SPRINT: Optimization of Staff Management for Desk Customer Relations Services at Hera

Daniele Vigo
DEI, Università di Bologna & OPTIT

joint work with A. Gordini, C. Caremi (OPTIT)
S. Bosso, G. D’Aleo and B. Beleggia (Hera Comm, Gruppo Hera)
What is SPRINT?

- SPRINT is a Decision Support System for medium and short-term planning of the Staff Allocation to Customer Contact Desks (CCDs)
  - Developed for Hera in 2009-10
  - Operational since February 2011
Summary

• Background and objectives
• Solution approach
  • Demand Forecasting
  • Adaptive Staff Optimizer
• Results and conclusions
Gruppo Hera

- Hera is the 2nd largest Italian multi-utility company
  - based in Emilia-Romagna
  - serving 3.5 million citizens
  - turnover 4.5 billion Euros (2012)
  - Gas (4\textsuperscript{th}), electricity (7\textsuperscript{th}), water (2\textsuperscript{nd}) and waste (1\textsuperscript{st})

- Hera Comm is a company of Hera
  - commercialization of energy (Gas and Electricity)
  - responsible of CRM for Hera
DEI-OR and OPTIT

• DEI-OR group is active since more than 20 years in personnel management optimization
  • in ‘93-’95 FARO and FASTER prizes for personnel management at Italian Railways
  • EU projects (TRIO, TRIS, REORIENT …)

• OPTIT is spinoff company created in 2007
  • DSS based on state-of-the-art OR for logistics, energy and services optimization
Summary

• Introduction

• Background and objectives

• Solution approach
  • Demand Forecasting
  • Adaptive Staff Optimizer

• Results and conclusions
CRM at Hera

• Major component for competitiveness after market deregulation
  • Quality of CRM is 2\textsuperscript{nd} reason (after price) for Energy provider choice (Hera customers survey)

- Desk CRM is a distinctive element with respect to many competitors (ENEL, ENI, EDISON, GDF-SUEZ, EON…)
  - 25% of 3M yearly contacts
Hera’s CCD network

>80 CCDs with 200 staff
  - 8 TOP and 20 Medium
  - 750K customers/year

- TOP and Medium CCDs:
  - include many counters (15-20)
  - supervised by Desk Managers
CCD Management: Challenges …

WORKING TIME of a DESK EMPLOYEE

FRONT OFFICE
Contact Desk Activities

BACK OFFICE
and SALES

• Efficacy: maintain high service quality at FO
  • Mean and max wait time

• Efficiency:
  • long and more compact intervals for BO/sales
  • reduction of resource requirements (even with increase in demand rate)
... and opportunities

- Pre-SPRINT
  - Good average quality of service
  - High variability of performance among CCDs
  - High resource requirements
  - Long Waiting Time in case of peaks
  - Back Office inefficiency (switch BO/FO and vv)
  - Limited proactive sales activities

→ Need of prediction and optimization tools to improve Efficiency and Efficacy
The SPRINT project

- Follows the redesign of CRM in 2007/08
- Started in 2009 with Optit SPRINT
- Design a complete DSS for Staff Management:
  - Forecasting of the arrivals at the CCDs
  - Scheduling and rostering of the personnel of each CCD
  - Performing “what if” analysis
  - Defining KPIs and control them during the year
- SPRINT DSS is operational since Feb 2011 and covers 85% of the CCDs demand
SPRINT Objectives (vs 2009)

• **Efficacy**
  - >20% reduction of the mean waiting time (MWT) (was 16’)
  - >25% reduction of PW40, % of users waiting >40’ (was 9%)
  - Increase of the customer satisfaction index (CSI) for desk services (was 72).

• **Efficiency**
  - >30% reduction of the backlog of back office (BBO) requests allocated to desk staff (was 10,000).
Summary

• Introduction
• Background and objectives
• Solution approach
  • Demand Forecasting
  • Adaptive Staff Optimizer
• Results and conclusions
SPRINT planning architecture

- demand forecasting
- long/medium term planning
- revision and control

Peripheral users (Desk managers)

Central Planning Unit

- monthly forecast & master plan
- monthly available staff & feedbacks

Peripheral user (Desk manager)

- operational planning
The main SPRINT modules

- The modules are used for
  - medium term planning
  - operational management support (with limited functionalities)
Summary

• Introduction
• Background and objectives
• Solution approach
  • Demand Forecasting
  • Adaptive Staff Optimizer
• Results and conclusions
Demand Forecasting

- Crucial for the success of staff scheduling
- Historical data on arrivals (last three years)

Requirements:
- for each CCD arrivals every 15’ and per user type
- medium-term forecast (1-3 months)
- existing forecast at HC had MAPD >15-20%

Current literature:
- Existing methods (moving avg, ARIMA ...)
  - Work only for short term forecast (1-3 days)
  - For long term equivalent to historical avg (MAPD >15-20%)
Mission impossible?

- Daily arrival forecast is performed through a M5 model tree approach
  - combines regression and classification
  - used successfully in other contexts
  - easy to use and understand, fast to train
  - we integrated billing and special events information

→ 25-30% better than historical average for monthly forecasts
TOP CCDs in 5 months of 2011: 125K arrivals
• BF : historical average (literature reference)
• HF (our approach) is 30% more accurate!
Forecast results (2011-13)

- The quality is rather constant during time
- heavy crisis period (+ 50% written complaints, +34% contacts ad CCDs )
Summary

• Introduction
• Background and objectives
• Solution approach
  • Demand Forecasting
  • Adaptive Staff Optimizer
• Results and conclusions
Staff Scheduling at HC

- Peculiar characteristics
  - Staff assignment to CCDs is fixed
  - CCDs are open 8am-3pm/Mon-Fri
  - most staff has working shift larger than CCD opening time
  - simplified meal break rules

- Aggregated scheduling for each day of the month (# staff used per time slot)
- Monthly staff rosters are easily obtained
Daily Staff Scheduling at HC

- Planning slots: 15 minutes
- Arrivals per slot: 5-20
- Average service time 10-22 minutes
- Maximum waiting time 40 minutes

High congestion: average # busy servers ~6
The SPRINT Staff Optimizer

- **Demand Forecast (DF) Module**
- **Data Analysis (DA) Module**
- **Schedule Generator (SG) Module**
- **Schedule Evaluator (SE) Module**

Solution Acceptance or Model Revision

Minimize FTEs given the staffing

Check solution feasibility (target SLAs)

Arrivals → Staffing → Shifts → Two-phase Scheduler

Service levels, Cost (# FTEs)
Requirements

• Fast optimization algorithm: hundreds of optimization problems to be solved daily

• Simple staffing approaches from the literature do not work on HC problems:
  • Period-by-Period staffing (SIPP) and LagMax (see Green et al. 2001, 2003)
  • Another Mission Impossible?
The solution: Adaptive staffing

- Staffing at time slot depends on a weighted sum of the arrivals in current and subsequent periods
- \((\text{Staff work time})_{t_1,t_2} = f(N_{t_1}, N_{t_1+1}, \ldots N_{t_2}, \beta)\)
- the open desks “cover” a fraction of the arriving users

- Staffing is controlled by a single parameter \(\beta \in [0,1]\)
  - \(\beta=0\): mostly served within 15-30’ ➔ high staff, short MWT
  - \(\beta=1\): mostly served within 45-60’ ➔ low staff, long MWT
Role of $\beta$ parameter

![Graph showing the relationship between $\beta$ values, FTEs, and MWT.]

- **Target MWT**: The dashed red line indicates the target Mean Wait Time (MWT).
- **Average FTEs**: The graph shows how Average FTEs change with different $\beta$ values.

**Graph Key**:
- **FTE** (red line)
- **MWT** (blue line)

**Axes**:
- **$\beta$ values** on the x-axis
- **Average FTEs** on the y-axis
- **Mean Wait Time** on the y-axis
Scheduling algorithm

- Based on an integer programming model
  - maximizes the unused staff
  - respects adaptive staffing and opening/closing rules
  - relaxes the target-SLA constraints

SPRINT: Optimization of Staff Management for Desk CRM at Hera

Daniele Vigo
DEI - UNIVERSITÀ DI BOLOGNA and Optit
Parameters & dec. variables

- $Q_s(t_1, t_2)$: total time needed for type $s$ in $[t_1, t_2]$
- $B_t$: staff available at time $t$
- $K^O, K^C$: min n. of time slots a desk must remain open or closed
- $g_t$: unused personnel at time $t$ (available for Back Office duties)
- $y_{it}$: opening event for desk $i$ at time $t$
- $x_{it}$: status of desk $i$ at time $t$
- $d_{st}$: not served work time of type $s$ at time $t$
The ILP model

\[
\max_D \sum_{t \in T} g_t - M \sum_{s \in S, t \in T} d_{st} - \epsilon \sum_{i \in I, t \in T} y_{it} \\
x_{it} - y_{it} - \left[ x_{i(t-1)} \right]_{t > 0} \leq 0 \quad \forall i \in I, t \in T
\]

(4)

\[
g_t + \sum_{i \in I} x_{it} = B_t \quad \forall t \in T
\]

(5)

\[
x_{it} - \sum_{p = \max(1, t - K_C + 1)}^{t} y_{ip} \geq 0 \quad \forall i \in I, t \in T, t > 1
\]

(6)

\[
\sum_{p = t - K_C}^{t - 1} x_{ip} + K_C y_{it} \leq K_C \quad \forall i \in I, t \in T, t > K_C
\]

(7)

\[
\sum_{i \in I_s} \left( D \sum_{t = t_1}^{t_2} x_{it} \right) + \left( d_{st_2} - [d_{s(t_1 - 1)}]_{t_1 > 1} \right) \geq Q_s(t_1, t_2) \quad \forall t_1, t_2 \in T, t_2 \geq t_1, s \in S
\]

(8)

\[
x_{it}, y_{it} \in \{0, 1\} \quad \forall i \in I, t \in T
\]

(9)

\[
g_t \geq 0 \quad \forall t \in T
\]

(10)

\[
d_{st} \geq 0 \quad \forall s \in S, t \in T
\]

(11)
Adaptive scheduler results

• The model is solved very quickly
  • 32 time slots, 11 counters, 4 types
    <1-2 sec with Cplex

• Evaluator: given the solution computes the service levels to see if the solution is feasible
  • fast custom discrete event simulator implemented in Java that runs 1500 day-simulations in 3-10 seconds

• Binary search on $\beta$ to meet target-SLA
Ongoing work

- Incorporate robustness with respect to arrival rate uncertainty
  - improved short-term forecast
  - fast scenario-based two-phase stochastic optimization approach
  - proactive within-day re-optimization
Summary

• Introduction
• Background and objectives
• Solution approach
  • Demand Forecasting
  • Adaptive Staff Optimizer
• Results and conclusions
The KEY for Success

“For us, SPRINT is an every day companion: … we sit at our desk, switch on the pc and start SPRINT to organize the work”

(from Desk Managers interviews)

This is the KEY for SPRINT Success:
High quality and reliable forecast and optimization tools &
Day by Day Commitment of Operation Management
(Desk Managers)
Benchmarking (vs other MU)

- Leadership in QoS - Utility Industry
- Service not available for Multinational Competitors

Mean wait time at desks (min) in 2011

<table>
<thead>
<tr>
<th>Company</th>
<th># Desks</th>
<th>Mean Wait Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hera</td>
<td>84</td>
<td>10.5</td>
</tr>
<tr>
<td>Iren</td>
<td>33</td>
<td>20</td>
</tr>
<tr>
<td>Acsn-Agam (2010)</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td>AceasAps</td>
<td>7</td>
<td>27</td>
</tr>
<tr>
<td>Veritas Venezia</td>
<td>19</td>
<td>27</td>
</tr>
<tr>
<td>Acea Roma</td>
<td>20</td>
<td>38</td>
</tr>
</tbody>
</table>

SPRINT: Optimization of Staff Management for Desk CRM at Hera

Daniele Vigo
DEI - UNIVERSITÀ DI BOLOGNA and Optit
Achieved results: Quality, Cost, Sales

Medium and Large CCDs (85% of contacts)

<table>
<thead>
<tr>
<th>Quality</th>
<th>2009 (pre SPRINT)</th>
<th>mar-dec 2011 (SPRINT)</th>
<th>jan 2012-march 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average monthly requests (n.)</td>
<td>31.871</td>
<td>38.527 (+21%)</td>
<td>42.839 (+34%)</td>
</tr>
<tr>
<td>Average Waiting Time (min)</td>
<td>16.00</td>
<td>10.32 (-36%)</td>
<td>10.37 (-35%)</td>
</tr>
<tr>
<td>% Customers Waiting &gt; 40 min</td>
<td>9.0%</td>
<td>4.6% (-49%)</td>
<td>4.6% (-49%)</td>
</tr>
<tr>
<td>Customer Satisfaction Index (n.)</td>
<td>72</td>
<td>78 (+8%)</td>
<td>81 (+13%)</td>
</tr>
</tbody>
</table>

| Cost                             |                   |                       |                     |
|----------------------------------|                   |                       |                     |
| Staff available (n.)             | 193               | 189 (-2%)             | 188 (-3%)           |
| Back Office Requests Backlog (n.)| 10000             | 1500 (-85%)           | 600 (-94%)          |
| Avg. BO time per employee (min/day) | 45               | 65 (+44%)             | 70 (+56%)           |

| Sales                            |                   |                       |                     |
|----------------------------------|                   |                       |                     |
| Monthly Sales by Desk Staff (n.) | 417               | 1420 (+241%)          | 3360 (+706%)        |
Achieved results: CSI & sales

- Contribution to 2 Corporate Objectives (MBO for Hera Top-Mgmt):
  - 1. Customer Satisfaction
  - 2. Sales

Customer Satisfaction Index per quarter

new customers acquired at desk (EE+Gas) per quarter
An important “lesson learned”

- Proactive re-optimization:
  - it is worth re-optimizing within day when arrival rate is different from forecast

<table>
<thead>
<tr>
<th>Date</th>
<th>MWT</th>
<th>O/F%</th>
<th>MWT</th>
<th>O/F%</th>
<th>MWT</th>
<th>O/F%</th>
</tr>
</thead>
<tbody>
<tr>
<td>17-Jan-12</td>
<td>27:54</td>
<td>1.57</td>
<td>05:51</td>
<td>0.60</td>
<td>31:06</td>
<td>0.80</td>
</tr>
<tr>
<td>18-Jan-12</td>
<td>24:59</td>
<td>1.30</td>
<td>08:53</td>
<td>0.95</td>
<td>28:43</td>
<td>1.06</td>
</tr>
<tr>
<td>19-Jan-12</td>
<td>24:50</td>
<td>1.25</td>
<td>14:02</td>
<td>1.28</td>
<td>24:07</td>
<td>1.36</td>
</tr>
</tbody>
</table>

**HEAVY (EXPECTED) DAY (269 vs 217)**
HIGH initial arrival rate: limited effect as all resources are used

**LIGHT (EXPECTED) DAY (184 vs 192)**
LOW initial arrival rate: saving of FTEs possible

**HEAVY (UNEXPECTED) DAY (245 vs 171)**
LOW initial arrival rate: MWT can be controlled
Conclusions

• Christian Fabbri (Hera Comm CEO):
  • … high quality-of-service improvement was combined with important operation costs reduction. Moreover, Sprint is widely used and appreciated by Desk Managers … and this is perhaps one the most important results.
  • … we estimate the Break-Even Point of Sprint Project to be reached in less than 2 years.

• Matteo Pozzi (Optit CEO):
  • After two full year of operations of the Service, we are proud to provide Hera Comm with a value added service recognized to be an area of excellence at national level
  • SPRINT is a key asset in the company’s value proposition with new significant sales to important players in the Italian utilities market
Conclusions and next steps

• Successful application of OR techniques to a real world context with very good results
• Huge commitment from Low and Top Mgmt
• Implementation of proactive scheduling support and further data analysis tools
• Extension to Call Centers (>2Million requests)
• Optit product (SPOT) currently implemented at another Multi-utility and at the leader of Electricity market in Italy