A RESOURCE AND CAPABILITY-BASED GLOBAL MANUFACTURING STRATEGY

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Abstract

This paper is an attempt to systematize diversified strategic issues in global manufacturing. It focuses on technological resources and capabilities, and forward and backward supports of the manufacturing companies. With the increased competition in the marketplace, businesses are more function oriented and as such technological capability based strategy has got its prominence among the manufacturers. The study classified global manufacturing strategic issues into acquisitive, operative, innovative and supportive technological capabilities. It presents a comprehensive strategic model for global manufacturing showing interplay between technological resources and capabilities, and forward and backward supports. The model suggests manufacturers to consider resource and capability-based strategies in global manufacturing to be more competitive in their operation.

1. Introduction

As global competitiveness intensifies, companies get new products

into all major markets quickly and respond distinctively to these market needs. The dramatic advances in manufacturing technologies and organizational infrastructures all over the world demands a right manufacturing strategy that provides competency in their operations (Roth et.al. 1989). Moreover, the global economy that is rapidly evolving into an integrated system presents both opportunities and threats to global manufacturers. These new frontiers warrant the analysis of global manufacturing strategic issues for competitive survival. The critical problem of the global manufacturers is to initiate and operationalize a competitive strategy that would evolve the firm to meet the challenges in the global market (Scully 1993). Manufacturing being highly technology dependent, its implementation of strategy requires a strong foundation of technological resources and technological capabilities. The accumulation of resources and constant up-gradation of the capabilities would provide competitive strengths for manufacturers in global scale. But studies in this arena hardly linked strategies with the resources and capabilities of firms in an articulated way.

2. Strategic Issues in Global Manufacturing

Manufacturing is generally viewed as transformation process in a narrower perspective. "Install the latest technology" is the recurring theme among the manufacturers to attain competitive leverage. There are divergences in the emphasis on manufacturing strategies and its practices in different economic systems (Ettlie 1996). But the proper approach is to embrace the critical strategic issues and translate them into actions at all levels of management in a broader perspective (Leong and Ward 1995).

Essentially, manufacturing strategy comprises a set of well-coordinated objectives and action programs aimed at securing sustainable advantages over competitors. It deals with the importance of manufacturing in business strategy and guides manufacturing decisions at the functional level of the company. The global manufacturing strategy involves manufacturing operations spread among many countries. Leong and Ward (1995) suggested six Ps of manufacturing strategy that includes planning, proactiveness, pattern of actions, portfolio of manufacturing capabilities, programs for improvement, and performance measurement. These six Ps individually provides a distinct view, which is partially revealing about the strategic intentions and capabilities of global manufacturing. Roth (1989) emphasized on priorities of the set of action programs including flexibility, quality, delivery and price as global manufacturing strategies. Hayes and Wheelwright (1994) outlined quality, production planning, technology, and the work force in explaining global

manufacturing strategy. They categorized four stages of manufacturing strategy distinguishing orientations from global to general such as, internally neutral (production simply makes the product and ships it), externally neutral (manufacturing merely meets the standards set by competition), internally supportive (manufacturing attempts to become unique compared to its competitors), and externally supportive (manufacturing pursues uniqueness on a global scale, and becomes a world-class competitors). These four stages range from reactive (internally neutral or defensive strategy) to proactive (externally supportive or offensive strategy). The fourth stage illustrates the global manufacturing strategy.

Production-allocation approach is a tool for enterprises in planning their global manufacturing strategy (Vos 1991). The prime objective of this approach is to lower the transportation and manufacturing costs in the long run considering locations of the plants and the extent of vertical integration (forward and backward). Sweeney (1991) identified four types of generic manufacturing strategies such as, marketeer, caretaker, reorganizer and innovator which progressively increases its proactive intensity and leads to global manufacturing strategy (innovator strategy). The strategic issues discussed above are summarized and presented in the Table 1.

3. Resource and Capability-Based Global Manufacturing Strategy

A manufacturing strategy is defined as a statement of how manufacturing supports the overall business objectives through the appropriate design and utilization of manufacturing resources and capabilities (Joseph 1999). In the process of formulating it could be explained from matching dimension where strengths and weaknesses of the company are matched with opportunities and threats (Grant1991). Resources and capabilities provide a basis of intensity of strengths or competencies to global manufacturers to avail the opportunities and to overcome threats.

3.1 Technological Resource-Based Strategy

Technological resources enable manufacturers to generate above-normal rates of profit and sustainable competitive advantage (Mata et. al. 1995; Grant 1991; Dierickx and Cool 1989; Oliver 1997). Its value is determined in the interplay with scarcity, demand and appropriability and is traded in open market situation (Collis et. al. 1995). Few researchers have classified technological resources in strategic perspective. In manufacturing organizations it is classified into technoware, humanware, orgaware, and inforware (Sharif 1995, 1997; Ramanathan 1994). In this classification, technoware refers to the tangible and palpable part of the

Table 1 Strategic Issues in Global Manufacturing

Proponents	Strategic issues
Contractor and Loarange (1988), Nassimbeni (1998), Wildeman, L. (1998)	Global alliances and networks in global manufacturing include supply relationships, agreements and joint ventures, and regional industrial systems.
Roth et. al. (1989), Ferdows et. al. (1985), Young et.al (1992)	Global manufacturing strategies are characterized by the sets of strategic action programs that link with competitive priorities of flexibility, quality, delivery and price.
Toni et. al. (1992)	Integration and co-ordination of all activities in the value chain
Scully and Fawcett (1993)	Explores the vital linkage between global manufacturing and strategic advantage of logistics and production costs.
Hayes and Wheelwright (1994), Harrison (1998)	Four stages of manufacturing strategy ranging from reactive (internally neutral) to proactive (externally supportive). They are (i) *Internally neutral*. Production simply makes the product and ships it. (ii) *Externally neutral*. Manufacturing merely meets the standards set by competition. (iii) *Internally supportive*. Manufacturing attempts to become unique compared to its competitors. (iv) *Externally supportive*. Manufacturing pursues uniqueness on a global scale and becomes world-class competitors.
Leong and Ward (1995)	Global manufacturing strategy should be viewed from a broader perspective that includes six Ps: planning, proactiveness, pattern of actions, portfolio of manufacturing capabilities, programs for improvement, and performance measurement. Each P is offered as a distinct view, which is partially revealing about the strategic intentions and capabilities of manufacturing.
Vos (1991)	Emphasized on the locations of the plants and vertical integration (forward and backward) to reduce transportation and manufacturing costs in the long run.

machineries, humanware refers to human skills needed to realize the potential of technoware, orgaware refers to the support net of principles, practices and arrangements that govern the effective use of technoware by the humanware, and inforware refers to accumulated knowledge needed to realize the full potential of the technoware, humanware, and orgaware (Table 2). It is important to note that technological resources are function specific and as such, all the components are required to be present for manufacturing processes (Saha and Islam 1998).

Table 2 Technological Resources - Examples

Technological resources	Examples
Technoware	Tools and equipment (manual and powered), Machineries (general purpose or special purpose), Vehicles, Other facilities (automated, numerically controlled, computerized).
Humanware	Skills (ability to comprehend and use job related components, ability to mobilize, setup and utilize technology components for work, ability to optimize use of available technology components for all tasks), craftsmanship, expertise, dexterity, creativity (ability to undertake component innovation activities for better performance).
Orgaware	Techniques and methods (tradition-based work organization, education and experience-based work facilitation, systems analysis and optimization, reengineering and innovation) organizational networks, management practices.
Inforware	Facts and formulae (documented knowledge for acquisition and optimal performance), design parameters, specifications, manuals (operations and maintenance), theories (state-of-the-art knowledge for innovation).

Source: Sharif (1995)

3.2 Technological Capability-Based Strategy

Technological capabilities explain why firms are different, how they change over time and whether or not they are capable of remaining competitive (Patel and Pavitt 1997). It is the ability or skill of the firm at coordinating its resources and putting them to productive use that leads to achieving competency.

Technological capabilities are defined and classified by number of researchers (Appendix 1). The differences in opinions are observed among them. Since early 90's, emphasis has been put mainly on acquisitive, operative, innovative and supportive technological capabilities (Sharif 1993, Ramanathan 1994, Lall 1992). The capabilities represent various functions of a firm involved in manufacturing. The functions are in turn associated with manufacturing strategies. Hence, technological capabilities and manufacturing strategies are closely interrelated. The descriptions of four technological capabilities in brief are presented below:

1. *Operative capabilities* - Ability for operating and controlling plant and equipment, planning and controlling production activities, providing information support and networking for operations, maintaining the plant and equipment in good order.

2. *Acquisitive Capabilities* - Ability for carrying out detail engineering

study, independently searching for good technology sources, assessing technologies offered, deciding technology transfer mode, and negotiating terms of technology transfer.

3. *Innovative capabilities* - Ability for duplicating acquired technology, adopting and carrying out improvements in imported technology, carrying out own technology development plan.

4. *Supportive Capabilities* - Ability for undertaking project planning and execution, obtaining funds for prototype development and modernization, planning and implementing human resource development, identifying and developing new markets for the firm's existing and new products.

4. Linking Global Manufacturing Strategic Issues with Technological Capabilities

The prime basis of formulating global manufacturing strategy is technological capability. It has been focused differently in various researches and thus lacks an integrative understanding to the manufacturers. As such, strategic issues in global manufacturing are translated into functions that include acquisitive, operative, innovative and supportive activities. Through performing these activities it is convenient to implement manufacturing strategies at the global marketplace.

The linkages between global manufacturing strategic issues with technological capabilities are presented in Table 3. The strategic issues in global manufacturing are shown in left side of the table and the right depicts different functions performed by manufacturers. Integration and coordination of activities in value chain on global scale is performed through primary and supportive activities that are in practice acquisitive, operative, innovative and supportive in nature. Likewise, competitive priorities could be achieved by emphasizing on cost, delivery, quality, and flexibility. To achieve the performance four types of functions are essential for all global manufacturers.

5. A Strategic Model for Resource and Capability-Based Global Manufacturing

The core of the global manufacturing strategy is to achieve manufacturing competency in its operations. Resources and capabilities provide a basis to shape manufacturing strategies that eventually builds manufacturing competency. The interrelationships of global manufacturing competency with technological resources, technological capabilities, backward supports, and forward supports are shown in Figure 1. It comprises mainly of three parts. The main part depicts the global manufacturing competency influenced

Table 3 Linking Global Manufacturing Strategic Issues with Technological Capabilities

Strategic Issues		Capabilities			
		Acquisitive	Operative	Innovative	Supportive
Integration and Coordination of activities in Value Chain on Global Scale	Primary activities	Inbound logistics	Operations		outbound logistics, marketing & sales, after sale services
	Supportive activities			R&D function (Development of new product and process technologies)	Firm infrastructure (organizational structure, control system, and culture) , human resource management, material management
Competitive Priorities in Actions	Cost Efficiency	Global Sourcing, New production technology (buy)	Increase in Production rates, reduction of scraps and inventories	Redesign of products, New production technology (make)	
	Delivery		Faster production rates, quicker shipping methods, better control of production of orders		Better Information systems, Large finished goods inventories, More realistic promises

	Quality		Performance and function, after sales service, Wear and enduring ability	Product appearance	
	Flexibility	Increase in production capacity, Outsourcing	Ability to change in type of production process used		Reduction of amount of work in process through JIT, CAD/CAM
Competitive strategies (Six Ps of global manufacturing)	Planning				Assuring fit between manufacturing goals and actions
	Proactiveness (and acquire capabilities in advance of needs)	Anticipate and implement new manufacturing process and technologies			
	Pattern of actions	Acquiring process technology		Actions related to new product development	Facilities planning (Capacity, Location, and Layout), production planning and control, vertical integration, Manpower planning, Quality systems, Organizing

	Portfolio of manufacturing capabilities (Competitive strengths or capabilities possessed by the manufacturing functions)	Flexibility	Cost, quality, delivery performance, Flexibility	Cost, quality, Innovativeness	Delivery performance, Flexibility
	Programs for improvement				TQM, JIT, Group technology, Cross functional teamwork
	Performance measurement				Labor standard, Time study, Work sampling
Global Alliances and network (Synergy)	Supply relationship				Cooperative and/or competitive relationships for material flow
	Agreements and joint venture	Technological transfer relationship		R&D relationship	Marketing and Distribution relationship
	Regional industrial system (to create joint marketing initiative, technological efforts, and common service structure)				Building triangular linkage between firm, public institution, and industrial association

Production-allocation approach	Choice of new production location, relocation of production, and reallocation of production	Evaluating production location, scale of operations, vertical integration, and production technologies			Planning to shift existing production plant, planning for disinvestment, planning for changing manufacturing activities
	Degree of vertical integration	Backward integration			Forward integration
Generic Manufacturing strategy	Innovator strategy	Sourcing and procuring	Operate and control the production process	Activities related to improvising, conceiving, devising and patenting products	Marketing and servicing activities, using people for production, information sharing, planning and coordinating production operations, maintenance and trouble shooting.
Proactiveness	Externally supportive			Anticipate the potential of new manufacturing practices and technologies	Coordinating marketing and engineering activities, pursuing long range programs

by technological resources, technological capabilities and supports. Each technological capability is derived from use of all the technological resources. Technological resources and capabilities along with the backward and forward supports result manufacturing competency. The second part deals with the requirement of resources and capabilities for manufacturing and the last part focuses upon forward and backward manufacturing supports in terms of suppliers and customers. The components of the model and their interrelationship will result manufacturing competence at global scale.

With the help of this model, a unique chain of decision trees leading to optimal solutions could be set more conveniently. This would also shorten lead-time between strategic problem identification and its solution. Quality, for instance, is a competitive priority for a product. The solution lies within two technological capability areas – operative and innovative (Table 3). For operative capability, the manager can either choose to enhance the product performance ability and/or improve after-sales service for increasing longevity of the product. Under innovative capability, the manager can improve the product at the core level and at the external level. As such, to achieve this quality competency, the two required capabilities must be prioritized through use of all four technological resources along with forward and backward supports (Figure 1). Similarly, to be competent in primary activities, acquisitive, operative and supportive capabilities must be obtained while using the technological resources and interacting with the forward and backward supports.

6. Conclusions

Diversified strategic issues, in global manufacturing, demand a systematic and elaborated framework. This study grouped various strategic issues in global manufacturing into acquisitive, operative, innovative and

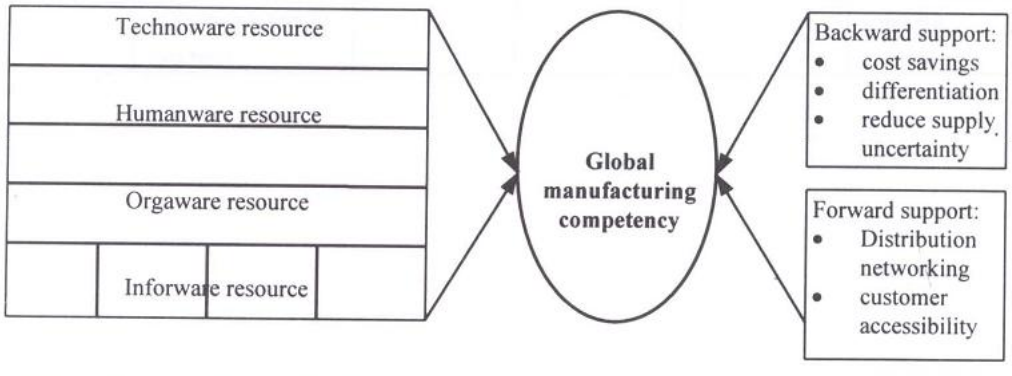

Figure 1 Strategic Model for Resource and Capability-Based Global Manufacturing

supportive technological capabilities. Technological capability is acquired through the use of all technological resources. For global competency in manufacturing, both technological resources and technological capabilities along with backward and forward supports are essential. However, this study does not include resources and capabilities other than technology and is based on survey of literature. There is ample scope for application of this model for manufacturers especially in the context of Asian economic and industrial scenario. With the opening of Asian markets to global players, the Asian companies could conceptualize this model and optimize their use of valuable resources for routine and innovative solutions. Such endeavor in turn may find new markets and customers. However, further research is necessary before the concepts discussed in this paper can be applied in practice with any precision.

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Appendix 1 Summary of Relevant Studies on Technological Capability

Proponents	Types of technological capability suggested					
	Acquisitive	Operative	Adaptive	Innovative	Supportive	Marketing
UNIDO (1968)	Ability to acquire technology	Ability to provide information support and networking for operations	Ability to adapt technology	Ability to carry out basic research and maintaining testing facilities	Ability to train manpower, provide information support and do networking	
Dore (1984)	Ability to search technology independently worldwide		Ability to undertake independent technology learning	Ability to create technology independently		
Bell (1984)	Ability to learn through searching, and learn procurement strategies from hired personnel	Ability to learn by operating	Ability to learn through performance feedback	Ability to learn by changing	Ability to learn through training	
Desai (1984)	Ability to purchase technology	Ability to operate plant	Ability to duplicate and expand	Ability to innovate		
Fransman (1984)	Ability to search alternative technology and selection of most appropriate ones	Ability to master technology through use during transformation input to output	Ability to adapt technology to suit specific production conditions	Ability to develop technology through minor innovation, major innovation, and basic research		
World Bank (1985)		Ability for production management, production engineering, repair and maintenance		Ability for creating and carrying out new technological possibilities	Ability for project management, project engineering and manpower training	Ability for marketing and production output
James (1988)	Ability for problem spotting, searching , selecting, and bargaining technology acquisition		Ability for modifying imported equipment and production	Ability for innovative alteration, design and organized R&D	Ability for transferring technology	

			procedure			
TDRI (1989)	Ability to search, assess, negotiate, procure, and transfer technology	Ability to use facilities in operation and control, to maintain, to manage operation	Ability to acquire knowledge, digest technology, and perform minor and major product modification	Ability to perform radical product modification		
Lall (1992)	Ability for local procurement of goods and services, information exchange with suppliers, search for technology source, negotiation of contracts, information systems, equipment procurement, detailed engineering, training and recruitment of skilled personnel	Ability for simple process engineering such as, debugging, balancing, quality control, preventive maintenance, assimilation of process technology, product engineering such as, assimilation of product design, minor adaptation to market needs, industrial engineering such as, work flow, scheduling, time and motion studies, inventory control	Ability for equipment stretching, process adaptation and cost saving, licensing new technology, product quality improvement, licensing and assimilating new imported product technology, monitoring productivity, improved coordination	Ability for basic process design, equipment design and supply, in-house process innovation, basic research, in-house product innovation	Ability for pre-feasibility and feasibility study, site selection and scheduling of investment, civil construction and ancillary services, equipment erection and commissioning	Ability for technology transfer of local suppliers coordinated design science and technology links, turn-key capability, cooperative R & D, licensing own technology to others
Sharif (1993)	Ability for upgrading all components of technology through searching, selecting, negotiating and arranging timely procurement	Ability for operation, monitoring and maintenance technology, components for transformation and other supporting		Ability for defining for market driven needs, developing new products, processes and techniques, building prototype and scale up models for testing, and arranging venture	Ability for commissioning all physical facilities, coordinating supply and demand, mobilization of all resources necessary for	

		activities		capital fund for implementation and innovations	transformation and support activities	
Ramanatha n (1993)	Ability for carrying out detail engineering study, independently searching for good technology sources, assessing technologies offered, deciding technology transfer mode and negotiating the terms of technology transfer	Ability for operating and controlling plant and equipment, planning and controlling activities, providing information support and networking for operations, maintaining the plant and equipment in good order		Ability for duplicating acquire technology, adapting and carrying out improvements in imported technology, carrying out own technology development plan	Ability for undertaking project planning and execution, obtaining funds and prototype development and modernization, planning and implementing human resource development, identifying and developing new markets for the firm's existing and new product	

Source: Panda, H. (1996), Technological Capability assessment of a Firm in the Electricity Sector, Doctoral Dissertation of Asian Institute of Technology, No. SM 96-3, p. 27-28