Sourcing-Production-Distribution Planning of Global Multi-Product Chemical Manufacturing Processes With Duty Drawback

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Over the years, the forces of globalization have evidently driven manufacturing companies to procure more raw materials and sell more finished products internationally. These transactions must invariably travel through a complex maze of heterogeneous international regulatory measures such as taxes, tariffs, customs, etc. In our previous work[1,2], we highlighted and demonstrated the importance of regulatory factors in supply chain management with a focus on the capacity expansion problem. Duty drawback is a key regulatory measure that involves full or partial refund of paid import duties, when the imported merchandise is destroyed, exported, or consumed as a raw material to produce an exported material. Most countries offer duty drawback incentives with the primary goal of assisting domestic manufacturers to compete in foreign markets. However, it is surprising that many manufacturers fail to even claim duty drawbacks, let alone accounting for duty drawbacks in their businesses. As a result, they fail to harness a significant cost saving opportunity despite (1) their extensive international trading activities, (2) widespread continual effort among manufacturing companies to reduce costs in their supply chains, and (3) history of duty drawback laws in some of these countries goes as far back as three centuries ago. In the U.S. alone, it was estimated that up to US$10 billion worth of duty drawbacks were not claimed by companies in 2001. The relevance of duty drawback in the world economy and its acceptance by the global community are clearly illustrated by the World Trade Organization (WTO) Agreement on Subsidies and Countervailing Measures. This agreement contains specific provisions that permit WTO members to offer duty drawbacks. In addition, the International Monetary Fund (IMF) has also recently recommended duty drawback favorably as one of the indirect tax incentives that developing nations should employ to attract foreign direct investments.

On the academic front, it is also astounding to note that only one production-distribution model[3] exists, which incorporates duty drawback computations. Moreover, this model has a couple of shortcomings that limit its application in the manufacturing industry. First, it was developed for the computer-maker companies that generally have single-product manufacturing operations. Since duty drawback computations for single-product and multi-product manufacturing operations are different, the aforementioned model is not applicable to all manufacturing companies, especially to chemical companies with their multi-product manufacturing processes. Second, the manufacturing drawbacks in their model are explicitly based on the total import and export quantities over the planning horizon and do not identify the linkages between the batches of imported materials and exported finished products. As such, their model solution does not offer direct details that are crucial for inventory management and duty drawback claims.

In this paper, we address a sourcing-production-distribution problem (SPDP) for a global supply chain network involving multi-product manufacturing processes as commonly

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found in the chemical industry. We define multi-product manufacturing operation explicitly as a manufacturing process that manufactures multiple products simultaneously. This is to be distinguished from manufacturing processes that manufacture multiple products sequentially. A normative SPDP for a supply chain network entails the determination of material sourcing plans, production plans of manufacturing facilities, and distribution plans of products across. SPDPs arise mainly because all manufacturing companies, including those in the chemical industry, are driven by the goal of meeting customer demands in a most profitable way. In the current intensely competitive economic era, sound sourcing-production-distribution planning is extremely crucial to the long term survival of many manufacturing companies. As indicated in our earlier work, supply chain models and solutions devoid of regulatory factors can be wholly misleading in this era of global trade. **Regulatory factors accompanied by complex legislative lingo, such as duty drawback, present unique and complex modeling and solution challenges**.

This paper addresses the neglect of duty drawbacks by industry practitioners and academicians in three ways. First, it creates a general awareness of duty drawback through the introduction of key definitions, concepts, and regulations related to duty drawback and elaboration of duty drawback's importance in supply chain management. Second, it presents a new linear programming (LP) model for a deterministic SPDP in the multi-product chemical industry, which incorporates three main regulatory factors, namely corporate taxes, import duties, and duty drawbacks to represent. Third, it discusses the distinguishing features of our new model and presents computational experience on a case study of industrial scale where the manufacturing processes concerned exhibit raw material flexibility with discrete number of production schemes. It also lists future research opportunities in this area, which would further enhance the application of our model in the general manufacturing industry.

References

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