

## **LEAN DESIGN AND ANALYSIS OF A MILK-RUN DELIVERY SYSTEM: CASE STUDY**

Ki-Hwan G. Bae  
Lee A. Evans  
Alan Summers

Department of Industrial Engineering  
University of Louisville  
J.B. Speed Building  
Louisville, KY 40292, USA

### **ABSTRACT**

Multiple discrete event simulation models are developed to represent a milk-run delivery system in an automobile emissions system production facility as part of a logistics system overhaul. The aim of this study is to analyze resupply configurations and variability in key model inputs in order to make recommendations based on supply train utilization and workstation starvation. This study includes three experiments that compare optimized routing, recommended routing, and on-demand resupply systems. Sensitivity analyses are conducted to measure the effects of various factors such as number of supply trains, travel speeds, and load and unload times to find the best combination of input parameters. The results of the proposed simulation models demonstrated potential impacts of a milk-run delivery framework on pull systems with limited transport capabilities, but diminished improvements on systems with multiple supply trains.

## **1 INTRODUCTION**

### **1.1 Background**

As the global leader in the production of emissions systems for automobiles, an automotive company develops and manufactures complete exhaust systems from hot end manifold to cold end tailpipes. The facility located in Louisville, Kentucky was selected as the future model production site for the North American division. To achieve this feat, the plant manager established a number of improvement objectives including an internal centralized delivery system known as a *supermarket*.

The logistics team was tasked to develop an internal centralized supermarket delivery system for raw material storage in order to support lean manufacturing. The term lean refers to the implementation of a focused factory design that facilitates grouped technology, balanced production cells according to customer takt time, execution of a pull system for final and preceding lines, and emphasis on one-at-a-time production. In order to support lean manufacturing, the management designed a milk-run delivery system within the facility, stabilizing the on-hand inventory. The corporate business group provided resources for the site to develop and implement an internal storage location for raw material components. The raw materials were initially stored externally, on-site, under industrial sized canopies, on 48 inch by 45 inch pallets used for delivery via forklift. This method turned out to be difficult to manage and existed as an unnecessary security risk to profit loss, a decades old problem identified by Ireson (1952) in early factory planning literature. Furthermore, the production cells were forced to hold excess raw materials on line, which impacted the amount of floor space required and the length of lead time for customer products as a























