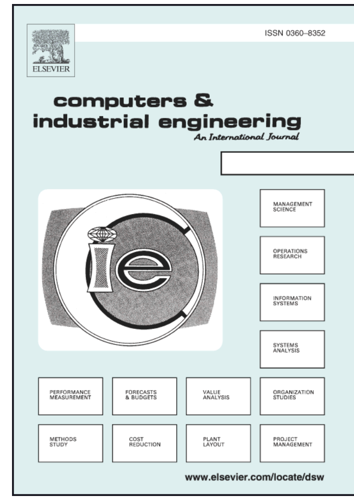
Accepted Manuscript



Collaborative Framework of an Intelligent Agent System for Efficient Logistics Transport Planning

Fan Feng, Yusong Pang, Gabriel Lodewijks, Wenfeng Li

PII: S0360-8352(16)30522-8
DOI: http://dx.doi.org/10.1016/j.cie.2016.12.044
Reference: CAIE 4596

To appear in: *Computers & Industrial Engineering*

Received Date: 15 March 2016
Revised Date: 5 October 2016
Accepted Date: 30 December 2016

Collaborative Framework of an Intelligent Agent System for Efficient Logistics Transport Planning

Abstract

In modern logistics chain, planning system which been applied for supporting daily operations, is becoming more information-intensive and technologically-dependent. Due to the growing operational complexities, the planning system is not only required to focus on ensuring the feasibility of daily plan, but also be capable of manipulating conflict of interest (COI) by exploiting efficient negotiation. This paper addresses a challenge of hinterland transport planning caused by limited information sharing, lack of collaboration and COI. We design collaboration and decision-making mechanisms for the implementation of autonomous control by means of multi agent technology and hybrid heuristics. It aims at providing quality plan to achieve high level of performance and robustness in hinterland logistics. From a system point of view, a service oriented architecture is proposed to integrate agent paradigm with a web-based planning system. From an operational point of view, special attentions are paid on establishing multi-dimensional collaborations between different stakeholders under the support of game theoretic approach. Specifically, we define how planning activities are executed, which level of collaborations are incorporated and how benefits are achieved with a global point of view. Due to the NP-hard nature of the addressed problem, an integrated NGSA-II and simulated annealing algorithm is implemented for assisting decision making. The parameters associated with the algorithm are tuned based on the Taguchi method. Case and comparative study will be presented to validate the appropriateness and performance of the approach.

Keywords: Collaborative planning, Agent system, Hinterland barge transport, NSGA-II, Simulated annealing

1. Introduction

In current logistics chain, the efficiency and effectiveness of transport plan system has a direct connection with the satisfaction level of logistics service. The overall system tends to be increasingly complex, dynamic and distributed which makes the process of Automating Transport Plan (ATP) a challenge task (Jiménez et al. (2012)). Conventional approach to ATP is optimization oriented by means of centralized control which aims at optimizing given objectives with the approaches from the field of operational research, includes VRP, TSP, flow job shop schedule and etc. The obtained solution primarily focuses on individual objective. In real logistics transport network, however, different entities (such as physical resources, human resources, business participants) are economically interconnected and physically distributed. It has proven to be difficult to integrate all information in any comprehensive way into an unified system (Prajogo and Olhager (2012)) due to the lack of alignment between different parties or stakeholders who posses different interests regarding the process. Therefore, it is a critical step to determine how participants with different interests could work together and what is the value of collaboration (Audy et al. (2012)). Confronted with the challenges, the concept of Collaborative Decision Making (CDM) has been put forward.

The concept of CDM incorporates the goal of working together in some mutually defined ways in which participants are actively sharing information and jointly making decisions in order to achieve global optimal solutions (Stadtler and Kilger (2007),Sun et al. (2012)). Recently, the use of CDM for supporting complex decision making has become popular in the domain of logistics and transport (Ramanathan (2014)). Sprenger and Mönch (2014) described a decision support system for cooperative transportation planning in the German food industry. The overall system was implemented with MAS which provides a distributed hierarchical algorithm for CDM. Hernández et al. (2014) proposed a multi-tier, negotiation-based MAS to promote the service and profit level of supply chain members by means of CDM. Panzarasa et al. (2002) presented a formal model for CDM in a multi-agent environment. They identified the conditions which the self-interested agent should full filled with to increase its cooperativeness towards joint decision making. Schuldt (2012) developed coordination mechanisms for the implementation of autonomous control in logistics with MAS technology. In summary, a stream of researches select MAS technology as the way for facilitating communication and information sharing in the process of CDM within logistics domain. It is demonstrated that MAS technology provides a design-and-implementation diagram for software solutions (Pang et al. (2013)) based on collective decision making in a community of autonomous, loosely coupled computational entities (Pechoucek et al. (2006)).

Agent technology has proven to be a sound tool for