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ABSTRACT

The paper describes main features of a strategy for managing complexity of the global market and real-time scheduling multi-agent system designed for the LEGO Company. The design is based on Multi-Agent Technology Group (MATech) own strategy blueprint and multi-agent platform, which provide real-time adaptive event-driven scheduling to replenish products to LEGO Branded Retail stores. The prototype system has been used to schedule 20 US-based LEGO retail outlets for a yearlong trial period and has achieved the following results: • Reduction of lost sale from 40% to 16%; • Increase in service level from 66% to 86%; • Increase in profitability 56% to 81%. The results show a considerable potential value for full scale LEGO supply chain multi-agent solution which would be able to dynamically and adaptively re-schedule deliveries in real time.

Keywords: Forecasting, LEGO, Multi-Agent Systems, Real-Time, Scheduling, Supply Chain

INTRODUCTION

LEGO is known worldwide for its famous LEGO bricks (LEGO web-site, 2012). In addition to supplying over 50,000 retailers worldwide, LEGO also has about 100 own branded retail outlets, which provide the LEGO brand experience. As this retail operation is built to provide a unique shopping experience for consumers, lost sales and service level are considered of paramount importance.

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Since the conception of the LEGO Brand Retail (LBR) outlets, the process of ordering stock to the retail outlets has been managed by the LEGO System, the organizational unit that purchases stock from the sole supplier. To create orders, the LBR inventory management team uses an in-house developed Visual Basic / Excel tool which is loaded with point-of-sales data summaries for the past four weeks of sale, inventory position and buying budget for each store. Based on this the LBR inventory management team creates orders for each outlet for each stock keeping unit (SKU), which are submitted to LEGO System.

As the molding process of LEGO bricks is of very high quality, constraints on the lead-time of molds for special plastic bricks propagate into product packaging and subsequently provide constraints on supply. As some products are more popular than others LEGO System has to make a decision on how to allocate the stock amongst its retail customers, and this also determines how large or small will be a share of LEGO Brand Retail.

In this paper we shall consider characteristics of the Internet-based global market within which LEGO System operates, key problems with the LEGO as-is business processes, a strategy for managing global market complexity for LEGO supply chain, the selection of technology for meeting the requirements specification, the architecture of the prototype solution, the results of the prototype evaluation using data from 20 US-based outlets, and, finally, the conclusion.

**LEGO AND THE INTERNET-BASED GLOBAL MARKET**

LEGO is a global business that sells LEGO bricks literally all over the world. The Company operates within the Global Market, which is characterized by a high level of complexity (Beinhocker, 2007) with prominent 7 key features (Rzevski, 2011):

1. **INTERACTION:** The Market consists of an exceedingly large number of participants, i.e., suppliers, consumers, service providers and service consumers, who make and change previously agreed deals with a high frequency thus generating disruptive events that affect all participants.
2. **AUTONOMY:** Global Market players have considerable autonomy, since they are not subject to a central control, which makes any prediction of demand and supply unreliable.
3. **EMERGENCE:** The global market behavior emerges from the interaction of market participants and is therefore unpredictable but not random – it follows discernable patterns.
4. **NONEQUILIBRIUM:** The Global Market operates far from equilibrium because the frequency of disruptive events is too high for the market to return to equilibrium between two consequent disruptions.
5. **NONLINEARITY:** The relations between market participants are nonlinear and even an insignificant disturbance may be occasionally amplified to cause an extreme event, such as a global financial crisis.
6. **SELF-ORGANIZATION:** The dynamics of the market is very high as it self-organizes in response to disruptive events.
7. **COEVOLUTION:** The Market irreversibly coevolves with political, social and technological systems.

The steep increase in complexity of the Internet based Global Market is a new phenomenon attributed to the genuine explosion of digital technology by the end of the 20th and beginning of the 21-st century. Our century has been recently described as the “age of complexity”.

Since complexity of the Global Market is increasing with time, the survival and prosperity of all Global Market players, including LEGO, depends on their capability to recognize the need and develop a Strategy for Managing Complexity. Multi-Agent Technology Ltd (MATech) has created a blueprint for such a strategy and is making it available to its customers, including LEGO.
10 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

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