The Role of Management Practices in Closing the Productivity Gap

IDEAS Factory Project
Uwe Aickelin, Giuliana Battisti, Helen Celia, Chris Clegg, Xiaolan Fu, Alfonsina Iona, Alina Petrescu, and Peer-Olaf Siebers
University of Aston, Leeds, Nottingham, and Oxford

A Multi-Agent Simulation of Retail Management Practices
Peer-Olaf Siebers, Uwe Aickelin
Nottingham University - School of Computer Science, UK
Helen Celia, Chris Clegg
Leeds University - Business School, UK
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Introduction

- The retail sector is one of the biggest contributors to the productivity gap between UK, EUROPE and USA

- There is a link between management practices and company’s productivity

- Current OR studies most often ignore HR management practices and do not consider the development of the system over time
Project Aim & Method

Project Aim:
- Develop a simulator that help to understand (and predict) the impact of different HR management practices on retail store productivity

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

Agent-Based Simulation (1/2)

Agent-Based Simulation
- Bottom-up approach

Agents
- A discrete entity with its own goals and behaviours
- Autonomous with the capability to adapt and modify its behaviour
- Examples: People, Organisations, Social Insects, Swarms, Robots

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].
Agent-Based Simulation (2/2)

- Example of an Interactive Organisational Agent-Based Simulation: The Sims™

**Conceptual Model Design (Simulator)**

- Customer Agent
  - Shopping need, attitudes, demographics etc.

- Sales Staff Agent
  - Attitudes, length of service, competencies, training etc.

- Manager Agent
  - Leadership quality, length of service, competencies, training etc.

- Global Parameters
  - Number of customers, sales staff, managers etc.

Visual Dynamic Stochastic Simulation Model

- Interface for User Interaction during Runtime

- Performance Measures
  - Staff utilisation, average response time, customer satisfaction etc.

- Emergent behaviour on macro level

- Understanding about interactions of entities within the system

- Identification of bottlenecks
Conceptual Model Design (Customer)

Example of a state chart:

Empirical Data

Sources (case study in 2 x 2 departments over 2 weeks)
- Informal participant observations
- Staff interviews
- Informational sources internal to the case study organization

Implementation:
- Frequency distributions for state change delays
  - Example: Leave browse state after … triangular (1,7,15)
- Probability distributions for supporting decision making
  - Example: Likelihood that someone requires help … 0.38
The Simulator
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

The Simulator
ManPraSim v2

Main additions:
- Realistic footfall & opening hours
- Customer types
- Finite population

Management practices:
- Effect of previously studied ones on different customer types
The Simulator
ManPraSim v3

- Main additions:
  - Staff pool
  - Customer evolution through external & internal stimulation

- Management practices:
  - Effect of previously studied once on customer evolution
### Experiment 1

#### Till availability
- **H1:** number of tills linked to increase in performance until a peak level is reached
- **H2:** peaks earlier in A&TV

#### Till Queue Lengths

| Till queue length means: | 4.15 | max: 15.0 |
|--------------------------|------|-----------|
| - satisfied (≥ 0): | 95.80 | 41.1% | 25953 | 2053 | 37% | 16252 |
| - don’t know (≥ 0): | 5310 | 23% | 6915 | 36% | |
| - not satisfied (≥ 0): | 8479 | 36% | -22418 | 6410 | 27% | -14966 |

### Overall Satisfaction

| Overall satisfaction level |
|-----------------------------|
| 0 | 100% |
| 1 | 0% |
| 2 | 0% |
| 3 | 0% |
| 4 | 0% |
| 5 | 0% |
| 6 | 0% |
| 7 | 0% |

#### Important parameters:
- **Empowerment level of cashier for refunds:** 0.7
- **Probability that refund is granted by cashier:** 0.8
- **Probability that refund is granted by authorized:** 0.7
- **Probability that staff stay with customers:** 0.0
- **Points required to become an expert:** 100000
- **Word of mouth adoption fraction:** 0

#### Overall decisions by cashier:
- 0

#### Overall decisions by authorized person:
- 0

**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 2 (1/2)

### Word Of Mouth

- **H3:** Word of mouth impact different for different departments

### A&TV

| adoption fraction | 0  | 0.5 | 1 | difference\(^1\) | difference\(^2\) |
|-------------------|----|-----|---|----------------|----------------|
| overall number of customers | 40755 | 41886 | 42698 | 1943 | 4.55% |
| number of customers that leave buying something | 12010 | 12065 | 12085 | 75 | 0.62% |
| number of customers that leave not waiting for normal help | 1050 | 1283 | 1682 | 632 | 37.57% |
| number of customers that leave not waiting for expert help | 459 | 446 | 486 | 7 | 1.50% |
| number of customers that leave not waiting to pay | 7161 | 7508 | 7603 | 442 | 5.81% |
| number of customers that leave without finding anything | 20075 | 20584 | 20862 | 787 | 3.77% |

| adoption fraction | 0  | 0.5 | 1 | difference\(^1\) | difference\(^2\) |
|-------------------|----|-----|---|----------------|----------------|
| overall number of customers | 63957 | 76643 | 85837 | 21880 | 25.49% |
| number of customers that leave buying something | 29634 | 30063 | 30225 | 591 | 1.96% |
| number of customers that leave not waiting for normal help | 2 | 44 | 91 | 89 | 97.80% |
| number of customers that leave not waiting for expert help | 63 | 129 | 185 | 122 | 65.95% |
| number of customers that leave not waiting to pay | 6450 | 13363 | 17955 | 11505 | 64.08% |
| number of customers that leave without finding anything | 27808 | 33044 | 37381 | 9573 | 25.61% |

\(^1\): ((adoption fraction = 1) - (adoption fraction = 0))

\(^2\): ((adoption fraction = 1) - (adoption fraction = 0)) / (adoption fraction = 1)

### WW

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Conclusions

- We have presented the design, implementation and operation of a management practices simulator

- We have found Agent-Based 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.