booths

if @.Name = "Wcut" then
    ServiceCharge := ServiceCharge + 20;
    Wcut:=Wcut + 1;


    elseif @.Name = "Wcolor" then
    ServiceCharge := ServiceCharge +20;
    Wcolor:=Wcolor + 1;

        elseif @.Name = "cut" then
        ServiceCharge := ServiceCharge +10;
        cut:=cut + 1;

        elseif @.Name = "Wcutcolor" then
            ServiceCharge := ServiceCharge + 30;
            Wcutcolor:=Wcutcolor + 1;

        end;

TotalNoServed:= Wcut + Wcolor + Wcutcolor + cut;
```

```
//Loss 'due to lost Customers

if @.Name = "Wcut" then
    Loss := Loss + 20;

    elseif @.Name = "Wcolor" then
    Loss := Loss + 20;

        elseif @.Name = "cut" then
        Loss := Loss + 20;

        elseif @.Name = "Wcutcolor" then
            Loss := Loss + 30;

        end;
```

$$Total\ Profit = \frac{Profit\ \ (Service\ charge)}{Profit(service\ charge)\ + Loss(lost\ customers)} * 100\%$$

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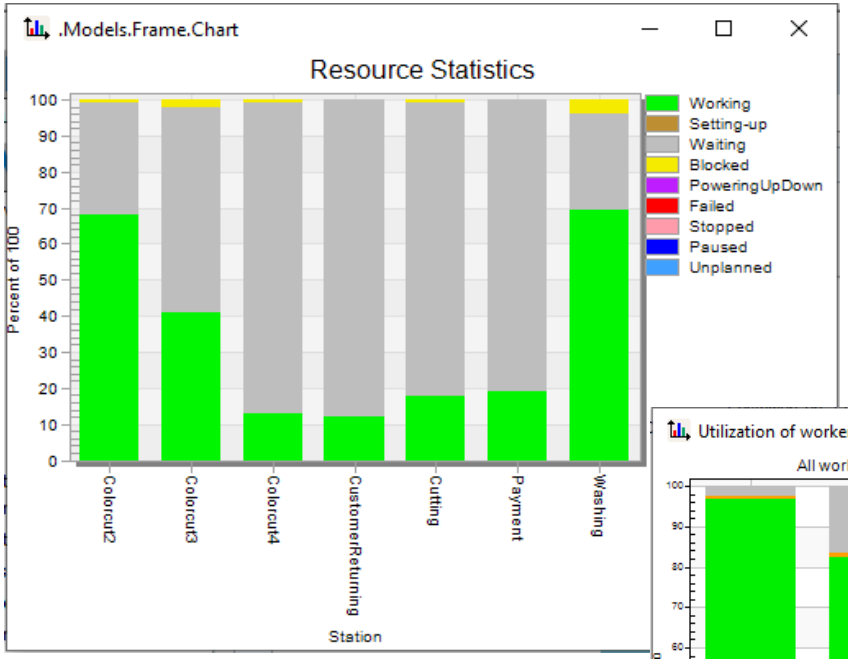
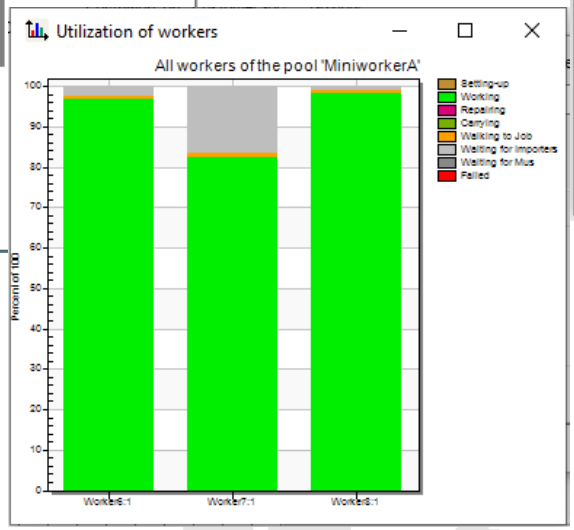
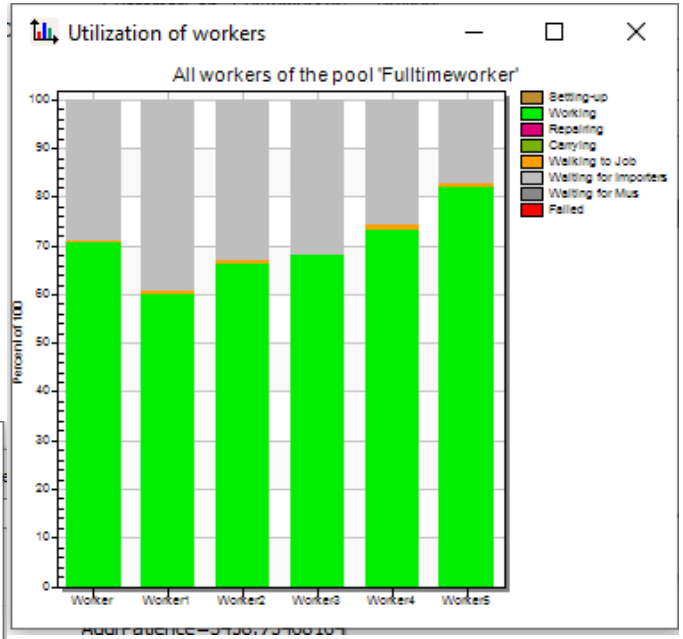
Charts

We have implemented bar charts to observe the % occupancy of our service units within our model and also agent % utilization over the working duration







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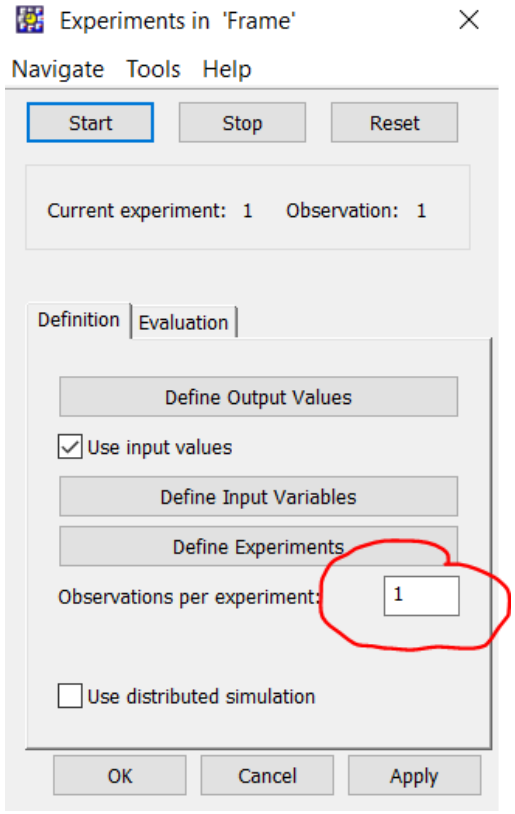
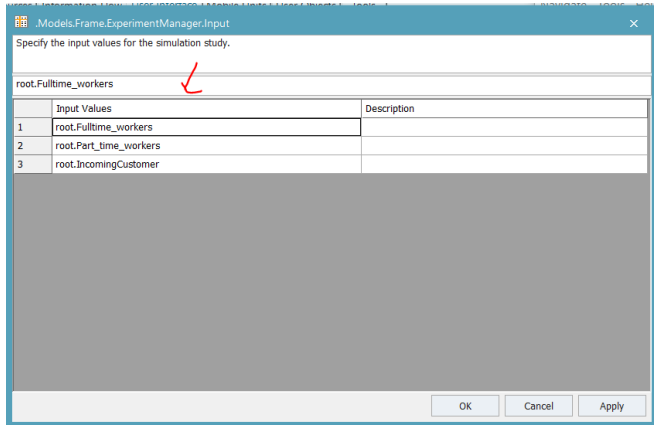
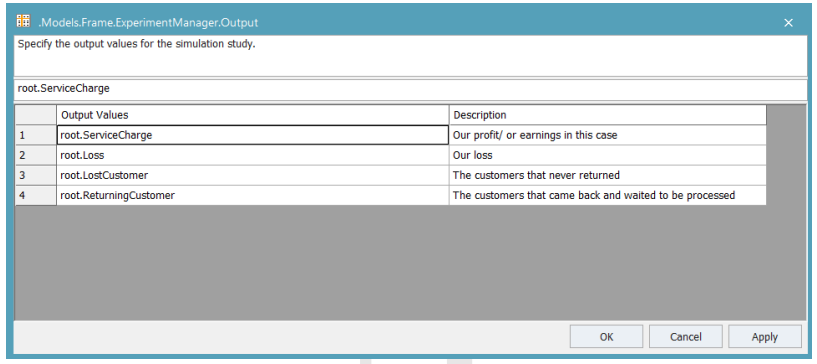
Using the ExperimentManager

Experiments in general, comprises of changes in input variables and investigation of the output varible behaviours.

The ExperimentManager is a crucial tool that is used for planning and executing experiments.







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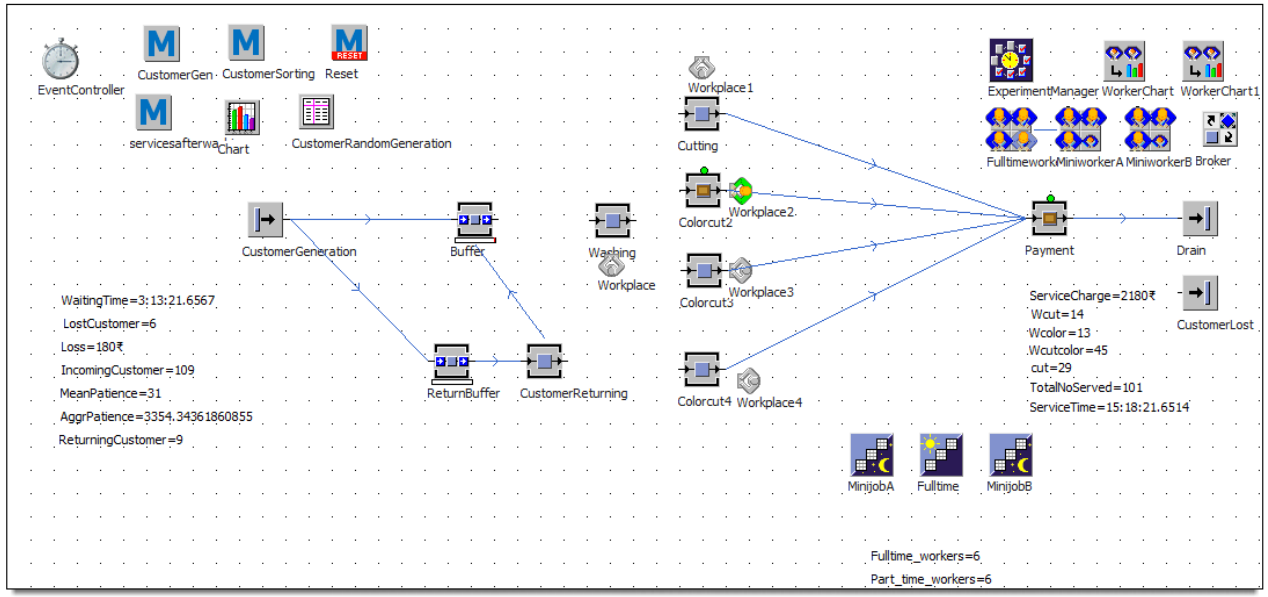
Results with 1 observation

Model



.Models.Frame

Overview

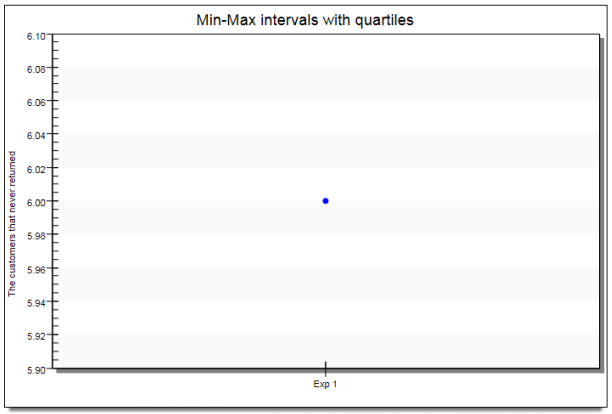
Overview of all executed experiments, their parametrizations and the mean values of the target values.

	root.Fulltime_workers	root.Part_time_workers	root.IncomingCustomer	Our profit/ or earnings in this case	Our loss	The customers that never returned	The customers that came back and waited to be processed
Exp 1	6	6	109	2180	180	6	9

TEST, SIMULATION, EVALUATION

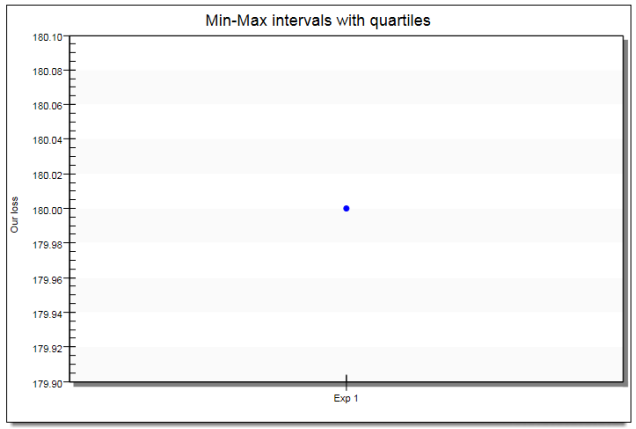
Output results

Evaluations of the output value 'The customers that never returned'



Experiment	The customers that never returned	Standard Deviation	Minimum	Maximum	Left interval bound	Right interval bound
Exp 1	6	0				

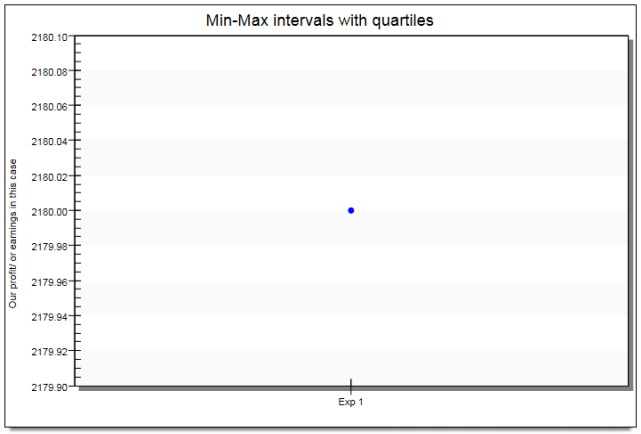
Evaluations of the output value 'Our loss'



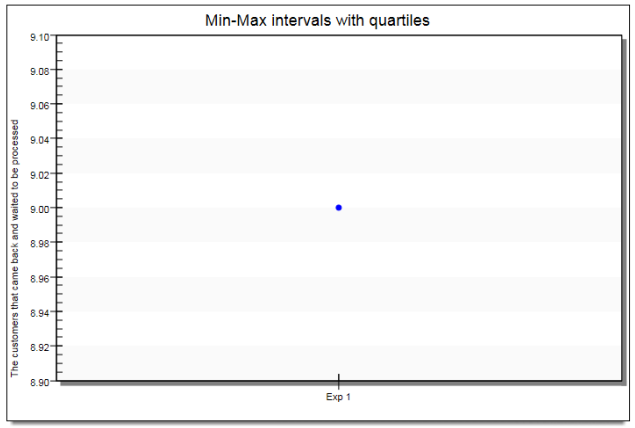
Experiment	Our loss	Standard Deviation	Minimum	Maximum	Left interval bound	Right interval bound
Exp 1	180	0				

Statistics of output values

Evaluations of the output value 'Our profit/ or earnings in this case'



Evaluations of the output value 'The customers that came back and waited to be processed'



Experiment	The customers that came back and waited to be processed	Standard Deviation	Minimum	Maximum	Left interval bound	Right interval bound
Exp 1	9	0				

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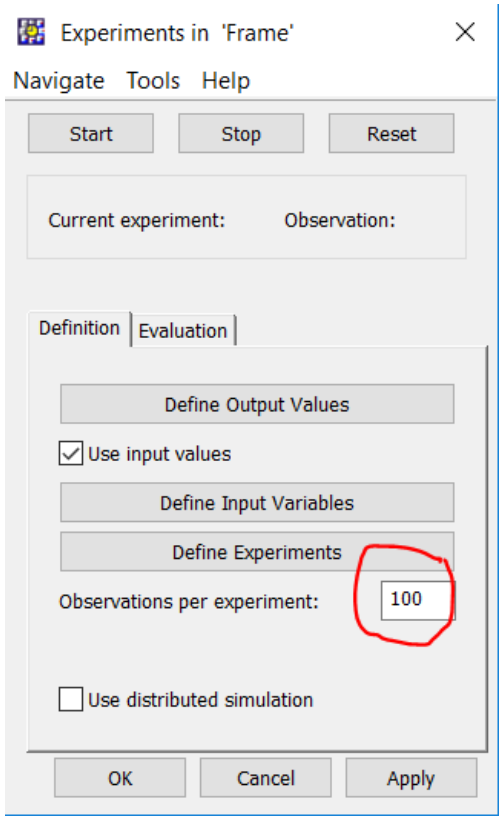
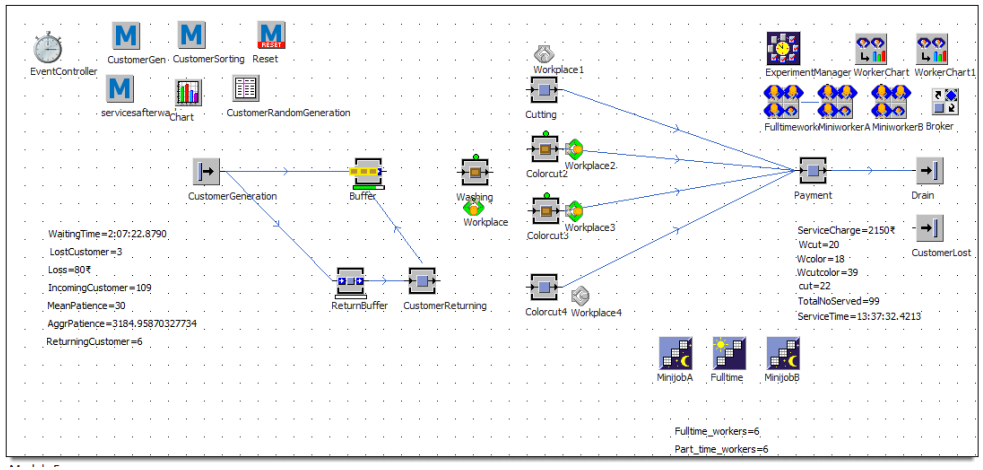
Results with 100 observations



Model



Overview

Overview of all executed experiments, their parametrizations and the mean values of the target values.

	root.Fulltime_workers	root.Part_time_workers	root.IncomingCustomer	Our profit/ or earnings in this case	Our loss	The customers that never returned	The customers that came back and waited to be processed
Exp 1	6	6	109	2177.4	153.7	5.81	4.76

Simulation effort: 1 experiments with 100 simulation runs
No special diagrams

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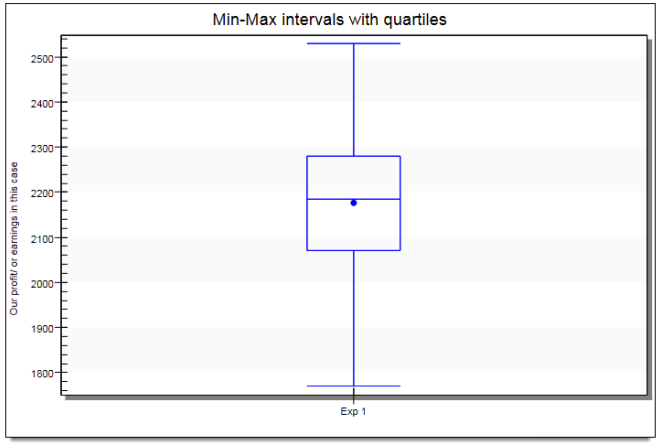
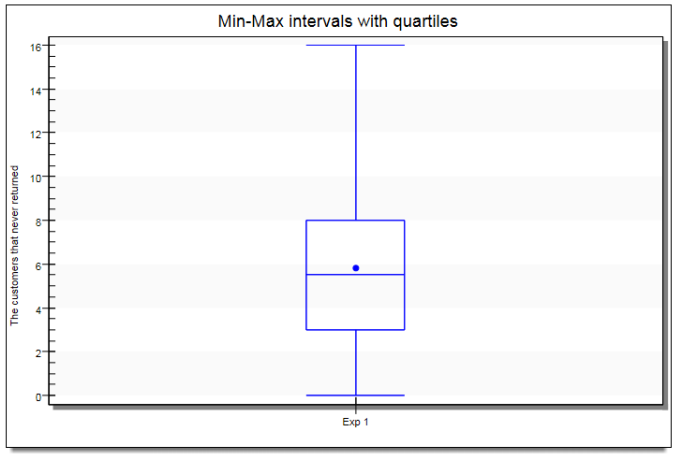
Output results

Statistics of output values

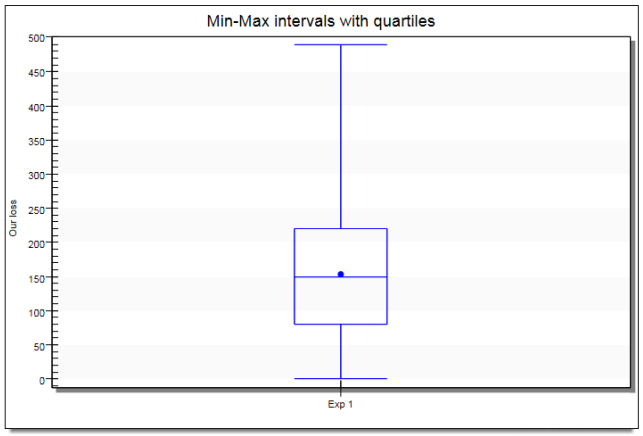
Evaluations of the output value 'Our profit/ or earnings in this case'



Evaluations of the output value 'The customers that never returned'

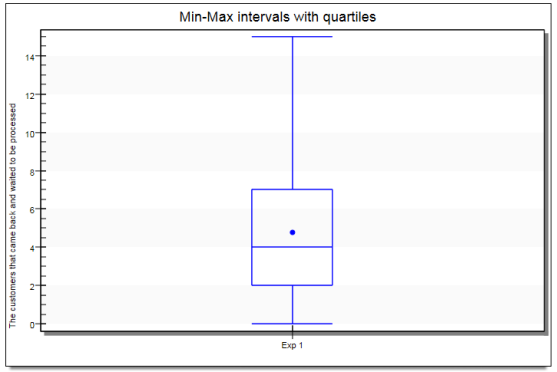


Evaluations of the output value 'Our loss'



Experiment	Our loss	Standard Deviation	Minimum	Maximum	Left interval bound	Right interval bound
Exp 1	153.7	100.168091050226	0	490	133.819961383801	173.580038616199

Evaluations of the output value 'The customers that came back and waited to be processed'



Experiment	The customers that came back and waited to be processed	Standard Deviation	Minimum	Maximum	Left interval bound	Right interval bound
Exp 1	4.76	3.64073474657925	0	15	4.03743509340671	5.48256490659329

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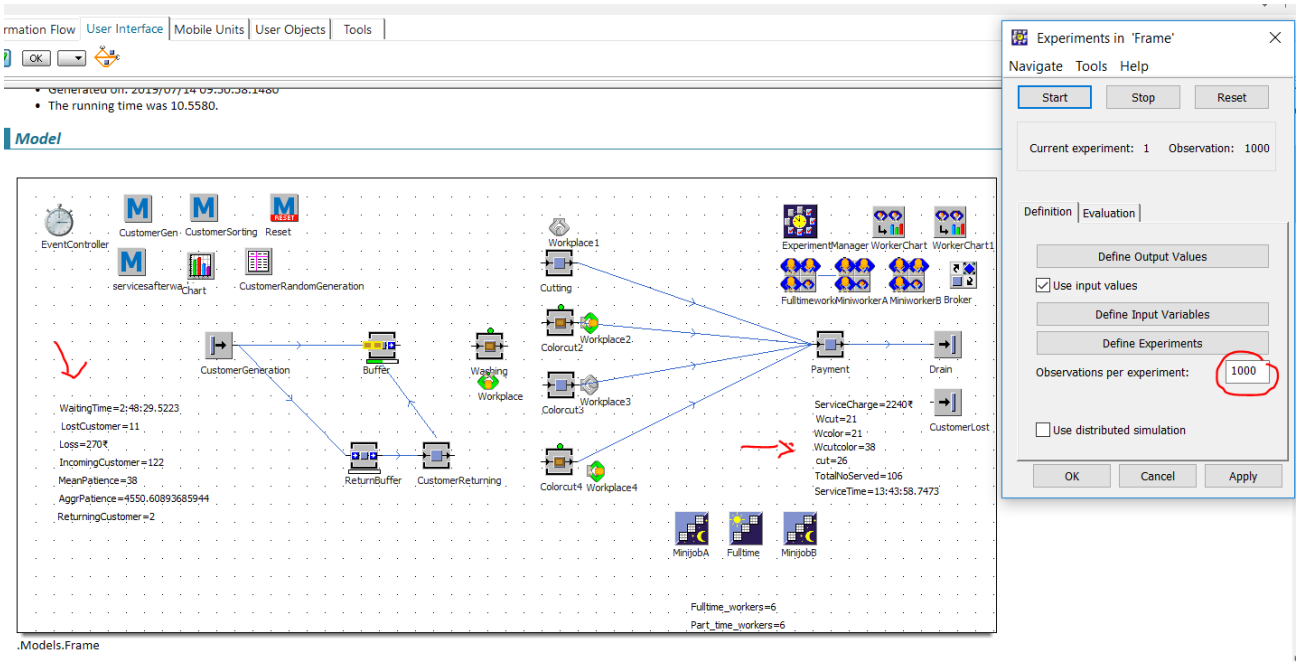
TEST, SIMULATION, EVALUATION

Results with 1000 observations



Overview

Overview of all executed experiments, their parametrizations and the mean values of the target values.

	root.Fulltime_workers	root.Part_time_workers	root.IncomingCustomer	Our profit/ or earnings in this case	Our loss	The customers that never returned	The customers that came back and waited to be processed
Exp 1	6	6	109	2176.85	156.96	5.88	5.048

Simulation effort: 1 experiments with 1000 simulation runs
No special diagrams

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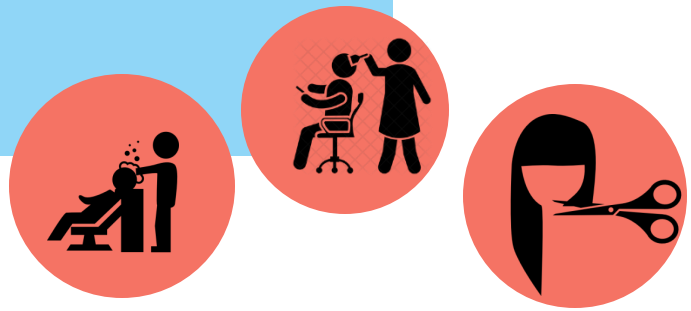
LIVE DEMO!



Conclusion

Experimenting with this model we discovered that quite a number of variables influences our goal of reducing waiting time and making profit. One of such is customer intensity and agent occupancy. To achieve our goal for this project, we tested out several methods and strategies and implemented those which gave optimum results for our target goal.

References

- Lecture slides delivered by Prof. Dr. Hartmut Westenberger
- Dr.ir. M.R.K. (Martijn) Mes, Department of Industrial Engineering and Business Information Systems . Simulation Modelling using Practical Examples: A Plant Simulation Tutorial

THANKS FOR LISTENING