Container planning inspired by ants

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(PhysOrg.com) -- According to PhD student Albert Douma, of the University of Twente, Netherlands, it is possible to optimize the handling of inland container barges in the port of Rotterdam without management from the top. This is similar to the way in which ants organize themselves, without a central director. As a result of his 'multi-agent' approach, the time barges spend in the port can be reduced considerably.

Douma has developed a new method for the optimum planning of the rotation of a barge in the port: the barge loads or unloads containers at various terminals in the best possible order, that is, the order that gives the least delay. A central director would seem to be the most obvious solution here, but this is not usual because barge and terminal operators do not like to divulge competition-sensitive information. However, the present system of making appointments is vulnerable and entails a great deal of uncertainty with regard to waiting times. In a port that is becoming busier and busier, this can cause unnecessary waiting times.

Agents negotiate

Douma has therefore opted for a multi-agent approach that is similar to the 'self organization' in an ant colony. An agent is an intelligent software program that has a limited number of tasks, as does the ant: it has to negotiate to the best of its abilities for its client but otherwise has no overview of the greater whole. The barges and terminals each have one of these agents. Mr Douma has the agents negotiate with regard to the 'service time' or total waiting time and handling time at any given terminal.

Of the negotiation strategies examined, this service time profile gave the best planning results. The barge's agent asks for the service profiles of the terminals and can quickly determine the best order in which to visit the terminals. Subsequently the barge's and the terminal's agents agree on the times: the barge arrives before a certain time and the terminal promises to complete activities within a maximum service time.

Mr Douma says that simulations with the multi-agent approach in realistic port situations show that the method is able to considerably reduce the average time for which barges stay in the port. The total waiting time decreases, for example, because the barge operator will first try to make agreements with the terminal which seems to be causing a bottleneck; he uses the waiting time for that terminal efficiently by planning other terminals in that same period.

However, the system is not rigid: the 'service time' concept allows a certain amount of leeway so that it is still possible for terminals to fit in other barges if circumstances change. The research also included the development of a 'serious game', which was played in various workshops with port professionals. The game sessions enabled the refinement of the agent concept and discussions on the feasibility of putting the system into practice.

Albert Douma will be awarded his PhD on 9 December for his thesis 'Aligning the operations of barges and terminals through distributed planning'. He was supervised by Dr Peter Schuur and Prof. Jos van Hillegersberg.

Provided by University of Twente

https://phys.org/news/2008-12-ants.html