An integrated vessel schedule and aggregated cargo route recovery model

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of views in one success verdict. The proposed approach for the project success measurement is based on Multi-Criteria Analysis, which is utilized in order to estimate an additive value system according to selection criteria. A combination of the disaggregation - aggregation multi-criteria decision aid UTAC methods and the Multi-Objective Linear Programming Techniques are used in the project selection phase. In the second phase, a multi-criteria effectiveness map is suggested for the qualitatively pairwise composition of different perspectives. The effectiveness map utilizes a developed set of indices capturing the deviations from the initial strategic planning and a set of indifference thresholds aiding the decision maker with the final conclusions.

4 - The decentralized multi-mode resource investment problem: a multi-agent based project scheduling problem
Patrick Gerhards, Andreas Fink

In this talk, we propose an extension of the multi-mode resource investment problem (MRIP). The MRIP is a project scheduling problem with a fixed deadline and renewable and non-renewable resources. The amount of available resources is variable and each extra unit of resource is associated with resource costs. In addition, each activity of the project can be processed in one of several modes that determine the resource usage as well as the activity duration. The goal is to find a schedule and a mode assignment that minimizes the resource costs while respecting precedence relations, resource consumptions, and the deadline. In the decentralized version (DMRIP) of this problem, we assume that more than one party conducts a project. We call the subjects involved with the project agents. Each agent is responsible for some of the activities of the project. The agents have to reach an agreement on how global resources are shared (i.e. the costs of these resources as well as the usage of the resources in each period of the project horizon) and when the activities start and end. The aim is to find negotiation protocols that do not rely on providing sensitive information by the agents. Each agent aims to minimize her or his resource costs. We present a distributed schedule generation scheme and apply it in several negotiation protocols for this complex scheduling problem.

It is well recognized that ship speed is an important variable affecting fuel consumption and emissions, and that in ocean shipping average ship speeds, ceteris paribus, decrease with bunker price but increase with freight rates. Empirical data suggests that identical ships in the bulk cargo and tanker industry, travelling identical routes under identical economic conditions, still travel within a wide distribution of speeds. The reasons for this cannot be well understood from current speed optimization literature. The models developed in this article lead to increased understanding of how optimal speed decisions are dependent on the charter contract, which sets out conditions that determine the relevant future to the decision maker. A wide range of different ship speeds would then be observed as a consequence of deliberate choice, i.e. profit-maximizing behaviour.

3 - An integrated vessel schedule and aggregated cargo route recovery model.
Grzegorz Siekaniec, David Franz Koza, David Pisinger, Emil Sokoler

Despite a precisely established plan, disruptions are a reality in liner shipping. They are caused by unforeseen factors such as weather, port congestion, low terminal productivity, crane breakdowns etc. Disruptions vary in magnitude. Smaller disruptions, such as the temporary stop of a crane operations due to fog, often impacts only a single vessel. In contrast, the closure of a hub terminal as Algocarriers for two days due to rough weather in Gibraltar Straits has severe ripple effects that spread across the entire network. Recovery actions for such major events require rescheduling of multiple vessels, as well as cargo re-routing. Maersk, in cooperation with the Technical University of Denmark, is working on a decision support tool aimed at recovering operations after disruptions of different sizes in near real time. The tool uses an integrated approach that jointly optimizes vessel schedules and cargo routes. The objective is to minimize (a) operational cost, mainly vessel related such as fuel and port stays, and (b) impact on cargo delivery dates. The outcome is “cargo-friendly” revised vessel schedules that recovers operations within a fixed time horizon. The practical considerations and mathematical formulation of the model(s) will be presented together with preliminary computational results.

4 - Liner-Network Shipping Design with Autonomous vessels
Mohamed Kais Msakni, Kjetil Fagerholt, Elizabeth Lindstad, Frank Meisel

Maritime transportation is witnessing an interesting opportunity by introducing autonomous vessels. With no crew on-board, autonomous vessels can be built with no deck house and no crew facilities. An immediate impact is reduced operational costs and more shipped cargoes. However, despite the real benefits to the existing shipping mode, international regulations per today limit the introduction of fully autonomous vessels in international waters. Norway, as one of the largest shipping nation, is highly motivated by introducing autonomous vessels, and authorities are positive for using autonomous vessels. In this regard, we propose to study a liner-network shipping design problem to transport goods from the European continent to Norway, and vice versa. This problem aims to find the best network design by determining the optimal fleet of vessels (number and size), and the route of each vessel. According to the current regulations, we assume that the network is based on mother and daughter vessels. Conventional mother vessels sail on a main route that links the European continent to the main Norwegian ports, while autonomous daughter vessels have smaller capacities and are intended to transport cargoes from main ports to the ports located at the Norwegian coastline. In this study, an optimization model is developed to find cost-effective network routes and is applied to a case study to show the economic benefits of introducing autonomous vessels.