

# NETWORK RAIL SIGNALLER'S WORKLOAD TOOLKIT

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Within the operational rail industry there has been a need to understand the concept of workload in relation to signallers. Research to develop a concept of workload in signalling suggested that workload is a multi-dimensional concept and therefore requires a number of different techniques in order to assess it in an operational context. To that end the Network Rail workload toolkit is made up of a number of different workload tools designed to measure different dimensions of workload including subjective perceptions, actual activities and elements of the work system. A combination of tools will always be used and the results are integrated in such a way as to present a 'workload profile' of an area of control. This paper outlines the work that has been undertaken to develop the toolkit and provides an overview of its application in field based assessments.

## Introduction

One of the most widely used and debated concepts in ergonomics is that of workload. The notion has found widespread acceptance as of value in assessing the impact of working arrangements, new tasks, and team sizes, in comparing the effects of different or job interface designs and in understanding the consequences of different levels of automation. However, workload is one of those seductive concepts that are so apparently meaningful to specialist and lay person alike, and which can be adapted to fit many contexts. This has resulted in a large number of (sometimes contradictory) viewpoints and theories on what workload is and how it should be measured. This was certainly the case in signalling in the rail industry where these multiple meanings have been the cause of great confusion. It highlighted the need for a clear understanding of what is embraced by the concept of workload before the most effective way of measuring it could be identified. A five phase project was undertaken involving: a literature review of the theory and existing tools; the development of a workload framework; development of a number of workload assessment tools; application of the workload tools in the field and workload tool evaluation. The outcome of this work was the Network Rail Signaller Workload Toolkit which consists of a number of different workload tools designed to measure different dimensions of workload including subjective perceptions, actual activities and elements of the work system. A combination of tools will always be used and the results are integrated in such a way as to present a 'workload profile' of an area of control.

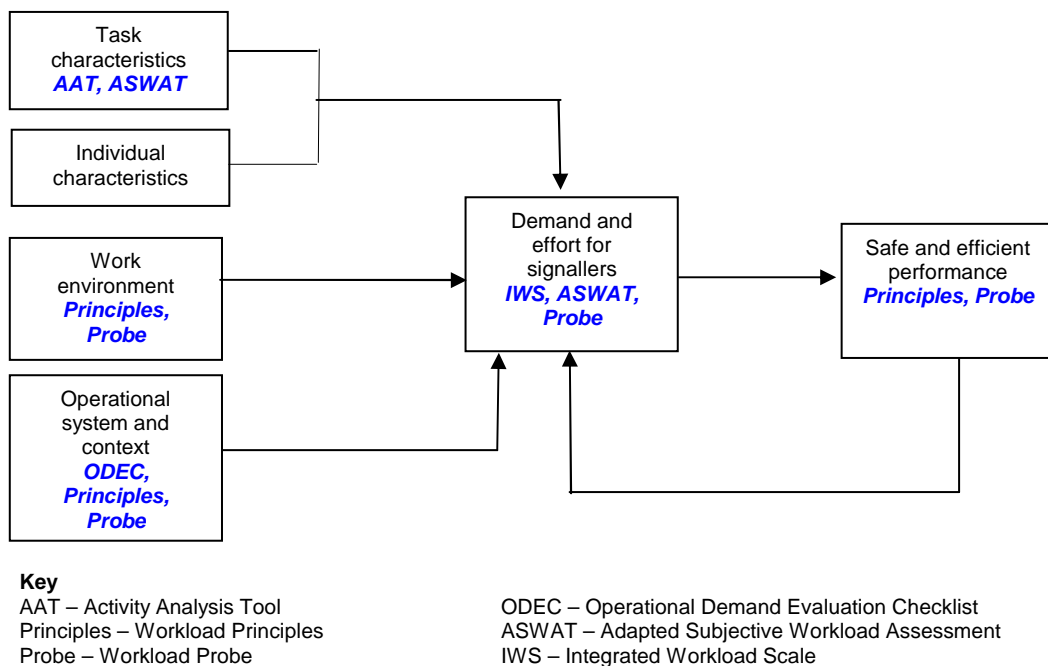
## Workload Framework

The literature review revealed that it is well established that workload is a multidimensional concept that can be considered as a combination of factors concerned with:

- the task – the number and combinations of tasks they have to complete
- the context – how and where they have to complete them and the urgency or accuracy necessary to ensure safety and organisational performance targets are met
- the individual – a signaller’s own skill, experience and perception of their work

Given that workload is a multi-dimensional concept it follows that a number of different techniques are required in order to assess it in an operational context.

A conceptual framework was developed (Pickup et al 2003) to help direct where assessment tools are required to assess the different dimensions of workload. A simplified version of this framework is shown in Figure 1 below. This is not necessarily an operational model but has been proposed in order to develop and position the toolkit of methods to understand and assess workload. Thus it is explanatory of routes to measurement rather than of the mechanisms by which workload is caused.



**Figure 1: Workload framework showing different assessment tools**

## The Network Rail Signaller Workload Toolkit

The Workload Toolkit is currently made up of six tools with an additional one, the Time and Pressure Evaluation tool (TAPE), still under development. Below is a description of the tools including details about the purpose of the tool and how it is used.

### *Workload Principles Tool*

The Workload Principles Tool provides an assessment of the work system in relation to the degree to which it meets a number of ergonomics principles. The rationale is that if a work system has been designed to meet generally accepted ergonomics principles then any mismatches between people's capabilities and their work are avoided and consequently workload is not increased. Therefore the tool works by assessing the extent to which the principles are met as an indication as to the impact workload is having on the signaller's ability to perform safely and efficiently.

Using the tool simply involves considering all the information obtained through observation or discussion with the signaller, or line manager, and identifying whether each principle is met. Through a paired comparison exercise some of the principles were identified as primary principles and essential for safety and performance. If they are not met then remedial action is required. The remaining (secondary) principles are desirable.

These principles have been found to be useful, meaningful and generally consistent with other observations made during a number of workload assessments of signal boxes. However, they do rely on the judgment of the investigator to state whether each principle is fulfilled or not. This judgment is only as good as the skill of the investigator and the quality of the information gained from signallers and their manager.

### *The Integrated Workload Assessment Tool (IWS)*

The IWS collects real time perceptions of signaller workload based on a nine-point scale. This tool can be used to identify peaks and troughs in the effort and demand experienced by signallers when responding to dynamically changing work conditions. If it is used in conjunction with video recording, subject matter expert commentary or the Activity Analysis Tool (AAT), it will assist in highlighting which combinations of tasks or situations are considered to produce high and low levels of effort and demand (workload).

The strength of the IWS lies in its ability to quickly and effectively provide data, which can be compared from minute to minute if necessary, from situation to situation or even between individuals. However, it does not differentiate between the different dimensions that are the essence of the multi-factorial concept of workload. One risk is that inappropriate interpretations are made from the data. This includes calculations of a 'mean IWS score'. This may not represent the dynamic nature or multiple dimensions of workload and misleading conclusions could potentially be drawn.

### *Task Activity Analysis Tool*

It is useful to be able to relate workload to activity. This can assist in assessing which activities or scenarios in signalling are more or less demanding than others. The Task Activity Analysis (TAA) tool involves observing and recording signaller's activities at certain times. It has proved to be very useful in providing estimates of time occupancy at key times. It is most effective when combined with workload scores from the Integrated Workload Scale (IWS), as described above, and/or with subject matter expert (SME) commentary, which can provide rich information regarding the nature of the work and the effectiveness and efficiency of the signaller including any compensatory strategies or deterioration in performance.

The main issue with the tool is that it cannot account for unobservable events such as mental processing, which may vary independent of the observable actions and events within the job.

#### *The Adapted Subjective Workload Assessment Technique (ASWAT),*

SWAT was developed in other industries but seemed to be generic in terms of workload dimensions. It includes dimensions that signallers suggested as representing their interpretation of the term workload. The tool provides a relatively quick and easy general comparison scale for signallers to assess three dimensions of workload retrospectively. It allows a comparison of signaller workload between two situations (e.g., change in timetable) or different times in the day over a work period of time. It also allows some degree of diagnosis about where the signaller's greatest demands or effort might be.

The original SWAT has been adapted in 2 main ways to facilitate use within the signalling context. Firstly the original SWAT has three dimensions - time load, mental effort and psychological stress load. Testing with signallers suggests that the 'stress' is inappropriate. The culture of signallers appears to view stress as a weakness; the term pressure was more frequently associated with workload and was suggested by signallers as a suitable alternative. Hence the Adapted SWAT refers to pressure rather than psychological stress load. Secondly, the original SWAT normally involves 2 stage scale development. However, using the SWAT scale by considering the dimensions as continuous and having equal weighting avoids the need for the first phase of scale development. This makes it easier to use in the field.

#### *Operational Demand Evaluation Checklist (ODEC)*

A signalling system or signalling workplace can be described in terms of a number of entities, which are constant (static characteristics, such as the number of signals or level crossings) or variable (dynamic characteristics, such as the number of unplanned or emergency possessions). All of these entities can influence the workload of a signaller. ODEC provides a systematic process to evaluate these entities within any one particular workstation, in order to represent the influence the overall system has on the signallers' workload.

ODEC can be used before employing any of the other workload tools, to understand and give context to the work of a signaller and it is increasingly being used in early predictions of potential workload within new or proposed signalling systems. It is applied to one work area at a time and requires objective, empirical data from a number of sources which are then categorised as either low, medium or high. This does not refer to workload per se, but to the extent that different entities are found in the target system or workstation as compared to other systems. That is, the scores are relative.

There are two main issues associated with this tool. Firstly, the implications of Automatic Route Setting (ARS) to signaller workload have yet to be understood and are not currently factored in. Secondly, when ODEC was first developed a final score could be obtained which was purely intended to represent the overall demand integrated across the ODEC ratings. However, field use suggested that there was a temptation to impose "redline limits" based on such scores, but without sufficient information on context or data on comparisons across sites. It was felt that such comparisons could be meaningless

and even dangerous. The single score was removed, leaving the more descriptive data - the percentage of high, medium and low categories - as the final ODEC output.

### *The Workload Probe*

The Workload Probe is an analytical interview based tool that explores workload issues considered to exist within the signaller's working environment. It is intended to identify how and where a mismatch exists in the signaller achieving their goals in the time available and the context of their workplace. This tool does not intend to provide a redline limit to judge a signaller's workload against. An interview is completed by a human factors specialist either with an individual or a group of signallers and aims to elicit information on positive and negative experiences that influence the signaller's workload. The interview involves general questions about their workload and then systematically asks the signaller to consider a number of loading factors that have been previously recognised as influencing signaller workload. This aims to understand how certain factors such as, signalling equipment and the timetable may come together to create a workload issue. A fishbone diagram with an exploration table is provided to facilitate the documentation of why signallers believe each loading factor influences their workload.

## **Developing a Workload Profile**

The workload profile is an overall view of the findings obtained from the tools. The choice of tools to build the profile will be dependent upon the questions being addressed by the workload assessment. For example, one common reason for a workload assessment is to assess the acceptability of an area of control for one signaller to manage. In such circumstances a combination of all six tools is usually most effective. However, assessing the impact on workload of an additional level crossing to the area of control, for example, may simply require a combination of ODEC, the TAA and the IWS to build up a profile. Understanding if the workload profile is acceptable is not a cut and dried decision but using a combination of tools to evaluate how compatible the working environment or context is in accommodating the signaller to achieve their work does offers a pragmatic approach to making that judgement.

## **Future Work**

The Workload Toolkit continues to evolve as experience is gained with its use. Specific improvements are being progressed for the ODEC tool so that it can capture information on the impact of automation and arrangements are being developed to ensure the results from the workload assessments are captured centrally to facilitate validation of the tools and so more reliable information and guidance can be given in respect of making judgements about workload acceptability.

## **References**

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