

# What can Simulation offer Retailers?

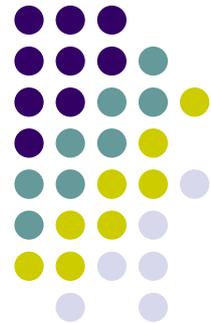
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# Operational Research & Simulation

## Operational Research



### ■ Definition:

- The discipline of applying advanced analytical methods to help make better decisions.

### ■ Methods applied (examples):

- Linear Programming
- Network Analysis
- Meta Heuristics
- Queuing Theory
- Game Theory
- Simulation



## Simulation (1/2)

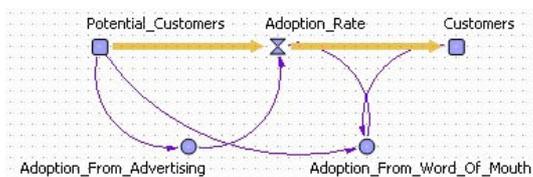
### ■ Definition:

- Simulation is the process of designing a model of a real system and conducting experiments with this model for the purpose of understanding the behaviour of the system and/or evaluating various strategies for the operation of the system.

### ■ Categories:

- Continuous
  - System Dynamics (SD)
- Discrete
  - Discrete Event Simulation (DES)
  - Agent Based Simulation (ABS)

## Simulation (2/2)

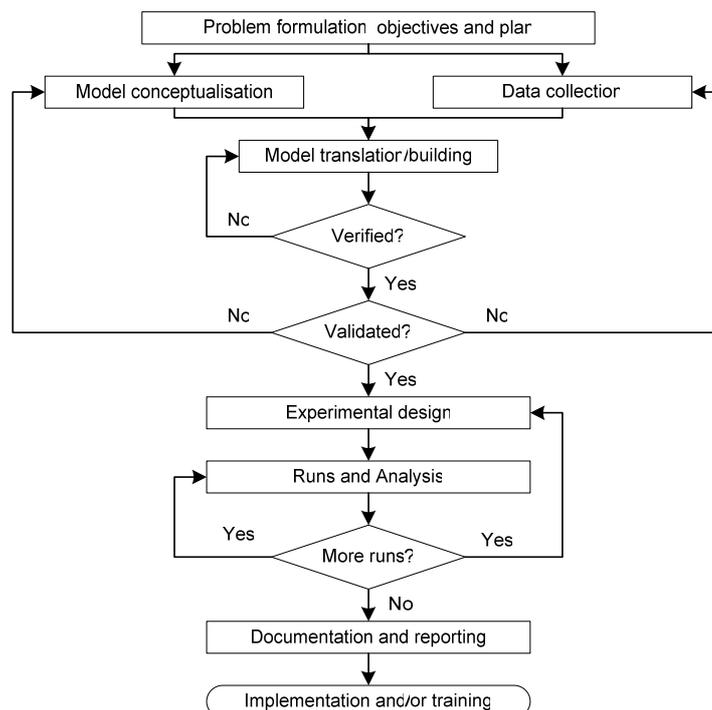




# Simulation Applications in Retail

- Design and operation of queuing systems
- Managing inventory systems
- Project planning
- Supply chain management
- Financial risk analysis
- Consumer behaviour analysis

# Outline of a Simulation Study





# Current Research

## Research Question & Method



### ■ Research Question:

- Can agent-based simulation help us with assessing the impact of HR management practices on customer satisfaction and the performance of service-oriented retail organisations?

### ■ Method:

- Case study approach
- Individual departments within department store
- Using agent-based modelling and simulation
- Incorporating variables from different levels of analysis



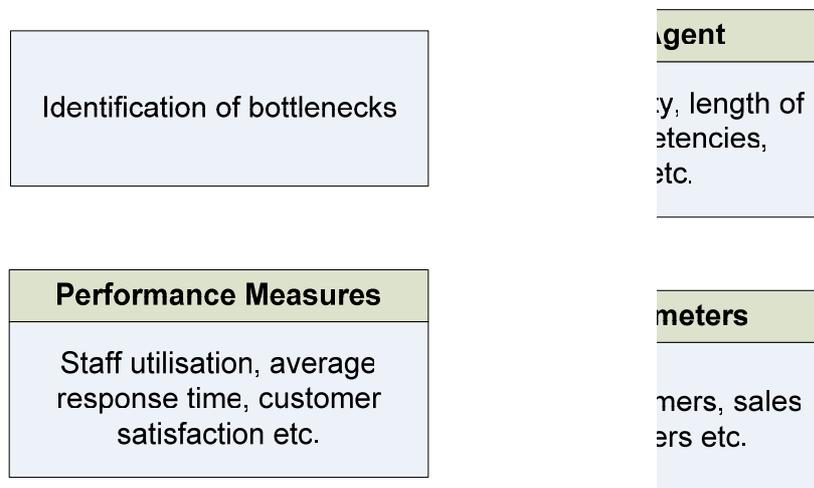
# Agent-Based Modelling & Simulation

- Approach
  - Bottom-up
- Agents
  - Discrete entities with their own goals and behaviours
  - Autonomous, i.e. capable to adapt and modify their behaviour
  - Proactive, i.e. actions depending on motivations generated from their internal state

Agent-Based Simulation is used to study how *micro level processes* affect *macro level outcome*; macro behaviour is not modelled, it emerges from the micro decisions of the individual agents [Pourdehnad et al., 2002].



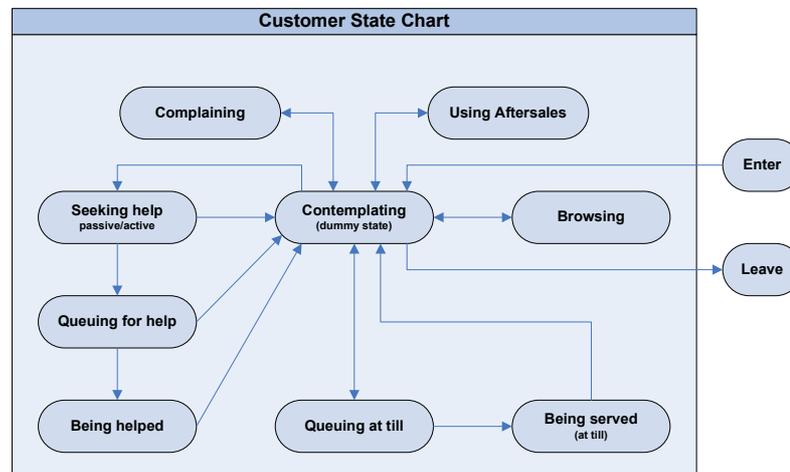
# Conceptual Model Design (Simulator)





# Conceptual Model Design (Customer)

- Example of a state chart:



# Empirical Data (1/2)



- Sources (case study in 2 x 2 departments over 2 weeks)
  - Observation of procedures
  - Observation of participant behaviours
  - Staff interviews
  - Data already collected by the case study company



## Empirical Data (2/2)

### ■ Implementation:

- Frequency distributions for state change delays

situation	min	mode	max
leave browse state after ...	1	7	15
leave help state after ...	3	15	30
leave pay queue (no patience) after ...	5	12	20

- Probability distributions for supporting decision making

event	probability it occurs
someone makes a purchase after browsing	0.37
someone requires help	0.38
someone makes a purchase after getting help	0.56

## Implementation ManPraSim v1



### ■ Features:

- Implemented in AnyLogic v5.5 (using state charts)
- Based on case study data
- Staff types: cashiers, 2 x selling staff, section managers
- Customer types: general customer

### ■ Management practices:

- Training: staff at different training levels
- Empowerment: refund decisions; staff learning on the job

### ■ Drawbacks:

- Homogeneous customers; no study of long term effects possible

# Implementation

## ManPraSim v2



### ■ Main additions:

- Realistic footfall & opening hours
- Customer types

Customer type	Likelihood to			
	buy	wait	ask for help	ask for refund
Shopping enthusiast	high	moderate	moderate	low
Solution demander	high	low	low	low
Service seeker	moderate	high	high	low
Disinterested shopper	low	low	low	high
Internet shopper	low	high	high	low

- Finite population

### ■ Management practices:

- Effect of previously studied ones on different customer types

# Implementation

## ManPraSim v3 (current version)



### ■ Main additions:

- Staff pool
- Customer evolution through external stimulation (word of mouth)

### ■ Still work in progress:

- Customer evolution through internal stimulation (triggered by memory of ones own previous shopping experience)

### ■ Management practices:

- Effect of previously studied once on customer evolution





# Experiment: Staffing (1/2)

## ■ A&TV: 2 cashiers, 4 normal staff, 4 expert staff

Overall customers:				Transactions:			
Overall customers:	41235	100 %		Transactions:	12057		
- leave happy (transaction or refund):	12057	29 %	*1 *2	Av. Transaction [£]:	149.7		
- leave not waiting for normal help:	930	2 %	8839 11 %	Sales [£]:	1,804,933		
- leave not waiting for expert help:	134	0 %	583 23 %	Missed [£]:	4,367,947		
- leave not waiting to pay:	7468	18 %	19128 39 %				
- leave without finding anything:	20646	50 %					
Till queue length: mean: 4.23; max: 19.0				Customers left:			
Normal help queue length: mean: 1.09; max: 13.0					41235	122742	
				*3	100 %	*4 *5	100 % *6
				- satisfied (> 0):	24972 61 %	144905 15682	38 % 48215
				- don't know (= 0):	8085 20 %	19670	48 %
				- not satisfied (< 0):	8178 20 %	-22163 5883	14 % -13796

- \*1 = number of people queueing for this service
- \*2 = % of those leaving the queue
- \*3 = considering accumulated history [number]
- \*4 = considering accumulated history [satisfaction growth]
- \*5 = experience per visit [number]
- \*6 = experience per visit [satisfaction growth]



# Experiment: Staffing (2/2)

## ■ A&TV: 3 cashiers, 6 normal staff, 1 expert staff

Overall customers:				Transactions:			
Overall customers:	40960	100 %		Transactions:	16800		
- leave happy (transaction or refund):	16800	41 %	*1 *2	Av. Transaction [£]:	149.7		
- leave not waiting for normal help:	1724	4 %	10958 16 %	Sales [£]:	2,514,960		
- leave not waiting for expert help:	761	2 %	1085 70 %	Missed [£]:	3,616,752		
- leave not waiting to pay:	1687	4 %	15605 11 %				
- leave without finding anything:	19988	49 %					
Till queue length: mean: 2.15; max: 17.0				Customers left:			
Normal help queue length: mean: 1.56; max: 14.0					40960	136411	
				*3	100 %	*4 *5	100 % *6
				- satisfied (> 0):	27979 68 %	152775 18512	45 % 50894
				- don't know (= 0):	7579 19 %	18924	46 %
				- not satisfied (< 0):	5402 13 %	-16364 3524	9 % -11610

- \*1 = number of people queueing for this service
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- \*3 = considering accumulated history [number]
- \*4 = considering accumulated history [satisfaction growth]
- \*5 = experience per visit [number]
- \*6 = experience per visit [satisfaction growth]



## What Else?

- Staffing levels
- Staff training requirements
- Profitability analysis
- Process optimisation
- Differences in strategic requirements for different departments
- Effects of marketing campaigns



## Conclusions

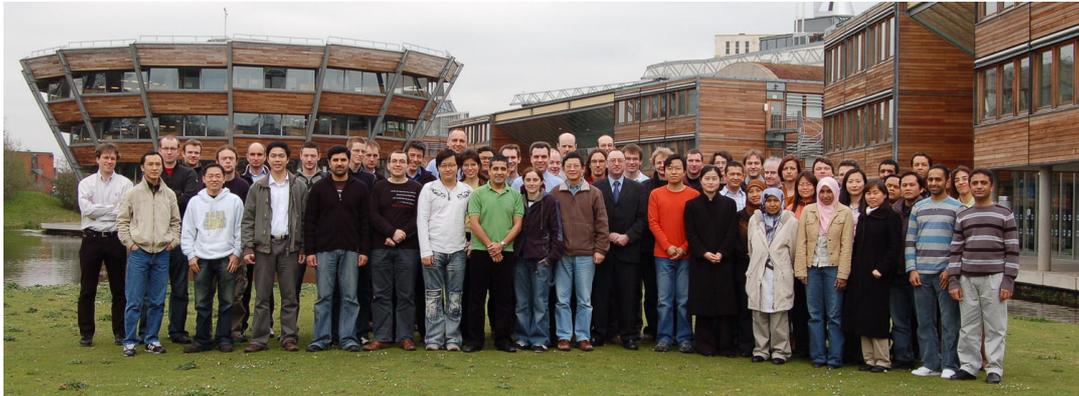
- We have presented the design, implementation and operation of management practices simulation models
- We have found Agent-Based Modelling & Simulation to be a useful tool for these kind of investigations
- Future Outlook:
  - Continue our investigations into customer evolution
  - Empower staff to respond to customer demand
  - Study the impact of team work related management practices



# Questions?

## ■ Reference:

- Pourdehnad, J., Maani, K., and Sedehi, H. (2002). "System Dynamics and Intelligent Agent-Based Simulation: Where is the Synergy?" Proceedings of the 20th International Conference of the System Dynamics Society, 28 July - 1 August 2002, Palermo, Italy.



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