# TOWARD A CONTINGENCY THEORY FOR EXPLOITING KNOWLEDGE TO SUPPORT GENERIC COMPETITIVE STRATEGIES AND COMMONLY USED PRODUCT MARKET LINE-OF-BUSINESS STRATEGIES

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## ABSTRACT

*A longtime widely held belief in organization and systems design is "form should follow function" or "structure should follow strategy". The form or nature of the systems used to select, gather, organize, analyze, communicate, and manage knowledge should support or follow the competitive strategy of the organization. Michael Porter of Harvard University has posited three productive generic competitive strategies for firms to use with products in the market place: product differentiation, market focus, and cost leadership. Since 1969, Wickham Skinner, Robert Hayes and Steven Wheelwright of Harvard and Terry Hill of the University of London have published that production and operations strategies should be designed and implemented specifically to support the line-of-business strategy for a particular product or product family. It follows that knowledge needed to support particular competitive and/or line-of-business strategies should be identified and exploited in ways supportive to that particular strategy and particularly its corresponding operations strategy. This paper proposes a contingency theory for knowledge selection and gathering, information technology systems design, information technology application selection, and knowledge management based on the manufacturing strategies appropriate for each of commonly used competitive and/or product market line-of-business strategies.*

**Keywords:** Strategy, IT strategy, manufacturing strategy, operations strategy, IT alignment.

## INTRODUCTION

Information technology (IT), a competitive burden? As late as 1987 this question was being addressed in such highly esteemed academic journals as the Sloan Management Review (15). The events and technological developments of the succeeding decade or so have challenged business and IT executives to insure that IT systems and IT staff are at best strategic weapons and at worst strategy facilitators. Roth has clearly placed the hope of strategic success for firms in the 2000s in the hands of IT and its proper management. She identifies the competitive priority of the 2000s to be knowledge, the process criteria to be economies of knowledge/mass personalization, and the source of value added to be intelligent systems and communities of practice (13). The need for speedy fulfillment of customer demand has become so intense that Rosabeth Moss Kanter of the Harvard Business School has introduced the term “simultaneity” to describe both the customers’ desires for immediate service and/or product delivery and the parallelization, rapidity, and necessary integration of processes required to meet the customer demands (6). IT, being the fastest resource available to managers, must be exploited thoroughly to approach the “holy grail” of simultaneity. It logically follows that IT systems and the competitive strategy of the organization must be aligned in synergistic ways.

Both academicians and practitioners have thoroughly researched the need for alignment of the IT strategy with the business strategy of the organization. IT practitioners have always recognized the need to tailor IT systems to the "nature" of the organization and its business. However, the enormous demand for IT solutions coupled with the desire of IT suppliers to leverage their resources and achieve increasingly higher economies of scale led to the development of commodity IT systems that could hopefully be tweaked to many different business environments. Most times these commodity systems were force fit to the detriment of the organization or, at best, with limited success. In 1983, Pyburn was one of the earliest researchers to identify the need to link IT planning and strategic planning (12). The next year McFarlan, writing in the Harvard Business Review, was one of the first to identify how a firm could use IT to change the nature of competition to its favor (9). Writing in what has become an IT strategy benchmark issue of the IBM Systems Journal in 1993, Henderson and Venkatraman pointed out the static nature of earlier corporate strategy-IT strategy concepts and introduced the dynamic concept of strategic alignment of IT (4). They considered alignment from two different views, business strategy as the driver and IT strategy as the enabler or strategic weapon, and examined two perspectives within each of these two views. The emphasis on alignment of IT and business strategies has continued to grow over succeeding years. Rockart, Earl, and Moss identify the first of eight IT imperatives for competition as achieving two-way strategic alignment between the business and IT strategies - Use IT as a mechanism for creating opportunities and parrying threats as well as a facilitator of business strategy (11). Bruce offers variables for measuring the degree of alignment (1). A five-year 500 firm study by Luftman and Brier identifies enablers of the alignment process and the components of alignment (8). Most IT alignment research is focused on levels of planning above and including the line-of-business strategy and not on the functional or operational IT alignment strategies that must be formulated and executed to achieve the line-of-business strategy. The alignment research has been primarily directed at the strategy formulation process as opposed to the contents and contingencies of the strategy. Very little research addresses the contents and contingencies of a properly aligned functional IT strategy, such as a properly formulated marketing IT strategy, finance IT strategy, or operations IT strategy. There is a need to extend the idea of alignment of IT strategy and business strategy to aligning functional IT strategies with line-of-business strategy. The purpose of this paper is to begin exploration of the alignment of functional IT strategies with the line-of-business strategies - particularly aligning manufacturing IT strategy with the line-of-business strategy - and move toward a contingency theory for exploiting knowledge to support generic competitive strategies and commonly used product market line-of-business strategies.

## LINKING LINE-OF-BUSINESS STRATEGY AND MANUFACTURING STRATEGY

A longtime widely held belief in organization and systems design is form should follow function or structure should follow strategy. The form or nature of the systems used to select, gather, organize, analyze, communicate, and manage knowledge should support or follow the competitive strategy of the organization. Michael Porter of Harvard University has posited three productive generic competitive strategies for firms to use with products in the market place: product differentiation, market focus, and cost leadership (10). Robert Hayes and Steven Wheelwright of Harvard University have indicated the need for compatibility between the design and deployment of manufacturing operations and the position of the product in the product life

cycle, whether in the introductory, rapid growth, or maturity phase (3). Since 1969, Wickham Skinner (14) of Harvard and Terry Hill (5) of the University of London along with Hayes, Wheelwright, and others have published that production and operations strategies should be designed and implemented specifically to support the line-of-business strategy for a particular product or product family. It follows that knowledge needed to support particular competitive and/or line-of-business should be identified and exploited in ways supportive to that particular strategy and particularly its corresponding operations strategy. Figure 1 provides a summary of the relationships between phases of the product life cycle, generic line-of-business strategies (LOB), and manufacturing strategies (LOB-MFG).

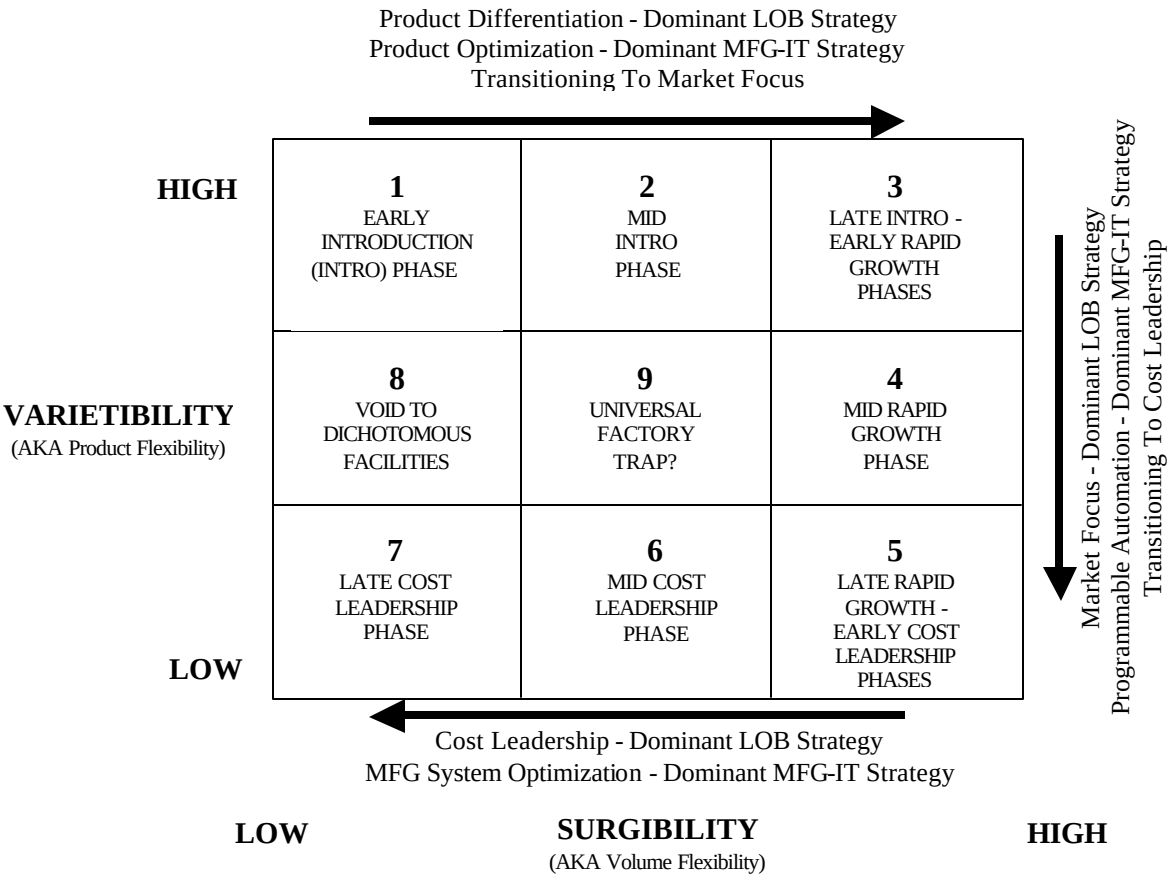
## LINKING MANUFACTURING STRATEGY AND IT SYSTEMS REQUIREMENTS

Bruce posits using value propositions to link business and IT strategies for each of Porter's generic line-of-business strategies but does not provide much detail as to the content or contingencies of the strategies (1). Grover and Malhotra offer a product-process-technology model for increased efficiency, flexibility, and innovation for further research (2). Kathuria, Anandarajan, and Igbaria provide a decision support systems approach for linking IT strategy and manufacturing strategy (7). The decision support system does not reveal its logic to the practitioner. Rather, it creates a dependency of the practitioner on the experts who design and maintain the decision support system (Kathuria). The purpose here is to try to begin to discover and reveal the logical links between the generic line-of-business strategies (LOB strategy), manufacturing strategies (LOB-MFG strategy), and IT strategies (MFG-IT strategy) which enable the manufacturing function to deliver what is required by the LOB strategy. Many variables such as flexibility, volume, technology, product complexity, process complexity, etc. have been suggested as determinants of the LOB- MFG strategy. Flexibility and volume have long been considered the primary variables for properly organizing manufacturing operations. Most of the other determinants can arguably be considered the outputs of the strategy not the inputs. The focus here is on flexibility and volume. Traditionally flexibility and volume were seen as almost mutually exclusive for constructing the best LOB-MFG strategy. The results were undesirable tradeoffs on product variety and/or volume. IT has made more flexibility available at higher volumes but the tradeoffs have just been moved to higher levels of flexibility and volume. Additionally, the focus has always been on increasing flexibility and volume simultaneously, not reducing them. The truly agile firm must be able to simultaneously change directions in flexibility and volume to meet the demands for mass customization/ personalization of the 2000s.

A more precise understanding of flexibility and volume is required to more clearly discuss the LOB, LOB-MFG, and MFG-IT strategies. The amount of flexibility demanded is determined by the amount of product variety demanded and the magnitude of change in volume demanded. Two new terms, varietibility and surgibility, are introduced to identify the components of flexibility. Varietibility is defined as the ability to differentiate or proliferate products. Surgibility is defined as the ability to deliver varying volumes of a product line. Varietibility can be either discrete, creating new products, or adaptive, reconfiguring existing products. Surgibility can be either scaleable, the ability to add more discrete increments of production capacity, or continuous, the ability to change the speed of existing production processes. Discrete varietibility demands scaleable surgibility and adaptive varietibility demands continuous surgibility. Figure 1

reveals the relationships between the product life cycle, the LOB strategy, the LOB-MFG strategy (varietibility, and surgibility), and the dominant MFG-IT strategy.

**Figure 1: Relationships Between the Product Life Cycle, LOB Strategy, MFG-LOB Strategy, and MFG-IT Strategy**




## EXPLOIT KNOWLEDGE TO ACHIEVE STRATEGIC RESULTS

Each cell in Figure 1 represents a different point in the life of a product and its accompanying market environment. The demands for flexibility, or varietibility and surgibility, are different in each cell. Therefore, each cell would have different MFG-IT strategy knowledge management requirements. Companies that introduce products and manage them through all phases of the product life cycle follow the path of cells 1-2-3-4-5-6-7. Knowledge management issues for only this path are addressed below. Other possible paths will be addressed in future research.

### Exploit Knowledge To Meet The Required Degree Of Flexibility In Operations.

High Varietibility - Increasing Surgibility LOB-MFG Strategy: The path segment cells 1-2-3 in Figure 1 reflects a constant demand for varietibility accompanied by a transition from low to high surgibility. Throughout this segment there is a tremendous need to manage product

knowledge to address market demand for variety. Initially the capability to completely redesign or design products for introduction, discrete varietibility, is foremost transitioning to adaptive varietibility in late introduction and early rapid growth. As the demand for surgibility to deliver higher volumes increases the need to collect and manage process knowledge becomes very important. Capturing skill and process knowledge and embodying it in software and systems is the most important knowledge management task for the High Varietibility - Increasing Surgibility LOB-MFG Strategy. High Surgibility-Declining Varietibility LOB-MFG Strategy: The path segment cells 3-4-5 reflects a constant demand for high surgibility to accommodate larger variations in volume accompanied by a transition from high to low varietibility. The collection and management of process knowledge is paramount during this segment to facilitate surgibility. The demand for surgibility transitions from scaleable to continuous as the product line is narrowed and operating ranges for volume are established. Product knowledge must be maintained and synthesized with process knowledge to facilitate the appropriate mix of varietibility and surgibility through programmable automation. Creating flexible manufacturing system (FMS) cells and deploying programmable automation are the most important knowledge management tasks of the High Surgibility - Declining Varietibility LOB-MFG Strategy. Low Varietibility - Declining Surgibility LOB-MFG Strategy: The path segment 5-6-7 reflects a constant low demand for varietibility. The demand for surgibility transitions from high to low and continues to become more and more continuous. Maintenance of both process and product knowledge are required to manage the operations in a manner that optimizes cost. The most important knowledge management tasks are to create and maintain simulation models of the system and monitoring and feedback systems to insure optimal performance for the Low Varietibility - Declining Surgibility LOB-MFG Strategy.

**Manage Knowledge To Support The Types Of Communication Required In The Environments Required By The Various Manufacturing Strategies.**

The High Varietibility - Increasing Surgibility LOB-MFG Strategy requires a negotiation style of communication to enable joint decisions between skilled labor, designers, and management regarding production and design for manufacturing. There is also a need to facilitate product teams. Email and Group Decision Support Systems (GDSS) coupled with easy access to customer, product, and process databases enable the free flow of knowledge and decision making. The High Surgibility-Declining Varietibility LOB-MFG Strategy requires a negotiation style of communication with people, but also requires communication with machines. In addition to Email and GDSS, machine/cell/robot control programs, FMS diagnostics, and computer delivered work instructions are required. The Low Varietibility - Declining Surgibility LOB-MFG Strategy requires directed communication to people and machines. Computer delivery of work instructions and schedules directly to workers and machines in the workplace is appropriate. GDSS should be provided for process improvement teams.

**Select and Manage Knowledge Appropriate to The Particular Manufacturing Strategy.**

The High Varietibility - Increasing Surgibility LOB-MFG Strategy requires the exploitation of skilled workers, engineers, and creative managers. Knowledge that needs to be available consists of employee skill proficiency, skill knowledge, process set-up knowledge, process operation knowledge, product knowledge, customer demand, and delivery due dates. The High Surgibility-

Declining Varietibility LOB-MFG Strategy requires the exploitation of IT, programmable automation, and IT savvy workers, engineers, and managers. Knowledge bases concerning product specifications, product routings, process capabilities, programmable automation capabilities and demand patterns must be created and maintained to facilitate FMS and robotic cell development, optimization, and operation. The Low Varietibility - Declining Surgibility LOB-MFG Strategy requires the exploitation of discipline to optimize manufacturing system performance. Process knowledge such as lubricant levels, temperatures, pressures, timing cycles, vibrations, etc. must be measured and the system controlled to maintain process discipline. Standard operating procedures, job designs, job instructions, and diagnostics must be created in the IT system and delivered by the IT system to insure disciplined decision-making.

**Deploy Knowledge Skills Appropriate To The Particular Operations Strategies.**

High Varietibility - Increasing Surgibility LOB-MFG Strategy: Worker skill, engineering creativity, and management creativity must be harnessed for this strategy. Decentralization of IT is the best architecture for achieving this result. IT expertise for CAD, CAE, virtual and/or rapid prototyping, database creation, development of DSS for scheduling, development of expert systems for operation set-ups and production planning, etc. are necessary knowledge skills for this strategy. High Surgibility-Declining Varietibility LOB-MFG Strategy: The collective knowledge of IT savvy workers, engineers, and managers is critical to this strategy. The principal IT skills required are CAM, CNC, robotics, networking, and FMS design, operation, troubleshooting, and optimization. A link to a mature CAD system is required to furnish product knowledge. Linked decentralized IT networks, each focused on one manufacturing cells is the appropriate IT architecture for this strategy. Low Varietibility - Declining Surgibility LOB-MFG Strategy: Optimization and discipline of the process (comprising people, machines, materials, data and IT systems) is essential to execute this strategy. As a result, centralized IT, either a mainframe or a fat server-thin client system, should be the dominant IT architecture for this strategy. Manufacturing system simulation, monitoring and feedback system development, text/document delivery systems development, database maintenance, and IT driven automation maintenance are the primary IT skills required. Accurate and stable product and process databases are essential.

## CONCLUSIONS

Prior business strategy-IT strategy alignment research and manufacturing strategy-IT strategy linking research is focused at high levels of abstraction. Therefore, the independent variables of strategy are necessarily, but somewhat ambiguously, aggregated into hopefully parsimonious proxies. As a result, prior research primarily addresses strategy formulation and not the content and contingencies of the strategy. While this prior research is very valuable, there is a need to drill down below these abstractions to more fully understand the content and contingencies of strategies necessary to meet the competitive future. This work has explored only two of these proxy variables, flexibility and volume. The variables, varietibility and surgibility, were introduced and explored to help move toward better understanding and a contingency theory for exploiting knowledge to support generic competitive strategies and commonly used product market line-of-business strategies. This exploration is not complete. Other variables - technology, product, process, and environmental complexity; uncertainty; and so forth. remain.

## REFERENCES


1. Bruce, Karin (1998). Can You Align IT with Business Strategy?, Strategy and leadership, (Nov/Dec), 16-21.

2. Grover, Varun and Manoj K. Malhotra (1999). A framework for Examining the Interface Between Operations and Information Systems: Implications for Research in the New Millennium, (Fall), 901-920.

3. Hayes, Robert and Steven Wheelwright (1979). Link Manufacturing Process and Product Life Cycle, Harvard Business Review, (57), 133-140.

4. Henderson, J. C. and N. Venkatraman (1993). Strategic Alignment: Leveraging Information Technology for Transforming Organizations, IBM Systems Journal, (v3n1), 4-16.

5. Hill, Terry J. (1994). Manufacturing Strategy – Text and Cases, Burr Ridge, IL, Richard D. Irwin, Inc.

6. Kanter, Rosabeth Moss (1998). Simultaniety, Forbes, (Nov 30), 219-220.

7. Kathuria, Ravi, Murugan Anandarajan, and Magid Igbaria (1999). Linking IT Applications with Manufacturing Strategy: An Intelligent Decision Support System Approach, Decision Science, (v39n4), 959-991.

8. Luftman Jerry, and Tom Brier (1999). Achieving and Sustaining Business-IT Alignment, California Management Review, (Fall), 109-122.

9. McFarlan, F. W. (1984). Information Technology changes the Way You Compete, Harvard Business Review, (62n3), 98-103.

10. Porter, M. E. (1980). Competitive Strategy, New York, Free Press.

11. Rockart, John F., Michael J. Earl, and Jeanne W. Ross (1996). Eight Imperatives for the New IT Organization, Sloan Management Review, (Fall), 43.

12. Pyburn, P. J. (1983). Linking the MIS Plan with Corporate Strategy: An Exploratory Study, MIS Quarterly, (7n2), 1-14.

13. Roth, Aleda V. (1996). Neo-Operations Strategy, Handbook of Technology Management, ed. G. H. Gaynor, New York, McGraw-Hill, 38.1-38.44.

14. Skinner, Wickham (1969). The Missing Link in Corporate Strategy, Harvard Business Review, (May-June), 136-145.

15. Warner, Timothy N. (1987). Information Technology as a Competitive Burden, Sloan Management Review, (Fall), 55-62.