CIM Strategy and Strategic Management: An MIS Perspective

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Abstract

This study provides an overview of Computer-Integrated Manufacturing in a conceptual and managerial context, and analyzes the organizational structure and managerial approaches required for successful CIM. CIM is considered as the (vertical) integration of computerized manufacturing systems at the shop floor with Management Information Systems, and as the (horizontal) integration of functional areas from design, manufacturing to business functions. This implies an integrated, company-wide, MIS approach toward CIM rather than a traditional and functional attitude. In this context, the organizational structure that "fits" CIM technology will be analyzed.

I. Introduction

Rapid changes in market conditions and competition as well as changes in information technology and manufacturing technology have contributed to the development of new approaches and strategies for designing business systems. At one time, information systems were regarded mainly as application developments to support operating and administrative activities. Efficient transaction processing and managing the paperwork explosion were of primary importance to an organization. However, in the new era of intensified competition, both international and domestic, information technology itself and productivity challenges have necessitated efficiency to save labor costs and, more broadly, to attain flexibility and timely responsiveness to the changing market conditions. Successful companies have been using information systems strategically to achieve competitive advantage. In other words, the primary focus of computer and information technology application has shifted from efficiency/process improvement to strategic/competitive uses.

Information systems are changing the way organizations compete, and they are altering the structure of entire industries. Today, the strategic use of information systems constitutes a major portion of their responsibilities. Organizations that have used their own good experience and expertise to effectively integrate corporate strategy, organization plans, and information systems have gained competitive advantage and market place success.

Metpath, a large clinical laboratory, has enhanced its customer service by installing computer terminals and linking them to its lab computers so that, for a small monthly fee, a physician can retrieve test results immediately. From a technical point of view, this is an on-line database application. Strategically, however, Metpath is consciously using this information system as a competitive weapon in two ways: 1) to build business against new and existing competitors by raising the information system ante; and 2) to gain advantage over other labs by differentiating an otherwise community service--it keeps records of patient data on file and offers financial processing services for billing and accounts payable applications. This differentiation is intended to secure the loyalty of physicians who would normally have a tendency to switch from lab to lab in search of lower costs. American Hospital Supply, the first to install on-line order entry terminals in hospitals, gained advantage by locking-in its customers (Rackoff, et al., 1985). Merrill Lynch, with its cash management account dependent on database and laser printer technology, preempted the market with its innovative product. American and United Airlines, through their computerized reservation systems, Saber and Apollo, established an edge that other air carriers have found impossible to overcome.

The significance of these computer-based information systems does not lie in their technological sophistication nor in the format of the reports they produce. Rather, they have led the way in their firm's quest for competitive advantage. These cases are instances of strategic information systems, used to support or shape an organization's competitive strategy, its plan for gaining and/or maintaining advantage. U.S. corporations are increasingly interested in managing the strategy-technology connection to develop new ways of achieving competitive advantage. They have attempted to link manufacturing strategy with business strategy, to examine the strategic impact of rapidly changing manufacturing and information technology, and to find new ways of viewing manufacturing as a competitive weapon.

Computer-Integrated Manufacturing (CIM) has recently surfaced as a new strategy in this process; it integrates computerized manufacturing and information technology, potentially a strategic solution for U.S. corporations to achieve competitive advantage. Although the dream of CIM seems so attractive, for the most part it has not yet materialized and the full utilization of CIM has not been realized anywhere in the world (Teicholz & Orr, 1987). The factories of only about two dozen U.S. firms even come close to the goal of total automation, even though the technology has been in place for several years.

The purpose of this study is to provide an overview of CIM and its component technologies in a conceptual and managerial context rather than technical, and to analyze the organizational environment and managerial approaches required for successful CIM. CIM is considered the integration of computerized manufacturing systems (CMS) at the shop-floor level and Management Information Systems (MIS), (CIM = CMS + MIS). This implies an integrated, company-wide, MIS approach toward CIM rather than a traditional, disintegrated, and functional attitude. This study, therefore, recognizes the key role of top management in planning, selecting, justifying, implementing, and managing a CIM system. The organizational structure that "fits" CIM technology is addressed.

II. What is CIM

The years since 1960 have seen a long list of manufacturing application developments and approaches identified as key solutions to problems existing in various manufacturing industries. Applications of classification and coding, and group technology systems emerged in 1970 which greatly improved batch manufacturing efficiencies by taking advantage of underlying part similarities, and by defining the most practical cost-effective methods for producing each and every part.

Computer-Aided Design (CAD) was developed in 1970, which automates design work (reducing design time), performs drafting and revisions, stores key specifications, and presents the simulation of a mechanism's parts. Computer-Aided Manufacturing (CAM) systems developed to aid in the manufacturing process are integrated with CAD. Material Requirements Planning (MRP), designed in the 1970s as a method to handle the ordering of dependent demand items, takes the customer order and back orders and converts them into a schedule of raw materials, parts, and subassemblies needed to produce the finished goods. MRP later evolved into a full-fledged manufacturing information system involving production requirements and feedback from the shop floor (Commerce, 1985). Manufacturing Resource Planning System (MRPII) was later developed as an enhancement of MRP which includes other production resources such as labor and equipment and is based on a dynamic simulation model of the manufacturing environment (Cox & Adams, 1980). This led to considerable reductions in inventory levels as well as providing improved customer service. It gave management the ability to anticipate material shortages as well as capacity "bottlenecks," and it gave marketing personnel accurate information on what was available (Dicasali, 1984).

Just-In-Time (JIT) philosophy has received attention for the significant benefits it has provided in productivity, quality, and inventory. JIT, stock less, or zero inventory concept--known as the core of Japan's productivity improvement in repetitive manufacturing--was firmly in place in numerous Japanese plants by 1970. It was implemented by some U.S. companies in 1980. JIT implied that engineering, accounting, sales and marketing departments must work together to produce the highest quality product at the lowest possible cost. This computer-based information system informed each process about what kind of parts, when, and how many to produce. Successful implementation of JIT, led to reduction in space requirements, inventory investment, and manufacturing lead time. It raised productivity, lowered cost, and increased flexibility and responsiveness to market changes.

However, computer technology in all these situations has been developed and adopted based on short-term, and measurable benefits. In many cases, the whole idea of automating was laborsaving efficiency. Because of technological factors as well as organizational infrastructure, the managerial attitude toward exploring technology has been functional or departmental rather than company-wide and long-run. The resultant "islands of automation," in which individual processes are automated without concern for comparability with one another, have limited flexibility because of limited information-sharing capability. Management responsible for corporate finance, purchasing, engineering and marketing clamored for timely and accurate information. While much of the information revolution taking place on the shop floor was of real value to other areas of the company, one very vital ingredient was lacking: there were no links to tie one area to another--marketing to order management, to engineering, to purchasing, to production, to finance, and back again. A solution was needed that would tie these elements together, integrating them in a way that allowed key functions of each area to communicate immediately and automatically with one another.

CIM is the term used to describe the complete automation of a factory, with all processes functioning under computer control and digital information tying them together (Teicholz & Orr, 1987). It is defined as a technology which integrates the design, manufacturing, and business functions in production/operations management. The cornerstone of CIM is the complete integration of all functional areas in the company into an interactive computer system.

However, CIM has been viewed and interpreted differently by people with different backgrounds and context. There has been a tendency in the past to consider CIM as a purely technological challenge in meeting short-term goals and as a quick payback solution. In this approach, CIM is viewed as the most advanced manufacturing technology known today (Barash, 1980) or as the use of database and communication technologies to integrate the design, manufacturing, and business functions that comprise the automated segment of the facility (Teicholz & Orr, 1987). CIM is also defined as the integration of CAD/CAM and production management (Taylor, 1980), encompassing all activities from planning and design of a product through its manufacture and shipping (Sadowski, 1984).

Based on the much experience in implementing the integration of advanced architecture, it has become clear and well recognized that adopting integration is not just a technical problem associated with linking different computer-based technologies. More importantly, it is a management issue that addresses the integration of diverse information processing and manufacturing technologies to achieve the corporate strategic business plan. As companies move toward the adoption and implementation of advanced manufacturing technologies, they realize that information flow is more important than the automation of tasks. The process of gaining necessary information from data, and knowledge from information, in a timely fashion is of paramount importance to today's organizational decision-makers.

In this context, CIM is viewed, more broadly, as a concept, business philosophy, or tool for strategic management as well as for tactical and operational management. For many manufacturing executives, CIM represents a chance to beat rising manufacturing costs, cut-throat competition and, therefore, provides the tools needed to develop a competitive advantage (Willis & Sullivan, 1984). This view implies executive leadership with the foresight to look beyond CIM as a purely technical issue and view it as management's challenge. This viewpoint further suggests that CIM is far more a strategic issue than a technical problem; and it is specific to each company. The need to develop a strategic plan detailing how a manufacturing concern can grow cannot be over emphasized.

III. Integration as the Key Characteristics of CIM

The dominant management and organizational theory employed during the evolution of the existing manufacturing base were centered around the specialization and division of labor. The majority of manufacturing organizations were built on these principles. Organizational infrastructure and management's attitude toward exploring computer technology has been functional or departmental rather than company-wide and long-run. Functional areas within the organization have been treated as independent entities and computerized in a fragmented manner, providing only localized efficiency. There has been a traditional separatism between, for instance, manufacturing and business functions. In most companies, departments using CAD/CAM must produce hard copy because other departments have no way to deal with digital information (Teicholz & Orr, 1987). The capabilities of CAD/CAM systems are thus constrained to fit within largely manual operations, and much attention is consequently given to issues such as pilot quality, that are irrelevant to CIM.

In traditional corporate structure, each department is given the challenge of maximizing its functions and profitability even if that is to the detriment of the organization as a whole. Before talking about integration, there are walls that have to be torn down, and that is a much more difficult problem than the technology. Based on past experiences (Chiantella, 1986), the biggest difficulty during the planning stage of CIM was getting the different functions to talk together and come out with a mutually agreeable system. Many people in an organization tend to think only of their specialty.

In addition to functional or horizontal separatism, there has been vertical disintegration within many organizations because management information and decision-making systems were located at the top of the hierarchy. They were virtually disconnected from shop floor data. Management has never really looked at manufacturing as anything other than an operation needed to get something out the door. Manual, labor-intensive tasks were required to move production data, qualify information and other shop floor information to decision making levels of an organization. Obviously, it was difficult to implement an integrated automation strategy without an effective information path between these two groups.

Xerox System Group Electronic Division manufacturing started planning for CIM in the early 1980s. Since then, Xerox is well along its evolutionary path to CIM. Xerox manufacturing management gradually transformed its operation from disconnected activity areas to integrated work centers coordinated through a cohesive base of data.

Tandem Computers determined in 1982 that the fault tolerance and expandability of its systems were being undermined by the technology of the terminal devices attached to the system. Terminals available from equipment manufacturers did not have the necessary features to give data integrity and availability to the systems they were attached to; thus they became the weak link in the system. Tandem determined that if it wanted to enter the terminal manufacturing marketplace with a competitively priced product, traditional manufacturing techniques would not work. The company moved toward a paperless factory in which the entire assembly and test operation at the manufacturing facility was tracked and controlled without paper. Bar code labels pasted on individual subassemblies and end units tell each work station where the piece has been, where it should be and where it may go, depending on events at that work station. The foundation of this entire system is a software system with the ability to track and control many different part numbers, at mass-production speed, in variable lot sizes (down to a single unit). Shop-floor control, networking to "islands of automation" and interfacing with existing manufacturing planning and general business systems are elements of CIM that have been brought together at this Tandem facility using an integrated manufacturing system called the paperless factory.

At the Allen-Bradley Co., the flexibility afforded by CIM is the major factor in the company's impressive growth. The firm's old method of operating made use of long assembly lines to fabricate even simple components. Now machines are able to shift quickly from one part to another. In one example, a machine can make any one of 777 different parts without pausing. The success of Allen-Bradley comes not only from flexible manufacturing but also from such factors as lower inventory and better quality.

TRW, Electronics and Defense sector, identified CIM as one of the fastest growing markets in early 1984 and developed a rapid prototype by integrating the three applications (CAD/MRP/ CAPP) most commonly used by TRW manufacturing divisions. By identifying the specific needs that have to be met in a practical situation, TRW has developed an integration concept known as the CIM data engine, which is applicable to most heterogeneous systems environment in general.

Therefore, the foremost issue to be addressed before the factory of the future can become a reality is integration. Integration in CIM can be seen as the combination of all design, manufacturing, and business elements into a coordinated, harmonious unit working together smoothly toward common organizational goals. By enhancing and supporting decision capabilities, the CIM system enables firms to efficiently produce multiple products, respond to rapid market changes, adapt to shorter product life cycles and develop high quality custom design.

Integration as the key element of the factory of the future refers to the holism of the organization. It is concerned with how different functional areas (horizontally) and managerial levels (vertically) are tied together. Integration has to be differentiated from mere interfacing where islands of automation are bridged and connected together. Functional integration is the thread that weaves the entire organization and manufacturing process, from engineering to material planning, to production, to marketing, and to accounting into one integrated fabric in which each of the different parts serves and supports the whole. In a manufacturing organization, market research information has implications for product design, scheduling, and manufacturing as well as for purely marketing activities. Information on production scheduling, in turn, is useful in determining personnel requirements which in turn translates into financial obligations and other decisions to be made.

By using Sprague's framework (Sprague, 1980), CIM may be conceptualized as an Integrated Decision Support System (Figure 1) which can support analysis and decision-making in various functional areas. The principle objective is to provide managers with a clear picture of the organization's current state and to simulate its future state under various hypothetical environment.

In this holistic view, functional areas are considered as subsystems and are evaluated against the organization's goals and strategic objectives, namely, optimization of total business, rather than sub-optimization. These functional areas and organizational units are integrated to work as a team, handling the present and looking into the future to better position the total company. That is when the synergy of having a factory floor-to boardroom flow of information, and the business control that goes with it, will occur. The availability of consistent, accurate, and timely information that results from integration leads to greater control, flexibility and the competitive advantage of the manufacturing process.

IV. Organizational Fit

According to Leavitt (1965), organizations of all types consist of at least four interrelated variables (Figure 2): 1) Task Performance, the production of goods and services; 2) Technology, direct problem solving inventions such as work-measurement techniques or computers including hardware and software, and processes that are used; 3) People (actors) with their values, attitudes, beliefs, education, skills and knowledge; and 4) Structure, the system of communication, authority (or roles), and work flow, systems of formal relationships among people in the organization. These four variables are highly interdependent so that changes in any one, requires corresponding changes in others. Particularly, it is the interaction among three major variables (technology, structure, and people) that really affects task performance and organizational goals. The dynamic interplay of these structural, technological, and people variables affects the degree of effectiveness and efficiency in task performance and achievement of objectives.

According to Greenhalph (1984), around 40% of information technology installed has never been used or has been abandoned since implementation. This is, he notes, due to incompatibility between technology and the organization into which it should fit. The reasons include false assumptions about rationality in organizational decision making, a lack of understanding of technology and the adopting organization, inappropriate matching of technology to organizational strengths and weaknesses, and the lack of suitable infrastructures to support new technology. A study by Brody (1985) indicates that rigid corporate rules that perpetuate old-fashioned approaches to manufacturing are a significant barrier to automation. Many companies that install computerized automation leave in place management principles of the past.

The challenge for management is how to build a business and organizational structure to fit CIM technology in order to enhance productivity, to improve product/market capability, and to improve managerial decision making.

The belief that problems, especially production problems, should be attacked with specialized knowledge and skill goes back to the Middle Ages and the advent of the craft guild. The concept of job specialization was subsequently raised to the level of a science early in this century by Frederick Taylor in his principles of scientific management. Furthermore, the notion that technical problems "belong to" technical specialists follows logically from Max Weber's classic "principles of ideal bureaucracy," which most modern organizations still practice today. As Bessant (1985) states, most firms have mechanisms in place for dealing with increasing complexity. However, the problems posed by integration are somewhat new and unfamiliar compared to the organization of individual tasks and departments.

These independent domains are built-in barriers to communication. While information theoretically should flow freely from point of origin to point of use anywhere in an organization, all too frequently it is forced to follow the line structure up the hierarchy and down again to its destination. The biggest difficulty during the planning stage of CIM at Allen-Bradley Co. was getting different functions together and arriving at a mutually agreeable system.

Bechtel Group, an engineering and construction giant, for example, historically leaned toward highly autonomous lines of business (LOB), each responsible for its own field operation. Recently, however, competitive pressures and the need to cut costs are driving the company to scale back and better coordinate activities of its LOBs. Bechtel is reorganizing its branch offices so that individually they can sell and deliver all of the company's product lines. The branch offices, however, all are managed by a single, centralized organization. The purpose is to cut costs by eliminating duplicated branch office management functions. The company, also, hopes to be more responsive to customers by no longer requiring them to do business with only a certain office. Hewlett-Packard Co. is simultaneously shifting to an organizational structure of smaller groups often geographically dispersed but with increased centralized

Figure 1. A Conceptual View of CIM as an Integrated DSS.

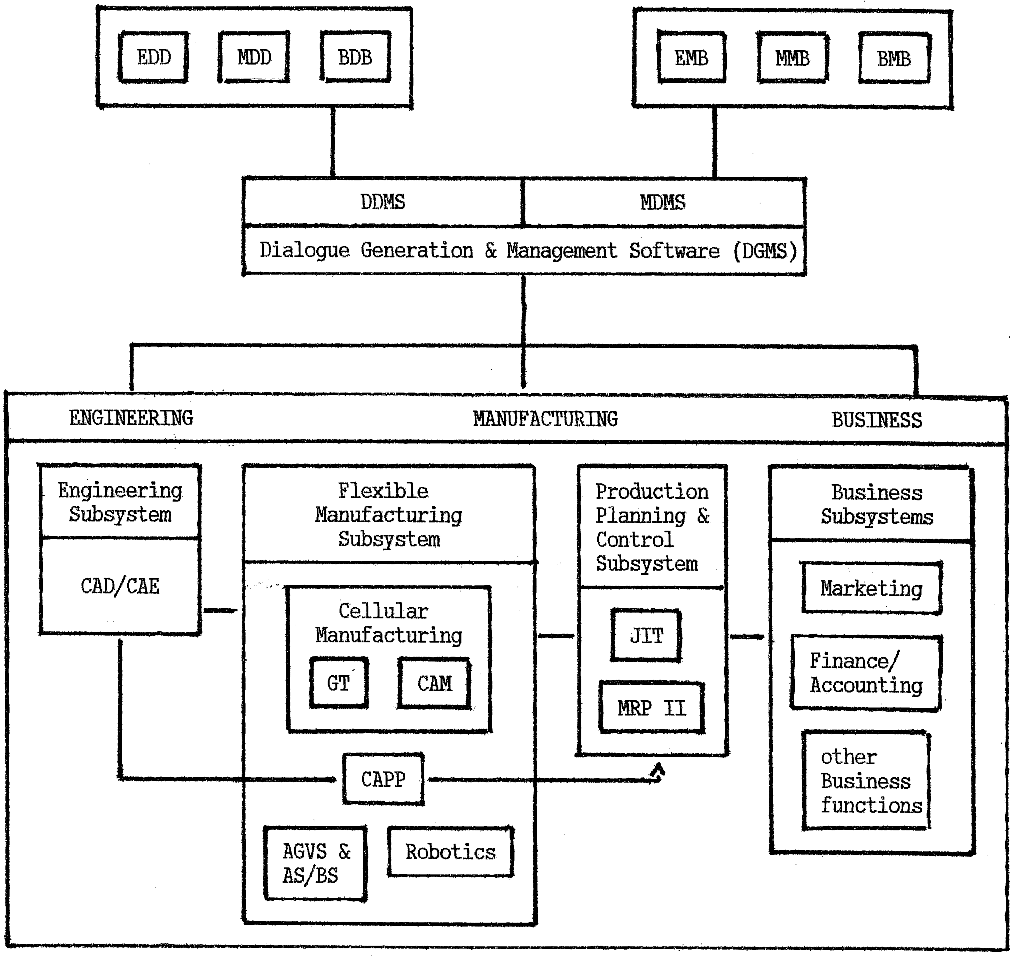
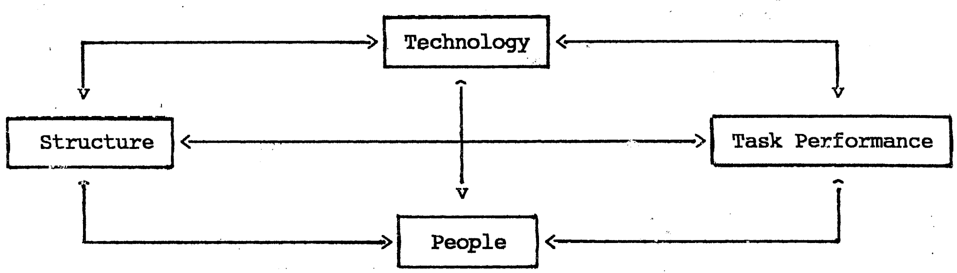


Figure 2. Leavitt's Model of Organization.



control and coordination of their activities.

People are becoming integrators aided by new organizational forms and technologies. Each worker on CalCom's high-tech assembly line, for example, is cross-trained so that he/she can do every job on the line. This organization of multidisciplinary individuals is a far cry from the specialist-based company with Machine or Professional bureaucracy. This is an organization of multidisciplinary teams and multifaceted individuals operating within the wider context of the global market itself. The measure of such a company's success is how well it achieves concurrency of efforts between its functions, products and geographic units and how closely the results match the needs of the market place.

Information technology can be successfully implemented if there are corresponding changes and adaptation in organizational infrastructure and managerial attitudes to support the new technology. Blumberg and Gerwin (1982) noted that an overwhelming majority of companies do not have an infrastructure that can control automation's operations once it is implemented. New technology will be effective only if it is supported by existing infrastructure. If it depends upon a more sophisticated human support system than exists, it will not achieve integration and is likely to cause unanticipated problems.

Burns and Stalker (1961) have categorized two types of organizational structure: mechanistic and organic. A mechanistic structure implies specialized tasks which are rigidly defined, a strong rules orientation with formal hierarchy of control, little decision-making responsibility in the domain of the production worker, and little horizontal communication. An organic structure implies higher levels of employee involvement, a greater degree of employee interaction, less emphasis on a formal hierarchy and regulations, and less centralization of authority. Also commonly attributed to an organic structure is a more highly trained and experienced staff and a narrower span of control for supervisors.

By viewing "fit" as a strong relationship between structure and technology, Argote (1987) discusses a particular aspect of structure (centralization) and technology (the uncertainty associated with the work process). She cites research showing that decentralized structure are more effective when there is uncertainty in the work process.

As Nolan (1987) notes, a new and emerging organizational form better suited to today's complex, global business is the network. A network is not characterized by either hierarchical levels or established communications patterns of the bureaucratic organization. Rather it is marked by four characteristics: it is diamond-shaped rather than pyramidal; it is coalition-based; it grows organically (vs. statically); and it embraces integrated information technology architecture. In a diamond-shaped organization, lower-level clerical jobs at the bottom of the pyramid are gone. The "knowledge worker" populates the middle level as information technology is better incorporated to carry out lowerlevel functions. Coalitions are the human building blocks of the network organization. At the core of a coalition are groups of knowledge workers assembled to treat a particular task or activity as it relates to implementing the organization's growth strategy. Decision making authority and accountability rest with these coalitions, each of which embraces overall business vision. The coalition-building approach to running a business engenders a fluidity and dynamism not found in less flexible bureaucracy. Coalitions of knowledge workers require information technology with members both inside and outside the organization.

Therefore, there has to be an organizational environment and structure to match technological advances. Management must have a new approach and point of view for a successful CIM. There has to be an integrated networking vision of the organization and its people, a strategic vision that guides organizational design to fit the information technology and enhances a company's business strategy. The factory and the business of the future require an organic organization that can process integrated information and has the capability to manage complexity with flexibility. It will adapt quickly to environmental changes, respond to rapid market shifts, cope with uncertainty, and deliver a variety of high-quality custom designs with short lead times. The organizational structure for a successful CIM will be characterized by networks, not hierarchies, where process replaces function. It will be decentralized, more informal and loosely coupled. To paraphrase Harrington (1984), the last two decades have seen the introduction of technologies that have not only revolutionized manufacturing [and business] processes, but which also demand the revolution of management systems [and organizational structure] that go with them.

V. CIM Strategy

As discussed earlier, CIM consists of the overall integration of design through manufacturing and marketing with an emphasis on high technology implementation. Because CIM requires such fundamental changes in organization, as well as a massive capital investment, it is difficult to measure its success with traditional equations. Many firms have tended to base their CIM investment decisions on traditional Return on Investment (ROI), payback period, or discounted cash flow financial justification methodologies that are more suited to meeting profitability criteria than to evaluating ways of reaching long-term strategic goals. One cannot cost-justify a CIM investment the same way as with new hardware or software.

The benefit and advantages of functional and structural changes that come with integration remain intangible for some time, and if the company becomes more profitable it is hard to know where to apply that profit. CIM consists of many components that do not lend themselves to traditional methods of evaluation. Therefore, as Canada (1986) noted, basing evaluation and justification of investment in CIM entirely on financial measures is both inadequate and misleading; it requires a new way of thinking about ROI. The problem associated with developing plans for CIM strategy pertain to the fact that the many benefits cannot be fully expressed in dollar terms. As Kaplan (1985) states, faced with outdated and inappropriate procedures for investment analysis, all that responsible executives can do is cast them aside in a bold leap of strategic faith. In his view, the trouble does not lie in some unbreachable gulf between the logic of ROI to these investment proposals. Managers need not--and should not-- abandon efforts to justify CIM on financial grounds. Instead, they need ways to apply the ROI approach more appropriately and be more sensitive to the realities and special attributes of CIM.

The basic motivation for CIM strategy involves many other factors beyond simply return on investment. These factors, although hard to quantify, are important to the overall implementation of CIM. Adaptability, or the flexibility to quickly and easily respond to customer demand and market conditions, is often a motivating factor for CIM.

CIM technology relaxes manufacturing and engineering constraints on marketing effectiveness in the sense that a variety of low-volume products can be produced concurrently with efficiency. Firms will seek manufacturing economies by building volume across product lines and market segments to achieve economies of scope rather than scale. By easily accommodating engineering change orders and product redesigns, CIM technology allows for product changes over time. If the mix of products demanded by the market changes, a CIM-based process can respond with no increase in costs.

Other factors such as better quality, reduced inprocess inventory and floor space, shorter lead times, experience with new technology, and the integration of design, manufacturing, marketing and other functional areas which cannot easily be quantified, are strong motivation factors for CIM. If competition currently is able to achieve much lower cost, higher quality, and much shorter lead times, the competitive edge will be strongly in its favor. A most compelling reason for implementing CIM is that otherwise the factory will no longer be competitive in the market place.

It is the top management's responsibility, with its long range company-wide view, to integrate CIM strategy into corporate strategy and to estimate all possible strategic and intangible benefits resulting from CIM strategy, judge its feasibility and whether to adopt it. Before a company commences a CIM project, it must have the support of top management. For those companies that make the commitment, CIM can radically improve the way they do business. Top management must approach CIM as a participant rather than as a spectator. Their role may shift from one where they choose a CIM strategy from among those presented by subordinates to one where they create business strategy with CIM as an integral component--a component as critical as technology, people, and organizational structure. Within this context, top managers can drive CIM strategy as an inseparable component of the overall business strategy.

To illustrate, one of the most widely used frameworks for competitive analysis, Porter's (1985), is discussed in terms of its implications for CIM strategy. In his view, the fundamental determinant of a firm's profitability is industry attractiveness. Its competitive strategy must grow out of an understanding of competition rules that determine an industry's attractiveness. The ultimate aim of competitive strategy is to cope with and, ideally, to change those rules in the firm's favor.

In any industry, in Porter's view, whether it is domestic or international or produces a product or a service, these competition rules are embodied in five competitive forces: the entry of new competitors, the threat of substitutes, the bargaining power of buyers, the bargaining power of suppliers, and the rivalry of existing competitors. He further proposes three generic strategies with which to combat these forces: cost leadership (become the low cost producer in all market segments), differentiation (distinguish your company's product and services along a number of dimensions such as quality, special design features, from others in all market segments), and focus (concentrate on a particular market segment and then either differentiate or become the low cost producer in that segment).

CIM and information technology can be of strategic value in any of these generic strategies. With respect to the first, strategy or cost leadership, for example, CIM can lower labor cost by automation, reduce fixed-asset expenses for each production unit by improving the use of manufacturing facilities by integration and better scheduling, reduce interest and facility costs by reducing waste (through integration of functional areas and better matching of orders, materials, and machines) and making better use of lower-grade materials in settings where quality is not an issue. Differentiation can be created along a number of dimensions such as quality, special design features, and availability. CIM technology contributes to achieving these goals by being responsive to market changes and being flexible to redesign and manufacture according to market conditions. Finally CIM can be a strategic tool in identifying the needs of a specialized market and responding effectively and efficiently to those needs.

Given the dimensions and characteristics of CIM strategy, CIM embraces considerations for the office of the future as well as the factory of the future. Therefore implementing a comprehensive CIM strategy goes beyond designing the factory of the future and/or the office of the future; more accurately, it redesigns the business of the future. It involves a dramatic change in manufacturing and business philosophy, since these changes will affect the entire company. Thus, the need for a strategic plan detailing how a manufacturing and business concern can move from its current position via CIM involves many of the problems and issues inherent in information technology and MIS planning because CIM strategy must be integrated into long-range business strategy by top management.

VI. Summary and Comments

The new era of intense competition, information technology, and productivity challenge has required companies to use information systems strategically to achieve a competitive advantage. CIM is viewed as the most important application of information technology: as a concept, as a business philosophy, and as a tool for strategic management.

CIM is considered the (vertical) integration of the flow of information from factory to boardroom with its control over business and also is the (horizontal) integration of functional areas from design and manufacturing, to marketing and other business functions. By enhancing decision support capabilities, CIM enables firms to efficiently produce multiple products, respond to rapid market changes, adapt to shorter product life cycles, and develop high-quality custom design. The availability of consistent, accurate, and timely information that results from integration leads to greater control, flexibility, adaptability, and competitive edge for the company as a whole.

It was emphasized that CIM is not a low-level technical issue to be dealt with from the bottom up. Instead it is a strategic challenge for top management to integrate CIM strategy into corporate strategy to ensure the company's competitive effectiveness. Manufacturing companies must have a vision of where they want to go and how they want CIM to help them get there. If a company has a problem with CIM, it is related to the lack of good planning or commitment, not with lack of technology. Automation can be an expensive toy if it is not tied in with a vision of where the company is going.

CIM strategy, therefore, must begin with a corporate vision that grows out of executive deliberation on how a company should operate in order to compete, prosper, and survive in the long- run. A business vision which is meaningful, understandable, and inspiring must capture the essence of what the company must do well to succeed in the marketplace. Such a vision, effectively translated into a business strategy, is an analytical process for determining key variables of success, the activities that must be done well and the resources that must be allocated to achieve the desired results.

To take advantage of information technology and CIM opportunities, management must recognize the new era, new technology, new assumptions and new structures in relation to their own business strategy.

Exploring the top-down design approach, business strategy can be translated into strategic vectors, as cohesive portraits of integrated strategic objectives, performance, and success measures, or into a finite set of programs packaged to achieve measurable progress toward the overall goals. It is this crucial step of translating from general to the specific that creates focus, defines quantifiable targets, stretches objectives and give a reasonable time horizon (Norton, 1987).

In this visionary context and top-down approach, the strategic roles of information technology and CIM are directly linked to the ways a company chooses to transform itself, such as building a network organization, leveraging knowledge workers, and creating strategic alliances. Management with business vision is challenged to integrate information technology and CIM strategy with corporate strategy to achieve a competitive advantage. The lack of active involvement of top management in planning and implementation of CIM will inevitably lead to the automation of functional tasks without achieving the integration vital to the functioning of business as a whole.

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