Deploying buffering strategies in pork meat supply chains to deal with disruptions

Introduction: The COVID-19 pandemic caused significant disruptions across global supply chains, with the food sector, particularly the pork industry in the Netherlands, being heavily affected. The disruptions included sudden shifts in demand and resource availability, making it challenging for pork producers and processors to maintain continuous supply. This study aims to explore the deployment of buffering strategies to enhance the resilience of pork meat supply chains, focusing on the trade-offs involved in using frozen inventory during crises.

Background: Buffering strategies in supply chains involve balancing between producing to stock (MTS) and producing to order (MTO). These strategies are vital in maintaining supply chain functionality during disruptions. The Dutch pork industry faced substantial challenges during the COVID-19 pandemic due to operational shutdowns and fluctuating demand. The perishable nature of pork adds complexity to maintaining buffer stocks, making it essential to evaluate how different buffering strategies can mitigate these disruptions.

Objectives: The paper evaluates the effectiveness of buffering strategies in mitigating supply chain disruptions using a system dynamics approach. It focuses on the response of a major Dutch pork processor to COVID-19, examining how different buffering strategies impact supply chain resilience, cost-efficiency, and service levels.

Methodology: A system dynamics model was developed to simulate the behaviour of the pork meat supply chain under various disruption scenarios. The model incorporates data from semi-structured interviews with a major Dutch pork processor and secondary sources. Key variables and relationships were identified, leading to the construction of a causal loop diagram (CLD) and a stock and flow diagram (SFD). Three stress-testing scenarios were devised: normal seasonal demand variation, a hypothetical swine flu outbreak, and the COVID-19 pandemic.

Results: The system dynamics model highlighted significant trade-offs in decision-making regarding the use of the frozen inventory. The findings indicate that hybrid MTO/MTS strategies can enhance supply chain resilience, but their effectiveness varies depending on the nature and extent of the disruption. During periods of extreme demand fluctuation, such as those seen during the pandemic, the ability to quickly adjust production and inventory levels is critical. The model showed that maintaining high levels of frozen inventory can buffer against demand spikes, but it also introduces risks of devaluation and increased costs.

Discussion: The study underscores the importance of dynamic buffering strategies in managing supply chain disruptions. While frozen inventory can serve as a buffer against unexpected demand spikes, it also poses challenges such as increased holding costs and the risk of product devaluation over time. The findings suggest that a flexible approach, combining elements of MTO and MTS, can offer a more resilient solution. This approach allows supply chains to respond more effectively to both short-term disruptions and long-term demand variability. Moreover, the study highlights the need for supply chain managers to develop robust decision-making frameworks that can adapt to rapidly changing conditions, ensuring both efficiency and resilience.

Conclusion: Deploying buffering strategies in pork meat supply chains provides a viable approach to handling disruptions, especially those of significant magnitude like the COVID-19 pandemic. This study offers valuable insights into the complex trade-offs involved in balancing cost-efficiency and resilience. Hybrid MTO/MTS systems can be effective if well-managed, enabling supply chains to maintain service levels and reduce the impact of disruptions. The research emphasizes the need for continuous assessment and adaptation of buffering strategies to meet the evolving challenges of supply chain management. Future research should focus on the operationalization of these strategies in practice, exploring their applicability to other perishable food supply chains and different types of disruptions.