

into the terminal to be loaded onto a ship. Furthermore, it is clear that due consideration must be given to the movement of feeder and trans-shipment vessels which also account for a significant number of container movements.

The core of the solution is the real-time scheduling (RTS) system which gives the software its name. It became clear during the team's initial analysis of the problem that for a solution to provide the level of response and feedback required to add value it must take continuous updates from other port systems in real time.

The port of Valencia already had a control system tracking the movement of the containers in and out of the terminal.

Using pre-programmed logic, the RTS system keeps updating the picture in terms of what the most effective and efficient movements should be.

Scheduling problems are known for growing very quickly in terms of how difficult they are to solve with the number of movements that you have to actually plan. Efficient and effective scheduling of the thousands of movements that take place in and around a container terminal every day is notoriously difficult.

This is because the number of permutations and combinations that must be considered increases faster than exponentially with the number of movements. In principle, it would be ideal to consider every possible solution and pick the one that's most efficient but even with today's powerful computers this just isn't practical due to the time it would take.

The Flagship-RTS system gets round this problem by deliberately not considering every single combination, but only considering solutions that are likely to be efficient. By using an intelligent solution based on optimisation algorithms and guided by a set of rules it can come up with an optimised answer very quickly.

The rules have been developed using experience of the container terminal and logistics industry to mimic the decisions that would be made if the parameters

surrounding each individual movement could be isolated and considered separately. Pairing movements to reduce wasted lorry mileage and smoothing movements in and out of the terminal so they don't all happen at the same time of day are just two of the outcomes that the rules promote.

A further spin-off benefit of the Flagship-RTS approach is that it introduces data integrity checks, encouraging all parties involved to be more vigorous and disciplined in their capture and input of information. This enhances visibility across the supply chain and facilitates the management of complex datasets from multiple (third-party) sources.

In order to make their system accessible to terminal operators, the Flagship-RTS team designed their software to run on a standard server.

By developing effective and robust algorithms it was possible to reduce the amount of processing power required and ensure that the software could run on existing hardware without the need for investment in specialist computers.

The Flagship-RTS sub-project has been extremely successful and in trials at the port of Valencia it has been demonstrated that it can reduce wasted repositioning movements by up to 25% while saving 10-20% of transport costs through improved planning and faster response times.

The benefits to the terminal operation include less wasted activity and less congestion, with a smoother profile of movements during the day.

This facilitates increased capacity without the need to invest in major development or extensions to the terminal infrastructure. However, although already established as a commercially deployable solution, this scheduling and optimisation technology does not stand still: faster algorithms and more powerful user interface tools continue to be developed to enhance its scope and the benefits that can be achieved.

Katerina Kerr is a reporter on IFW and Julian Stephens is Technical Development Manager at MJC²

Scheduling problems are known for growing very quickly in terms of how difficult they are to solve with the number of movements that you have to actually plan