SPORTING TIMES (AND PLACES)
Analytical approaches help sports administrators timetable competitions

FASHIONING A MODEL FOR ZARA
How Zara worked with analytical experts to determine stock levels for new products

OPTIMIZING DESK CUSTOMER RELATIONS SERVICES AT HERA
Algorithms enabled an Italian utility company to deal with a significant increase in demand
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INTRODUCING NEIL ROBINSON

Impact is using the services of several professional writers. Neil Robinson is a managing editor at Bulletin, a strategic communications consultancy that works with academic institutions to help their research have the greatest possible economic, social or cultural impact. He studied English Literature at the University of Liverpool but left after three days to embark on a career in journalism. Before joining Bulletin he spent more than 20 years working as a reporter, sub-editor and editor, writing for national newspapers, TV, radio and a wide range of specialist and consumer magazines. He has worked with universities across the UK and in Europe and Australia, "translating" and disseminating research, book editing and delivering Research Excellence Framework consultancy. Visit www.bulletin.co.uk.
OPTIMIZING DESK CUSTOMER RELATIONS SERVICES AT HERA

HERA GROUP is a large Italian multi-utility company that provides water, energy (natural gas, electricity and district heating) and environmental services (collection, treatment and disposal of urban and industrial wastes) to more than 3.5 million citizens in northern Italy (for more details see http://eng.gruppohera.it/group/investor_relations/hera_overview/pecr/).

The company was created in 2002 as the aggregation of several municipal agencies from which it inherited a strong relationship with the territory and the people served. For this reason Hera always relied on a high-quality Customer Relationship Management (CRM) service to keep contact with their users, by coupling standard channels, such as web and call centres, with a large network of physical Customer Contact Desks (CCDs). In 2011, the network comprised more than 80 CCDs employing 200 persons who served about 650,000 users per year which represented more than 20% of the yearly users' contacts. By 2014, with the acquisition of some new companies in northern Italy, the
number of CCDs had risen to 120, serving more than 750,000 contacts. Most CCDs are small and open only a few days in a week, but 90% of the contacts are managed by 8 large and 20 medium CCDs located in the most important towns. The whole CRM service of Hera is managed by Hera Comm, the commercial company of the group that is also responsible for the commercialization of gas and energy.

For Hera, the CRM service, and in particular the CCD network, represents an important advantage in such a competitive market for three main reasons: (i) such a widespread and highly-skilled service is normally not available to competitors who usually manage post-sales only through call centres or the web; (ii) Hera's residential and business customers are used to top-quality desk services within easy reach; and (iii) the quality of post-sales customer care is crucial in order to gain, and keep, customers' loyalty. The quality of service provided by Hera is regulated by Service Level Agreements (SLAs). The two most important SLA-related indicators are the Mean Waiting Time (MWT) of users at CCD and the percentage of users waiting more than 40 minutes (PW40). Hera's CRM service always ranked among the best in Italy, but improving such a high quality service in a fast expanding market requires relevant economic and human resources.

The main target for Hera in the CRM area was to enhance the quality of service of the system, and in particular that of CCDs, without increasing costs.

the need to foster innovation towards more powerful and automated prediction and optimization techniques became clear to Hera's management

After introducing in 2006-7 several procedural innovations (e.g., in CCDs layout, desk opening/closing rules, customer arrival forecasting and profiling, and desk staff training) based on office automation tools and written instructions, the need to foster innovation towards more powerful and automated prediction and optimization techniques became clear to Hera's management. As a consequence, a project was initiated in 2009 by Hera Comm for Optit to create an advanced Decision Support System (DSS), called SPRINT, for the complete management and optimization system for CCD staff to deliver customer services. Optit is a spinoff company of the University of Bologna that had been previously involved in several projects related to service optimization for the Hera group.

The main requisites established for SPRINT system design were twofold. First, to give the planners access to forecasting and optimization tools in a user-friendly environment that offers simple controlling tools to guide the system to the desired solutions. In addition, the system should achieve good integration in the chain of processes for the planning, management and control of CCDs. To this end, it must take into account the needs of central planners who, being in charge of large and medium-term planning and with control responsibility of the operational management, must have full access to all components of the system. SPRINT must also be helpful for desk managers, each responsible for the operational management of large and medium CCDs, who should have access just to the limited components required for the operational planning. The structure of the planning and management systems for CCDs at Hera is depicted in Figure 1. Figure 2 shows the central planning team during one of the meetings. Therefore, the functionalities of SPRINT are:  
• forecasting the arrival rate of users at the CCDs;
• determining optimized scheduling of the staff of each CCD by guaranteeing that target SLAs are met;
• performing "what-if" analyses for scenarios of long and short-term planning;
• monitoring the main Key Performance Indicators (KPIs) and objectives.

SPRINT was implemented in 2010 and has been fully operational since February 2011. It initially supported the central planning office and the eight larger CCDs. During 2012 the system was gradually extended to medium CCDs and now covers more than 85% of the demand of Desk CRM for Hera.

At the core of SPRINT there are effective forecasting and optimization modules which implement state-of-the-art approaches that compare favourably with other models described in existing literature.

The forecast module is based on a so-called M5-model tree that, by combining regression and classification, predicts the daily arrivals at each CCD for a time horizon of one or more months. The tree-structured regression is built from the assumption that functional dependency between input values and forecast is not constant in the whole domain, but can be considered as such in smaller subdomains. The partition of input domain and the corresponding linear models are derived automatically by the method that uses as input the historical data on arrivals and other relevant service demand drivers, such as information about the billing process. The experimental results obtained by such a model are extremely good. As shown in Figure 3, which reports the average results obtained in 2011-14, SPRINT’s forecast turned out to be 25% more accurate, in terms of mean absolute percentage deviation (MAPD), than competing methods used in the literature for long term forecast of arrivals at service desks, such as de-seasonalized historical averages. Moreover, the number of days with large errors in forecast (i.e., with MAPD > 30%) were also considerably reduced.

At the core of SPRINT there are effective forecasting and optimization modules which implement state-of-the-art approaches.

The other main SPRINT module is the Optimizer, which implements a two-phase approach incorporating an explicitly-tailored Integer Linear Programming algorithm as Schedule Generator which determines the scheduling for the staff by relaxing some SLA-related constraints and defines the staffing requiring by using an innovative adaptive rule that is designed and tuned for the scheduling of desk staff. The overall quality and feasibility of the schedules is determined through a custom simulation model. The two components interact in an iterative process that converges within a few seconds to the solution that meets the required service level with minimum use of the available staff for desk activities, thus maximizing the resources available for other duties, such as back-office or sales activities. The schedules produced by SPRINT are generally considered by planners as very consistent and efficient with respect to those created manually, and favourably compare with respect to competing methods from the literature.

The CCDs may include up to 20 counters and are open from 8am to 3pm of each weekday. The typical arrival rate of users at a CCD is given in Figure 4, which indicates that during peak time more than one

**FIGURE 2 A PERIODIC MEETING OF THE CENTRAL PLANNING UNIT AT HERA COMM**
user per minute enters the CCD. By considering that the average service time per user is well above 10 minutes it is clear that in some periods all available counters must be open to provide a timely service to the customers. On the other hand, in other periods an adequate service level can also be achieved when some counters are closed and the relative staff is detached for back-office duties. Such balancing between front-office and back-office duties for the counter staff is well illustrated by Figure 5, where a screenshot from the SPRINT console shows the daily plan for a large CCD. The green line represents the forecasted arrivals, the blue bar indicates the available staff in each 15 minutes time interval (note that it is halved during lunch break) and the red bar gives the number of open desks, hence that of staff employed in front-office duties. It can be clearly seen how the optimized openings and closing of desks (i.e., the red bars) try to anticipate arrivals peaks and keep some staff available for back-office for the longest possible time intervals.

The quantitative results obtained during more than four years’ use of SPRINT are excellent. From 2011 to 2013 the total service demand of Desk CRM at Hera Comm increased by more than 25% and the staff number remained almost unchanged, while previously, keeping the service quality constant generally required an increase in staff proportional to that of the demand. Furthermore, also thanks to the support provided by SPRINT’s algorithms, in the same period the mean waiting time for the customers was reduced from 16 to 10.3 minutes and the customer satisfaction index of desk CRM rose from 72 to 81 points. In addition, the backlog of back-office duties assigned to CCDs has been almost eliminated and the CCD staff was able to perform an intense proactive commercial activity during the time made available by the efficient front-office scheduling. During 2014 the achieved results confirmed those of the previous years. Moreover, in the same period Hera always ranked first among Italian utilities for the quality of CRM services.

Sandro Bosso, director of the Consumer Market Division at Hera

FIGURE 3 QUALITY OF THE FORECAST PROVIDE BY SPRINT AND THE COMPETING METHODS FROM THE SCIENTIFIC LITERATURE

FIGURE 4 TYPICAL ARRIVAL RATE DISTRIBUTION AT A LARGE CCD ON TWO DIFFERENT DAYS.
Comm, declared “SPRINT represents a perfect example of O.R. methods application in the real world. Its success was achieved by a good blend of high quality methodological support, strong managerial vision and state-of-the-art technological implementation. The achievements of the project will certainly boost the diffusion of OR not only within Hera but also in other Italian companies, as new performance standards are being set in this field.”

**SPRINT represents a perfect example of O.R. methods application in the real world**

The results obtained by SPRINT motivated several projects that introduced the use of advanced analytics in the domain of back-office activity planning and operations management.

Furthermore, after the first successful implementation in Hera, the main elements of SPRINT were incorporated by Optit into a software product that was adopted in 2012 by Gruppo Veritas, another multi-utility active in Northern Italy. In addition, a strategic version has been used extensively to support ENEL, the major Italian operator in the electricity market, in collaboration with SCS Azioneinnova, an Italian Management consulting firm.

For further details the reader is referred to:


Daniele Vigo is Full Professor in the Department of Electric, Electronic and Information Engineering at the University of Bologna, Italy. He has concentrated his research activities on the design and analysis of models and algorithms for Combinatorial Optimization problems arising in several application areas. He is a founder, and member of the management team, of Optit, an accredited spin-off company of the University, that produces decision support systems and provides consultancy based on state-of-the-art O.R. for the optimization of logistics, energy production and resources management.

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**SPOTLIGHT ON OR ESSENTIALS**

One of the newest books in the O.R. Essentials series, Mike Wright’s Operational Research Applied to Sports showcases how O.R. can be applied to sports including tennis, football and cricket, for: timetabling fixtures, scheduling officials, optimizing tactics, forecasting outcomes and measuring performance. It brings together some of the best research papers on O.R. and Sport from the journals of The OR Society.

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