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Reporting on Internationalization of Operations, GLOBOP: Design and Management of Global Supply Chains

Josefa Mula*

Research Centre on Production Management and Engineering (CIGIP), Polytechnic University of Valencia, Spain

***Corresponding author:** Josefa Mula, Research Centre on Production Management and Engineering (CIGIP), Polytechnic University of Valencia, Spain; Tel: 34966528423; E-mail: fmula@omp.upv.es

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Abstract

The research project entitled Design and Management of Global Supply Chains (GLOBOP) focuses on the specific model configuration stages with productive multi location and new productive implantations, which affect the design of productive and logistic systems, and the associated supplier network design. This research project aims to offer a methodological and technical solution for those companies that have begun an internationalization process in recent years (late movers).

Introduction

The need to accomplish international markets development with sophisticated, diverse customer requirements and, at the same time, to put into practice global purchasing strategies that exploit worldwide supplier market opportunities is influencing the way production and logistics networks have to be configured and managed. Fragmentation of productive processes and multilocation of activities have become relevant. This implies that the agents integrating the global supply chain (i.e., distributors, original equipment manufacturers, other manufacturers, suppliers and logistic operators, etc.) have to carry out new operations and supply strategies over national borders to reach optimal levels of quality, flexibility and costs.

The internationalization process is one of the most difficult decision-making processes as it implies numerous risks, mainly for SMES, whose resources are limited. The research project entitled Design and Management of Global Supply Chains (GLOBOP) focuses on the specific model configuration stages with productive multi location and new productive implantations, which affect the design of productive and logistic systems, and the associated supplier network design.

This research project aims to offer a methodological and technical solution for those companies that have begun an internationalization process in recent years (late movers). The general research project objectives are to: a) propose a methodology and associated techniques to analyze and design global networks with productive multilocation, and to design plants, warehouses and supplier networks in the new international contexts that imply contemplating all the economic, social and environmental factors.

The above-mentioned factors, which are not incorporated into the design, are generating delays in implantations, major costs, and even unsuccessful implementations or redesigns; b) develop conceptual models with associated working methods, simulation and optimization decision support tools, and implementation guides to facilitate the design and management of global supply chains; c) provide empirical research from the proposed models and tools.

Key Factors in Design and Management in Global Supply Chains

The design of a productive and logistics system must fall in line with the company's internationalization business strategy [1]. To this end, it is necessary to make productive and logistic decisions by managing resources and developing competences to accomplish market requirements. Critical decisions when dealing with the design and configuration of a global supply chain are the:

- Localization of supply sources (own and otherwise);
- Strategic role of plants, suppliers and warehouses;
- Integration or fragmentation of productive and logistic operations (production or purchasing decisions);
- Service delivery strategies (supply strategy, production strategy, and purchasing strategy
- Global operations network (distribution network, production network, supplier's network).

Productive and logistic designs must continuously undergo adaption and reconfiguration. Therefore, they must be designed to have the capacity to be modifiable in the near future to consider changes in products, variations in the mix of products, capable-flexible-adequate-efficient equipment and technologies, priority operational functions of installations-equipment-people, and contingent action protocols.

These factors and characteristics, which must be developed by global supply chains have been summarized as [2,3]: reactivity, scalability, rapid adjustment of existing systems and efficient production.

In today's economic crisis, characterized by a globalization context, poor demand and financial difficulty, the SMEs located in developed economies are seeking new productive implementations or reconfigurations in their productive and logistic networks to remain competitive.

The internationalization processes of both the business and operations supporting them have especially accelerated in order to cover markets in emerging economies [4]. These productive and

logistic strategies require a model configured with productive and/or distributed multilocation production, as well as organized direct and inverse logistic flows [5].

The processes and practice to improve and optimize the performance of a productive network have not been sufficiently analyzed [6], especially as far as new productive implementations, and constantly reconfiguring and adapting international manufacturing networks, are concerned [7]. Many SMEs and BUIGs (Business Units of Industrial Groups), which act locally and prosper, fail in foreign markets.

Change in markets means having to develop a new analytical framework from which international specialization is understood. The conventional business theory can offer analytical tools, but it is necessary to adapt them to new operations-based specialization conditions. Likewise, there is the need to reflect on the analytical framework from which new forms of SMEs' internationalization are interpreted. It is therefore necessary to use the distributed or multilocation production concept in supply chain design models; covering several objectives simultaneously; considering productive and logistic decisions together. Moreover, there is: the incorporation of tools into the analysis and design phase which allow robustness and security concepts to be incorporated into reconfigured production plants and supply chains; the provision of comprehensive, effective mathematical models to help management make suitable decisions on internationalization. Some relevant works on these matters are provided in the Table 1 below.

Reasons for internationalization	[8-12]	Access to production in low-cost countries; 2) productive units close to new markets; 3) fragmentation of the value chain and redesigning the value chain to gain an advantage in each plant and node individually, and to obtain the coordination synergies of this network; 4) creating new products and markets with the complete value of global activities, and using the capacities of companies in the production network. Production-purchasing economies of scale and investment returns, thus extending the life cycle of articles in other markets.
Internationalization phases	[13,7]	Sporadic exports; exports with independent agents and/or exports with own commercial delegations; implementing a shared productive unit (joint venture); implementing productive units. Some authors have added the need to continuously reconfigure and adapt the global production and manufacturing network.
Possible configurations for operations	[8]	For products in which a rapid response to consumers can significantly increase sales and sale prices, it is necessary to make attempts to carry out all the manufacturing phases as close to the customer as possible by trying to apply lean and mass customization principles. For products with greater sensitivity to price, but which also require a rapid response (seasonality or volatile demand), the design phase and productive process must be jointly located in a nearby area that offers the lowest shared costs. Commodity-type products with a high value-weight ratio, whose long-term demand can be foreseen, must be located in countries where labor is cheap, even beyond the sales area. Existing guidelines for global supply chains design and management are insufficient to help with design and to set up an internationalization process of operations.
Design models of supply chains	[11,14-16]	It is concluded that: (1) hybrid approaches are mainly adopted, which combine integer-mixed linear programming or Multiobjective integer-mixed linear programming with meta-heuristics; (2) first minimization of costs, or combined with other customers-based criteria; second, with other operations-based criteria, these being the main objectives; (3) more validated models with numerical examples are proposed than those with applications with real supply chains; (4) the main novel aspects of these works relate more with developing meta-heuristics algorithms than problems modeling; (5) the main identified limitations refer to the simple nature of the modeled problem (one stage, one source, one product or one planning period, among others). Other identified limitations include poor computational efficiency and uncertainties in parameters like demand not being considered.
Need for new analysis models and tools	[7,17,18]	Supply chain management researchers should produce comprehensive models or working frameworks of international manufacturing systems that help managers design and manage their networks. These working models/frameworks should bridge the gap between production systems (Toyota PS, Volvo PS, Bosch Siemens PS, etc.) and adjusted manufacturing programs (lean manufacturing), which lead to excellence when implemented into a plant with a stable setting. However, they are not advantageous in a dynamic market setting and in new international multilocation contexts, or for reconfiguring an existing network.
Shortcomings in SMEs	[19]	A Delphi study with 20 industrial managers showing that the working methods of SMEs lack the decisions made in the production networks design and analysis phase to achieve new scalable processes for production plant design, or to develop supplier's networks with a global purchases strategy.

Table 1: Relevant aspects of the internationalization of operations

Modeling Techniques and Solution

In specific terms, and based on the identification of requirements, this project will conceptually characterize and model operations design and management processes in global supply chains, which is the main objective of this project. [12,20,21] developed a conceptual model (GLOBOPE), which will act as a starting point for this research project. Analytical techniques, based on operational research, shall be employed in which linear programming, mixed-integer programming, and particularly Multiobjective mathematical programming, stand out to analytically model global supply chains based on conceptual modeling.

In order to formalize uncertainty, fuzzy mathematical programming techniques will be applied. On the one hand, they can be used to incorporate the epistemic uncertainty or lack of knowledge in input parameters into the analytical models or fuzziness in their objectives [22-24]. On the other hand, fuzzy optimization can be used as a solution technique for Multiobjective mathematical programming models [25-27].

Moreover, meta-heuristics will be most suitable to solve optimization problems with integrality constraints of the variables since they seek many solutions in parallel. Simulation models have been widely used in supply chains ([28-30]). This project will use

simulation to do what-if analyses to improve the developed analytical models and algorithms. Finally, the applications of the multiagent systems of [31-33] for validating the proposed models are highlighted.

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