In today’s world, supply chains are facing market dynamics dominated by strong global competition, high labor costs, shorter product life cycles, and environmental regulations. Ripple effects that have a huge, negative impact on the behavior of the supply chain are called instabilities. They can produce oscillations in demand forecasts, inventory levels, and employment rates and, cause unpredictability in revenues and profits. To reduce these negative impacts, modern enterprise managers must be able to change policies and plans quickly when those consequences are detrimental.

This research proposes the development of a methodology that based on the concepts of asymptotic stability and accumulated deviations from equilibrium (ADE) convergence can be used to stabilize a great variety of supply chains at the aggregate levels of decision making that correspond to strategic and tactical decision levels. This methodology captures the dynamics of the supply chain by using system dynamics (SD) modeling. SD was chosen because it can capture the complex relationships, feedback processes, and multiple time delays that are typical of systems in which oscillations are a main attribute. If the behavior of the supply chain shows instability patterns, such as ripple effects, then the methodology solves a policy optimization problem to find a stabilization policy to remove instability or minimize its impact. The policy optimization problem relies upon a theorem that states ADE convergence of a particular state variable of the system, such as inventory for example, implies asymptotic stability for that variable.

The optimization algorithm combines the advantage of particle swarm optimization (PSO) to determine good regions of the search space with the advantage of local optimization to find quickly the optimal point within those regions. The local search uses a Powell hill-climbing algorithm as an improvement procedure over the solution obtained from the PSO algorithm that assures a fast convergence of the ADE. The experiments showed that solutions generated by this hybrid optimization algorithm were robust.

A framework built on the base of this methodology can contribute to the analysis of planning strategies to design robust supply chains that can effectively cope with significant changes and disturbances, with the corresponding cost savings to the companies.

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Approved for distribution by Dr. Luis Rabelo, Committee Chair, on February 8, 2010.

The public is welcome to attend.