Séminaire du CIRRELT

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« Theory and Practice of Lean Manufacturing Systems »

Short Abstract:

Lean Manufacturing and Lean Supply Chains are now recognized and widespread in industry. However, theoretical models that scientifically underscore and offer a framework for lean practice are scarce. Stochastic models of manufacturing systems and supply chains, underpin the practice of Lean.

In this seminar we will review a quantitative framework which relates the system parameters with the system performance in terms of lead time and throughput. This leads to an exogenous definition of Lean. We show that the ideal level of both idle capacity and work-in-process are determined by the Lean level wanted. Moreover, it is shown that it is a dynamic concept. This means that if the external conditions for the definition of Lean change, the idle capacity and the work-in-process level will change. The latter stresses the need for a comprehensive, analytical and consistent approach.

In industrial practice, the concept of Lean operations management is the hype of the new millennium. In academia, the Lean concept has received rather limited attention, based on the reproach that Lean did not offer much more on top of the traditional JIT body of knowledge, and hence should be qualified primarily as a philosophy without rigorous scientific foundations. This is only partly true. It is indeed true that the spectrum of lean management techniques is often rather descriptive, failing to offer analytical modelling and/or optimization tools that could guide managerial decision making.

In order to develop a quantitative approach to the Lean concept, we rely on stochastic models for flow systems.

(For more information see Long Abstract on https://www.cirrelt.ca)

Le vendredi 16 octobre 2009

14h00

Local 2327

Pavillon Palasis-Prince

Université Laval

Bienvenue à tous et à toutes!

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Abstract for
Research Seminar in the Annual Seminar Series of CIRRELT

Theory and Practice of Lean Manufacturing Systems

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Lean Manufacturing and Lean Supply Chains are now recognized and widespread in industry. However, theoretical models that scientifically underscore and offer a framework for lean practice are scarce. Stochastic models of manufacturing systems and supply chains, underpin the practice of Lean.

In this seminar we will review a quantitative framework which relates the system parameters with the system performance in terms of lead time and throughput. This leads to an exogenous definition of Lean. We show that the ideal level of both idle capacity and work-in-process are determined by the Lean level wanted. Moreover, it is shown that it is a dynamic concept. This means that if the external conditions for the definition of Lean change, the idle capacity and the work-in-process level will change. The latter stresses the need for a comprehensive, analytical and consistent approach.

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In order to develop a quantitative approach to the Lean concept, we rely on stochastic models for flow systems. Flow systems are systems where a set of resources is intended to perform operations on flows (see Vandaele and Lambrecht, 2003). All these systems share some common physical characteristics: on their routing through the system, flows visit resources in order to be processed, and hence consume (part of the) capacity of the resources. This competition for capacity causes congestion: flows may need to queue up in front of the resources. This congestion in turn inflates the lead time of a flow entity through the system.

These basic mechanics of a flow system imply that every decision related to the flow has consequences for the resource consumption over time. Vice versa, all resource-related decisions have an impact on the flow. Consequently, flow systems contain three fundamental decision dimensions: flows, resources and time. If a flow system, either a manufacturing system or a supply chain, is to be managed in an effective and efficient way, the management decisions must consider the flow, resource and time aspects simultaneously.

Important system performance measures are resource utilization, flow time, inventory, throughput and various forms of service level. Some of these (e.g. flow time and inventory) are flow oriented, while others (such as utilization and throughput) are resource oriented.

In order to maintain an acceptable performance in a stochastic environment, a flow system has to operate with buffers (Vandaele and De Boeck, 2003). Conform the three basic system dimensions mentioned above, three types of buffers may be used: inventory buffers (e.g. safety stocks, work-in-process,…), capacity buffers (spare capacity, temporary labour,…) and time buffers (safety time, synchronization buffers, …). Any particular combination of the three buffers leads eventually to a specific performance level.

In this view, a system is defined as “Lean” when the buffers present in the system are restricted to the minimum level necessary in order to support the target performance, which is referred to as the Lean level. Consequently, all buffering in excess of that necessary minimum can be considered as obese, in the meaning that there is too much buffering for the desired performance. This state of obesity can manifest itself into too much inventory, too much safety time or overcapacity. An obese system could reach its target performance with either smaller buffers, or a better allocation of buffers. If these excess buffers are systematically reduced while keeping up with the desired system performance, the systems gets leaner. However, excessive reduction of buffers will cause system performance to erode: the target performance will eventually become unachievable. In these situations, we characterize the system as anorectic. Note that the above definition of Lean is not static, as it depends both on the system characteristics and the targeted performance, which is pretty given the current economic downturn.

We will also give an overview of current research issues and future options.

References

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Vandaele, N. and Lambrecht, M. (2003), “*Reflections on Stochastic Manufacturing Models for Planning Decisions*”, Stochastic Modeling and Optimization of Manufacturing Systems and Supply Chains, edited by J.G. Shantikumar, David D. Yao and W. Henk M. Zijm, Kluwer, 2003, 53-86.

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Womack J. and Jones D. (1997), *Lean Thinking: Banish Waste and Create Wealth in Your Corporation,* London, Touchstone.