International Journal of Innovative Computing, Information and Control
Volume **2**, Number **4**, August **2006**

ICIC International ©2006 ISSN 1349-4198
pp. 771–788

A MODELLING-OPTIMIZATION APPROACH FOR DISCRETE EVENT SYSTEMS USING THE (MAX,+) ALGEBRA AND GENETIC ALGORITHMS

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Received August 2005; revised February 2006

Abstract. *Discrete event systems (DES) involving only synchronization phenomena can be represented by linear models in some particular algebraic structures called dioids. The $(max, +)$ algebra is a dioid over which, these systems can be modelled by linear mathematical equations with special sum and product operations. The study of the DES over this algebra is usually made through the corresponding timed event graph (TEG). In this paper, we extend the study to DES that are subject to time-varying constraints. We enrich the existing TEG formalism to characterize these systems and propose a modelling and a just-in-time control policy. The proposed approach is illustrated with a supply chain system subject to non constant logistic demand. Then, we present a simulation-based optimization technique, which implements a genetic algorithm, to evaluate the proposed just-in-time control and the model performances while minimizing the supply chain costs.*
Keywords: Discrete event systems, Modelling, Timed event graph, (Max,+) algebra, Supply chain, Just-in-time control, Genetic algorithm.

1. **Introduction.** Like transport and production systems, supply chain systems (SC) are a typical example of discrete event dynamic systems. Supply chains are often subject to synchronization phenomena (products and transporter availability, etc). Moreover, the event behaviour of the demand, the production and the transport processes can be easily described using a timed event graph (TEG) that are a subclass of Petri nets.

In the recent SC literature, the proposed work often focuses either on the performance evaluation [20] or on the optimization. For the performance evaluation, some models based on Petri nets (PN) are proposed to study the material accumulation within a framework of a high-speed production [11] and the inventory management [3] or to deal with batches of goods with a given size [5]. Logistic systems have been also modelled using coloured Petri nets [1]. Although different models have been developed, very few papers deal with the supply chain control.

Moreover, a broad category of work in the operations research have been developed for the class of lot sizing and scheduling problems. Thus, the authors studied the economic lot delivery scheduling problem which deals with deterministic and continuous-time production [15]. Others developed a policy with equal and unequal sized shipments from a vendor to a buyer [17]. A dynamic programming model to select the load patterns for