# Workload: getting it to work

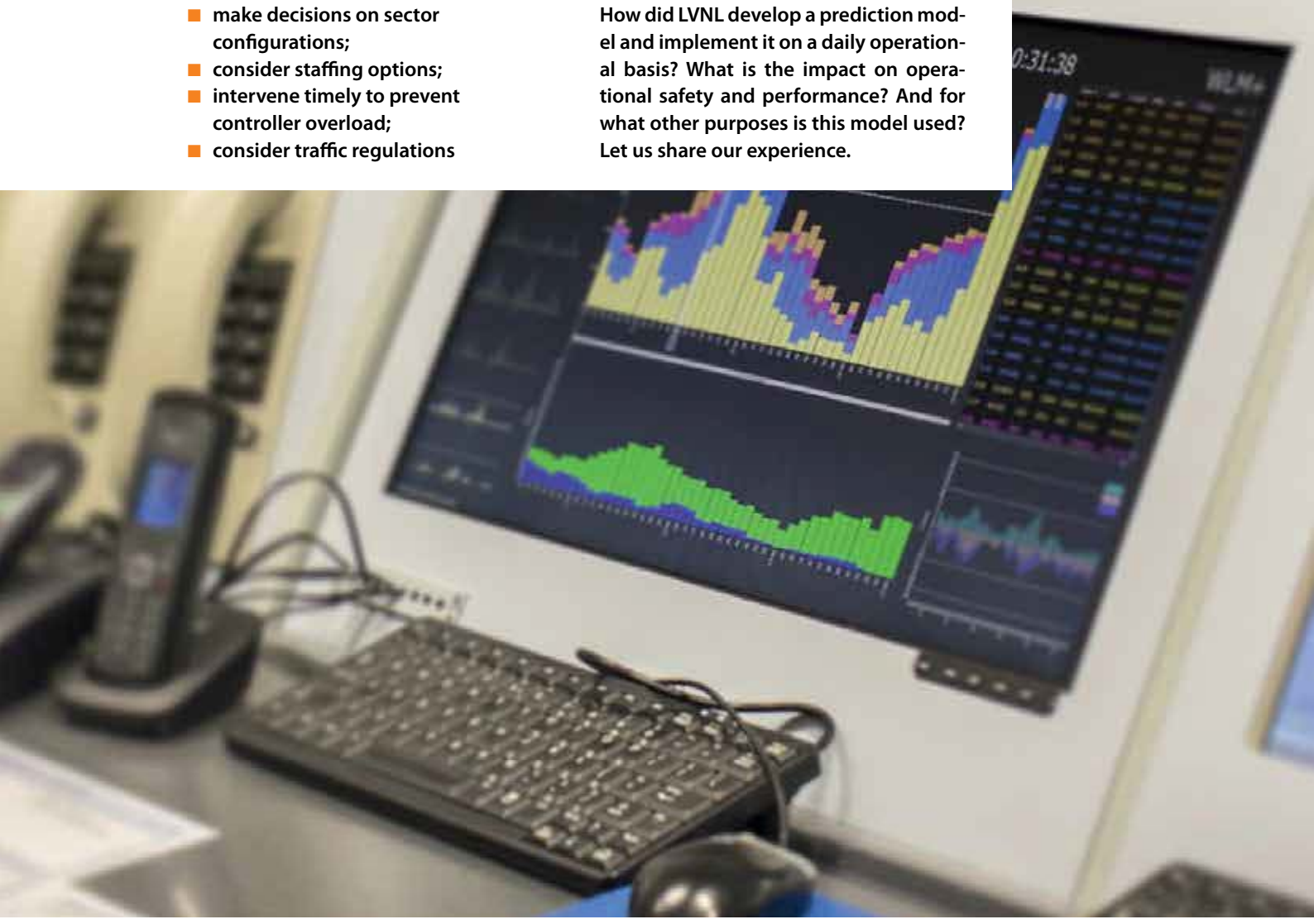
by Yoram Obbens and Rob Bezemer

On 16 March 2015, a system for predicting controller workload was introduced for Amsterdam ACC operations. Now, ACC supervisors have the ability to use workload data to:

- manage ACC operations;
- make decisions on sector configurations;
- consider staffing options;
- intervene timely to prevent controller overload;
- consider traffic regulations

This is a significant step in modelling and predicting of controller workload for Amsterdam ACC operations. It is part of a larger project that started within Luchtverkeersleiding Nederland (LVNL) almost a decade ago.

How did LVNL develop a prediction model and implement it on a daily operational basis? What is the impact on operational safety and performance? And for what other purposes is this model used? Let us share our experience.



## Workload: from past to present

Until 2005 LVNL relied mostly on the judgement of controllers to assess the impact on controller workload of major airspace changes and projects. Understanding of this impact is important for assessing the effect on sector capacities and assuring safe operations with adequate performance for the airlines. Although the use of expert judgement can be very valuable, it is subjective and can be inconsistent. Subsequently, the need has arisen to assess effects on controller workload for major airspace changes using a quantitative method.

**Strategic use first**

The development of a Workload Model (WLM) for Amsterdam ACC operations began in 2006 as a research project. In the early years, the model was developed and validated with operational data – various data sources were used for this purpose. Results showed that WLM performed better when predicting executive controller workload compared to other traffic count metrics like sector entries or occupancy.

Based on these results, WLM development accelerated in 2008 and 2009 and was used in major strategic airspace projects, for example the AMRUFRA project. Since then WLM has also been used in numerous airspace changes to assess the effects of temporary changes or special events like the 2012 London Olympic Games and the 2014 Nuclear Security Summit in the Netherlands.

**WLM for operations**

Traditionally, supervisors and FMP controllers use traffic counts to predict controller workload. However, during WLM development, the opportunity for operational use of the model was identified. To determine the usefulness of WLM in daily ACC operations, a separate project began in 2012. From non-operational trials conducted in that same year, it was concluded that the model could add value as a support tool for ACC supervisors and FMP controllers. Benefits identified include:

- **Sector management:** managing sectors, their configurations and staffing. With workload information readily available, situational awareness of ACC supervisors is improved. This information can further assist decision making regarding sector staffing, the opening of additional sectors or ad-hoc coordination of unexpected overload with adjacent centres. The result? Improved safety for ACC operations.

- **Flow management:** managing traffic flows within sectors by regulating traffic. Again, with workload information readily available, FMP controllers can make more accurate decisions on regulating traffic. The result? Achieving more efficient operations with less delay.

In 2014, efforts were made to develop the model as an operational system, developing standard procedures and training personnel and WLM for Amsterdam ACC was commissioned on March 16 2015. ▸▸


**Yoram Obbens**
has been a senior performance analyst for the Dutch ANSP LVNL since 2005. He holds a Master's degree in aerospace engineering from the Technical University of Delft and has been involved in the development of LVNL's workload model from the beginning.

**Rob Bezemer**
is a supervisor and executive controller at the LVNL Amsterdam Area Control Centre. He has over 25 years of operational experience and has been involved in the develop-ment of LVNL's workload model from the beginning.

Workload:
getting it to work (cont'd)

## The principles of WLM

A fully detailed description of LVNL's workload model would be too comprehensive for this article so here are the key principles of WLM:

**1. ATS route structure**
The ATS network and its relevant traffic flows within a specific ACC sector is one of the fundamentals of the WLM. Also, sector boundaries, available airspace and specific characteristics (e.g. sector balconies and delegated areas) are incorporated. This means that for each ACC sector, a list of relevant routes or traffic flows is defined. Traffic entering the sector is then allocated appropriately.

**2. Controller workload breakdown**
The workload of a controller is the result of:

- routine actions (e.g. standard handovers, check-ins or standard issued clearances), and
- actions required to manage potential conflicts (detection and resolution). For WLM these potential conflicts are called traffic interactions.

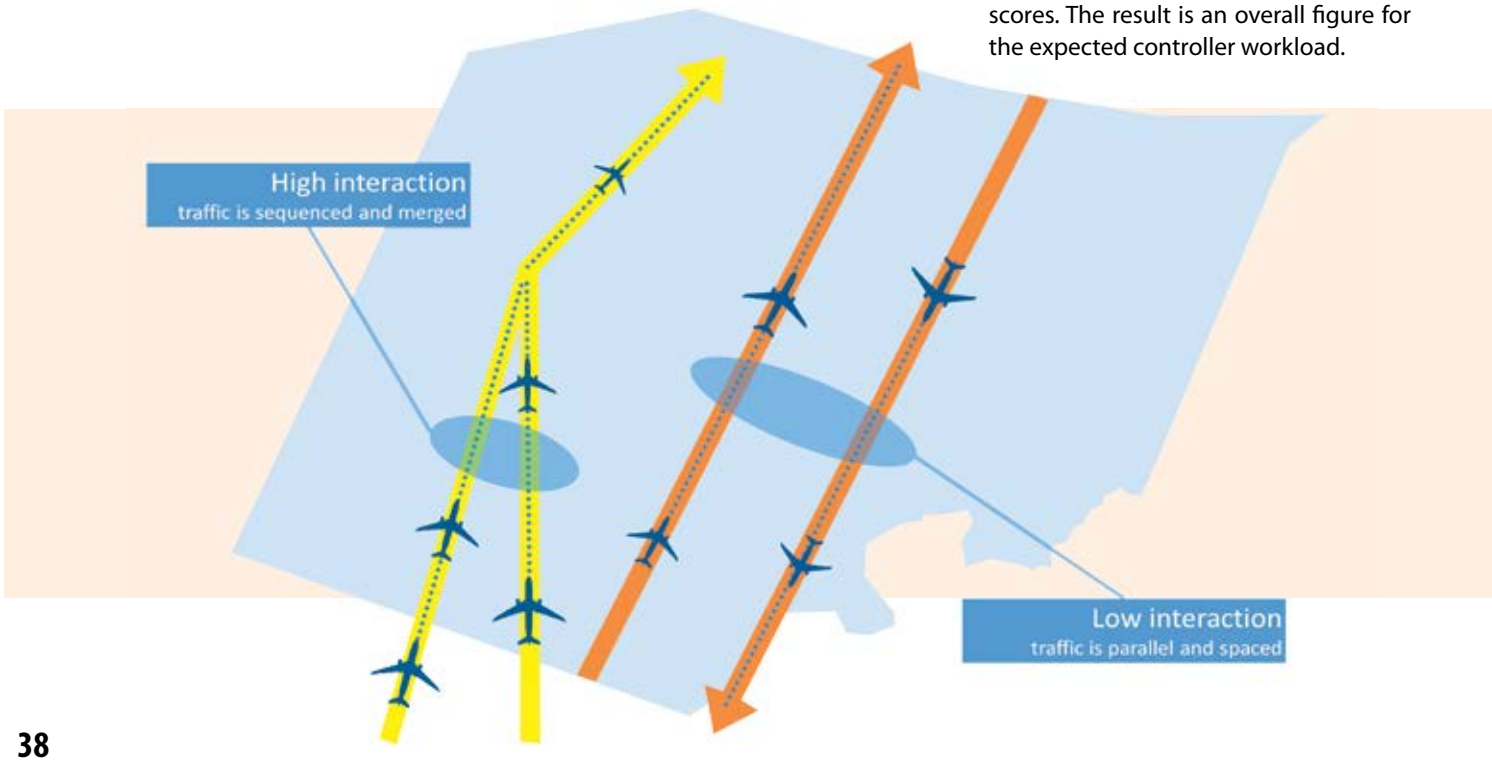
For each specific route or traffic flow it is established how demanding these routine tasks are. Routes with no specific procedures are less demanding whereas routes that require specific controller action to ensure adherence to procedures, are considered more complex. In addition, for each specific route and for each pair of routes, the intensity of the interactions is established by considering:

- the airspace available for manoeuvring;
- the geometry of routes and crossing points;
- the time available for conflict resolution.

For example, the interaction of traffic on two widely-spaced parallel routes is considered to be minimal and the potential for conflict is low. On the other hand, two traffic flows that have to merge at a certain defined point means increased interaction, given that the traffic is moving in the same direction and has similar flight profiles.

The level of intensity of traffic interactions and routine tasks is established by using weighted scores. These scores are fed into the WLM algorithm for calculating workload. A five-point scale is used ranging from zero (lowest weight) to four (maximum weight). Scores are determined by operational expertise. Guidelines describe the scoring criteria and provide examples to ensure consistency. An extract from these guidelines is shown below as an example.

**3. Time Blocks**
Traditionally, sector capacities are defined as the maximum allowable number of flights passing through a sector per hour. However, workload is not experienced per hour by controllers. Periods of high workload tend to occur in much smaller time frames. As a compromise between the two, 20 minute-time blocks are used in WLM. This means that the model takes into account all traffic that enters each sector during a period of 20 minutes. Each flight within this period is allocated to one of the predefined routes and the expected controller workload for the period is then calculated using the traffic distributed on routes and the previously-discussed weighted scores. The result is an overall figure for the expected controller workload.



| Traffic interaction within a route | Route limitations |
|---|---|
| 0 (minimum score) | ■ No significant lateral, vertical or time limitations |
| 1 | ■ Lateral limitation along the route;<br>■ Vertical limitation along route (temporary);<br>■ Ample time (flight distance) along a route to adhere to procedures and to manage conflicts. |
| 2 | ■ Lateral limitations along a part of the route;<br>■ Vertical limitations along route (available flight levels limited, <9);<br>■ Available time sufficient (flight distance) along a route to adhere to procedures and to manage conflicts. |
| 3 | ■ Lateral limitations along one side (distance < 10NM);<br>■ Vertical limitations along route (available flight levels limited, <6);<br>■ Available time limited (flight distance) along a route to adhere to procedures and to manage conflicts. |
| 4 (maximum score) | ■ Lateral limitations on both sides of route;<br>■ Vertical limitations along route (available flight levels very limited, <3);<br>■ Available time very limited (flight distance) along a route to adhere to procedures and to manage conflicts. |

**4. Workload threshold**

Defining a threshold for maximum controller workload is essential for obvious reasons. During the development of WLM, it was calibrated to establish threshold values for acceptable workload. R/T calls, instructions issued to aircraft and workload measurements with Instantaneous Self-Assessment (ISA) scores were used for this purpose. The result was the determination of an universal WLM threshold value for all sectors.

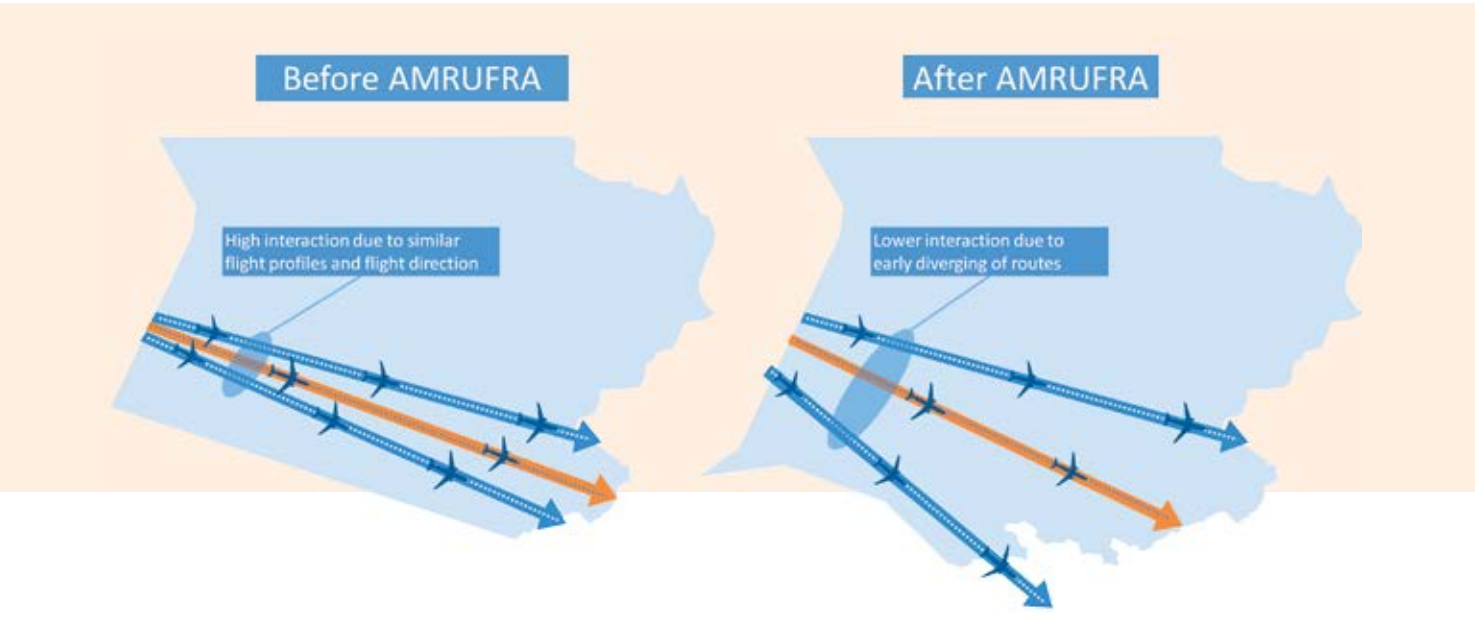
## Analysing changes: AMRUFRA

The AMRUFRA project implemented in 2009 provides a good illustration of the use of WLM in assessing the changes which will result from strategic airspace projects.

The most important changes in the AMRUFRA project (the parties involved being AM=Amsterdam, RU=Ruhr, FRA=Frankfurt) from the point of view of Amsterdam ACC were:

- the expansion of ACC Sector 2 (southern boundary displacement with military TMA-D);
- the introduction of a new outbound route via waypoints LUNIX-NAPRO-AMOSU to the (U) Z738 airway.

The implications for controller workload and sector capacity were analysed using WLM. Versions of the planned changes were input to the model – new routes were added, existing routes were re-evaluated, old routes were deleted and all weighted scores for routine tasks and traffic interaction were assessed. The next



## Workload: getting it to work (cont'd)

step was to benchmark the workload results of the finalised new sector design with the old sector design as a reference. The early divergence of Amsterdam departure routes and the increase in available airspace decreased the traffic interaction. Analysis showed that controller workload for handling Amsterdam departures and en-route traffic to EDDL/EDDK would decrease significantly. Based on these results it was decided to increase the capacity of ACC sector 2: the declared capacity of movements per hour for weekdays was increased from 36 to 38.

**Daily operations using WLM**

As noted earlier, WLM is now being used to actively assist ACC supervisors and FMP controllers in making daily operational decisions. Centrally-placed at the ACC supervisor´s working position, the WLM display provides relevant and timely access to controller workload information.

### System Overview

The WLM platform gives users different views of the expected controller workload and provides insight into traffic characteristics. It calculates and displays expected controller workload based on traffic information from Network Management by using flight plan data available via ETFMS.

The platform interface provides the following information:

- The expected workload for all elementary sectors and combinations of Amsterdam ACC is shown clearly on the *workload dashboard*. Supervisors can manage the activation of sectors in WLM and are alerted as soon as the calculated controller workload exceeds a pre-determined threshold.

- A specific sector can be selected and viewed in the *workload view*. This screen shows the projected workload for each 20 minute period. Colour indicators are used to represent the main traffic flows within Amsterdam ACC. Anticipated controller workload can be viewed up to 20 hours in advance, although the projection up to 4 hours ahead is more practical and accurate.

- Traffic counts for a sector can be viewed in the *traffic view*. This screen shows the number of flights entering the selected sector every 20 minutes.

- Detailed flight information can be shown in the flightlist. When selecting a specific 20-minute period in the *workload view or traffic view*, the corresponding flights are shown with detailed flight information and the individual contribution to the overall calculated controller workload.

**One small step for WLM…**

To familiarise operational users of WLM with the system and its use in their decision-making, a gradual introduction into daily operations was considered most appropriate.

As a first step, WLM information is being used for sector management at Amsterdam ACC. With this information, ACC supervisors have a better overview of expected controller workload. This provides them with key information for their decision-making on how to manage the ACC sectors which normally takes place between 10 and 60 minutes in advance. When managing sectors, the ACC supervisors first consider WLM information and they then combine this with other relevant information to make their decisions on sector opening schemes, staffing or coordination with adjacent centres in specific conditions.

The next step for operational use of WLM will be the introduction of capacity management which is scheduled for the second half of 2015. During this stage of implementation, FMP controllers will use WLM information for regulating traffic. With the availability of this information, it is expected that less traffic regulation will be necessary and that regulation will be more precise. This should lead to less delays and increased network performance.

**The future looks good**

Plans for future development of WLM at Amsterdam ACC includes enhanced features for detailed analysis, the development and incorporation into WLM of Short Term ATF Measures (or STAM) and the integration of the WLM-system with other operational systems so as to enable data-exchange (e.g. provision of WLM information at controller working positions).

Alongside this, the development of a workload model for Schiphol Approach and Ground Control has begun. Only the future will tell if a WLM will be useful for all Schiphol operations, but based on Amsterdam ACC experience alone, the prospects appear good!