Dynamic Skill Based Routing: 
a System Dynamics approach to a Policy Definition in Call Center Management

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Queue Time incorporates: Ringing + Delay Announcement + Music

Call Center structure

Trunk Load
Queue Waiting Time
Talk Time
After-call Work
Call-handling Time
Agent Occupancy
Some Call Centers need to process different types of calls at the same time.

This can be made in different ways, but the most common are the Static and Dynamic Skill Based Routing.

**Skill-Based Routing is a technique used to route calls to operators according to the requested skill for that peculiar call**

We will first have a look at what a static and dynamic SBR are and then build a model in order to explore which one of these two approaches behave better in a given situation.
Static SBR and Dynamic SBR

Incoming calls → IVR → Type 1 calls → Type 1 agents

Type 2 calls → Type 2 agents

Type 3 calls → Type 3 agents

Dynamic Skill Based Routing

Pooling
Reasons to choose simulation

Erlang:

• overestimates staff and trunking needs
• Doesn’t account for different groups of agents (effect of the “pooling principle”), Skill-Based Routing or network interflow
• Cannot analyse the transient behaviour of the system
• Distributions vary with time, also according to various relationships between dynamic parts of the system
• Does not account for burnout

Simulation:

• Uncertainty
• Complexity
• Dynamic Environment
Applications of a simulation model

• Tactical
• Strategical
• Policy evaluation
• “What if” analysis
• Financial analysis

CALL CENTER MANAGEMENT
Characteristics of a CC environment

- High dynamism
- Non-linear relationships
- Different types of data processed (both hard and soft)
- Multiple feedback processes
- Many interdependent components

DYNAMIC SIMULATION & SYSTEM DYNAMICS APPROACH
Call Center calls flow

Inbound Distribution

Queue

Free Agents

System Capacity

Queue Length

Answering

Service Stage

Handled

Talk Time

Talk Time

Errors Factor

Occupancy/Burnout

Abandoned

Needing Rework

ASA

Customer Satisfaction

Leakage Fraction

Assumptions made

- 2 types of incoming calls (A-premium and B-standard)

- **SBR:**
  - *STATIC*: 2 groups of Specialized Agents (A-premium and B-standard)
  - *DYNAMIC*: 1 pool of Generalists (blended A and B skills)

- Call value based on Customer Satisfaction (Return on Quality)

- Callbacks generated by a % of both unanswered and unsatisfied calls

- Simulation run on a short period (tactical analysis)
  - No feedback on Customer Satisfaction on a long time-scale
IVR causal relations

A-type calls blocked

L1

Incoming A-type calls

A-type calls in the IVR

B-type calls in the IVR

L2

B-type calls blocked

Incoming B-type calls

B-type calls in the IVR

+ +

- -

+ +

- -
Model example - A type calls arrivals

TRUNKS-OUT BLOCKING:
If a call finds no free trunks, it’s blocked

The Inbound traffic flow is regulated by both A and B calls in the IVR
Queue insertion causal relations

- A-type calls
  - A-type calls in the IVR
  - A-type calls in shared queue
    - A-type calls blocked
  - A-type calls in dedicated queue
    - A-type calls
      - Awaiting A-type calls
        - A-type calls in the IVR
        - Awaiting B-type calls
          - B-type calls in the IVR
          - B-type calls
            - B-type calls in dedicated queue
              - B-type calls in shared queue
                - B-type calls blocked

- B-type calls
  - B-type calls in the IVR
  - Awaiting B-type calls
    - B-type calls
      - B-type calls in dedicated queue
        - B-type calls in shared queue
          - B-type calls blocked
Model example – A calls SBR behavior

If a call finds no free trunks, it is blocked

Trunks in the shared queue can be occupied by both calls

The dedicated queue is the first choice for call queueing

FEEDBACK TO B SHARED QUEUE FLOW
Model example – A specialists behavior

Agents in reserve are assigned to different tasks, both in and out flows are dependant on the actual quality of the service.

Agents get to work as soon as there is a call waiting, and return available after completing the After Call Work.

The “get on pause” flow is a function of the Agents’ occupancy; after a certain amount of time, the agents return available.
An SBR Scenario Analysis

– Basic assumptions at start:

- 2 types of incoming calls (A-premium and B-standard)

- **SBR:**

  *STATIC*: 2 groups of Specialized Agents (A-premium and B-standard)

  *DYNAMIC*: 1 pool of Generalists (blended A and B skills)

– Premium and Standard calls share the same call-processing parameters (see next), and get however processed with a **priority policy** set according to their relative importance, the latter due to expected revenue from each call-type (€10 for a premium call, €6 for a standard call)

– The agents cost depends on their training and skill-set mix (skill levels adjusted so as to reflect an equal cost for specialized and generalists)
Some other main assumptions and parameter settings:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation Duration Time (seconds)</td>
<td>2700 (45mins)</td>
</tr>
<tr>
<td>Number of Operators</td>
<td>120</td>
</tr>
<tr>
<td>Number of Calls/Type/half hour</td>
<td>250 (375)</td>
</tr>
<tr>
<td>Average Talk Time (seconds)</td>
<td>180</td>
</tr>
<tr>
<td>Average time (seconds) due to After Call Work</td>
<td>30</td>
</tr>
<tr>
<td>Service Level objective</td>
<td>80% answered in 20 seconds</td>
</tr>
</tbody>
</table>
## Simulation results

<table>
<thead>
<tr>
<th></th>
<th>A type calls answered</th>
<th>B type calls answered</th>
<th>Service Level</th>
<th>Profit (€)</th>
<th>Quality factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static SBR</td>
<td>356</td>
<td>371</td>
<td>0,76</td>
<td>2554</td>
<td>0,83</td>
</tr>
<tr>
<td>Dynamic SBR</td>
<td>372</td>
<td>349</td>
<td>0,85</td>
<td>3497</td>
<td>0,89</td>
</tr>
</tbody>
</table>

**Profits** = Revenues due to call_value – overall costs

**Quality Factor** = SL (N:0,20) + Avg_Skill_Lvl (N:0,20) + Abnd_Pct (N:0,20) + RwkPct (N:0,20) + Profit_Factor (N:0,20)
Dynamic Skill Based Routing

Abandoned calls are slim to none during the whole simulation.

There is a good decrease in unsatisfied calls.

Static Skill Based Routing

Increasing abandoned calls at the end of the simulation.

High number of unsatisfied calls throughout the simulation.

A calls behavior in time

Static Dynamic Skill Based Routing

Dynamic
Dynamic SBR allows for a greater number of calls to be processed at the same time.
Conclusions and future work

• Call Center management can make a good use of simulation instruments

• Dynamic SBR can dramatically improve a CC performance

• Future work could focus on considering a strategic (middle-long term) level of simulation (thus including the development of soft factors like Agents Experience, Customer Satisfaction, etc…) and on making the model able to communicate with Informative Systems (ERP) or in general with data-sets