A STUDY OF COMPUTER INTEGRATED MANUFACTURING PROGRAMS IN COMMUNITY COLLEGES

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Since both of my parents did not have the opportunity for a formal education beyond the eighth grade, my doctorate is an accomplishment for my family. The sacrifice in time and finances has been shared with my sons, Geoff and Brad, stepson, Greg, and husband, Ed. I want to dedicate this work to my husband. There have been many times I was tempted to end my doctoral pursuit because of the strain it placed on my family, but my husband provided the support and encouragement to continue.

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CHAPTER I

INTRODUCTION

Background of the Problem

Although there is strong support for interdisciplinary programs in higher education, the traditional organizational structure in community colleges separates rather than integrates the disciplines (Abt, 1970). To meet the changing needs of the community, where employees are expected to share a vision and possess a broad organizational view, colleges are developing interdisciplinary curriculum and programs. To respond to the educational demands, the organizational structure should allow for flexibility to meet the changing needs of the community (Parnell, 1990).

New technologies such as computer integrated manufacturing are being implemented by companies in response to pressures for increasing productivity (Clark, 1989). Since this technology is so complex, encompassing both the manufacturing and the business functions, organizations are struggling with integration of areas which have traditionally remained separate and have not shared a common data base of information (Stefanides, 1989). Standardized systems are not prevalent in large corporations, where different control systems are operating in each plant. Integration of these operations through a common data base enables companies to share information from the various functional areas saving time and increasing efficiency in developing and delivering quality products (Fusaro, 1989).

Successful implementation of this new technology within organizations has involved forming teams of top managers from the various functional areas to develop the strategy. Then, a smaller project group guides the implementation in addition to their regular job responsibilities (Endrijonas, 1989). Obtaining the commitment and continued support throughout the implementation phase of a project that integrates functional areas which have existed in isolation requires an organizational structure that allows for flexibility.

The conversion of manufacturing process systems to Computer Integrated Manufacturing provides business with economic and quality advantages; however, major communications problems are experienced. CIM integrates the entire enterprise. It uses a common data base and links the various functional areas of an organization including business management, accounting, marketing, planning, shop floor operations, and systems maintenance. Separate computer-network systems and process controls are being replaced by CIM. As new control equipment is required to meet sophisticated product needs, CIM will permit its integration through open architecture which allows for future expansion. Integration will be with a minimum of disruption to the manufacturing process. Common data bases and shared information will be critical to successful changeover. This will require open communications regarding hardware acquisition as well as strong human relation skills (Stefanides, 1989).

An emphasis on the systems approach will be required by educators in preparing students for the new field of mechatronics, which merges mechanical components and electronics into the same machine. This same emphasis will be required for CIM, which combines computers with electronics and mechanical systems utilizing a central data base. A holistic approach including applications and interaction with other areas of knowledge will be needed for individuals to communicate and work in teams to solve complex problems. The integration of scientific principles and applications and the development of divergent thinking will be required as technologies expand exponentially (Baker, 1989).

As an industrial leader and supporter of higher education, IBM has formed a consortium of 57 colleges and universities called the IBM/CIM Alliance in Higher Education. The purpose of this alliance between business and education is to help restore industrial leadership in the United States and provide hands-on experience for students with state-of-the-art equipment to prepare them for the rapidly changing technical environment. Through the consortium, colleges receive tailored configurations of IBM equipment, software, and technical consulting support. The ability of organizations to adapt to technical changes will determine the responsiveness of companies to customer needs. The need for higher education to prepare students to develop an integrative approach to handling complex problems is a theme shared with researchers and business leaders.

Purpose of the Study

The purpose of the study was to conduct research that described and identified organizational structures utilized in community colleges for developing and implementing computer integrated manufacturing programs.

An additional purpose was to conduct research that identified obstacles created by existing organizational structures and provide recommendations for alternative organizational arrangements.

Statement of Problem

There are problems and obstacles present in the organizational structure when attempts are made to develop and implement an interdisciplinary curriculum. A Computer Integrated Manufacturing program involves the integration of business, engineering, and manufacturing disciplines which are separated by academic division boundaries.

Research Questions

The research was designed to explore the following questions:

1. What were the characteristics of the organizational structures utilized for developing and implementing computer integrated manufacturing programs in community colleges?
2. What major obstacles related to the organizational structure were encountered when attempting to integrate the program into the separate academic divisions representing the manufacturing and business disciplines?
3. What alternative structural arrangements were recommended for integrating similar interdisciplinary programs in the future?

Scope of the Study

The study dealt with all forty community colleges that were members of a Computer Integrated Manufacturing Alliance in Higher Education. These colleges were selected by a major industrial firm to receive software and hardware to establish computer integrated manufacturing programs within their institutions. The colleges were located nationwide, representing both urban and rural communities.

Since the program involved the integration of an entire enterprise, from manufacturing to accounting and business functions, it crossed the traditional academic divisional and departmental boundaries of the community college.

Limitations of the Study

Because the respondents were involved in the operational day-to-day activities of computer integrated manufacturing programs, they were in positions to experience first-hand how the departmental and divisional integration was progressing and how the organizational structure was facilitating or hindering program implementation. However, the respondents may not have been aware of what other members of the college perceived as problems.

Also, the communications and integration problems encountered in this highly technical interdisciplinary program may not be representative of other interdisciplinary programs that have terms and concepts of which faculty have a common understanding across disciplines. Problems encountered with integration of business disciplines and manufacturing and engineering disciplines may not be similar to those encountered by the integration of the liberal arts area with other academic areas.

Assumptions

It was assumed that the college representatives to the CIM in Higher Education Alliance would have access to information required to complete the survey. Also, they would have experience dealing with the program and the people on a day-to-day basis.

Definitions

The following definitions are provided to clarify terms used in this study. In some instances, academicians may not share these definitions when studying the various disciplinary states; however, for the purpose of this study the following definitions will be assumed:

1. Collegial Structure - an organizational arrangement that provides flexible hierarchical relations for faculty and administrators to work as a team across traditional academic departments or divisions to assume various roles that may be redistributed or rotated to accomplish a common goal (Cleveland, 1985).
2. Computer Integrated Manufacturing (CIM) - the integration of an entire enterprise using the computer as a tool to share a common data base, that provides information for management decision-making in all functions within an organization.
3. Crossdisciplinary - the process by which different disciplines are utilized to solve specific problems.
4. Interdisciplinary - the process by which distinct disciplines are brought together to create a curriculum, or program which may result in a new discipline (Kockelmans, 1979).

5. Map - an interconnected set of understandings formed by frequently implicit views of what one's interests and concerns are, what is important, and what demands action. A cognitive representation of the world and ourselves in it (McCaskey, 1982).
6. Mapping - reframing a problem by developing a broader perspective of a situation to help manage ambiguity and change in an organization (McCaskey, 1982).
7. Metadiscipline - a new, more comprehensive and transcending related discipline designed to deal with the original discipline (Kockelmans, 1979).
8. Multidisciplinary - the process by which several disciplines are brought together for a broad educational experience, and the disciplines maintain their separate identities (Kockelmans, 1979).
9. Organizational Structure - the hierarchical arrangement within an organization that defines reporting relationships and areas of responsibility.
10. Pluridisciplinary - the process of grouping together several related disciplines to provide unity in the academic area of study (Kockelmans, 1979).
11. Synergy - the resulting product that is created when entities are brought together for a common purpose and accomplish more than they could if working separately.

Organization

This study is organized into five chapters.

In Chapter I, the background of the problem, purpose of the study, statement of problem, and research questions are presented. Also, the scope of the study, limitations, assumptions and definitions are given.

Chapter II provides a review of available literature. It describes the ideas of different authors on interdisciplinary education and programs and organizational structures within the community colleges for developing and implementing them.

In Chapter III, the methodology is described. Also, this chapter presents the procedures utilized in conducting the survey and collecting primary source data from community colleges nationwide that were members of a Computer Integrated Manufacturing Alliance involved in developing and implementing interdisciplinary programs within their respective institutions.

Chapter IV is a description and analysis of the results of the survey.

In conclusion, Chapter V describes the research findings, provides analyses of the collected data and identifies organizational structures currently utilized for developing and implementing computer integrated manufacturing programs.

In addition, the chapter provides recommendations for alternative organizational structures that could be utilized in the future for implementing computer integrated manufacturing programs. This is followed by a section that provides recommendations for future research.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

In this chapter, ideas and theories of authors are presented regarding the characteristics of interdisciplinary programs and organizational structures in community colleges.

The role of the college in providing an education that integrates the disciplines and the barriers traditional organizational structures create in developing and implementing interdisciplinary programs are reviewed.

Interdisciplinarity

In higher education, it has been acknowledged that the world is interdisciplinary, with all sciences interrelated. Even the relationship of God to the world is pursued through the study of Theology. To disregard a science would give a distorted view of the world. There is a need to understand the relationships among the sciences in order for man to relate to the world (Newman, 1960).

Moving from the concept of God's relationship to the world, the connectedness of life is acknowledged through man's relationship to man. Even men separated by different discipline choices have a need to find that connection. Snow (1986) contends that the gulf between scientists and non-scientists is caused by the lack of understanding by one group about the other. The connection between these two cultures must be made through acquiring a better understanding of each other in order to develop solutions to major problems in the world.

Jantsch (1980) described the world as a "holistic reality" referring to its processes and interactions. In business and industry, he observed that processes in the workplace were ad hoc interdisciplinary. This condition of interdisciplinarity is the basis upon which education should be approached.

Describing the emergence of a "worldwide electronic infrastructure for ideas and information" Gardiner (1990) acknowledges the interdisciplinary state of the information-processing society of today. The author urges the establishment of networks to integrate and use this information.

Organizational Structure

The formal organizational structure is a deliberate planned attempt to establish patterned relationships among the components to meet objectives. Functions and responsibilities are prescribed by the formal organizational structure. Interactions that are not prescribed by the formal structure but occur spontaneously from interactions of organizational members create the informal structure. According to the author, many organizations are replacing rigid bureaucratic structures with dynamic, flexible forms that allow for more frequent position and role changes, and more dynamic interaction among the various functions (Kast, 1979).

The basic functions of the organizational structure are to produce organizational outputs and achieve organizational goals, to ensure conformity to organizational requirements, and to establish which positions have power to make decisions in specific areas (Hall, 1987).

The organizational mission and goals, and the individual's perception of them, influence how members of the organization interact and make decisions. What people believe is expected of them, the unwritten rules and procedures, control their conduct. It is within the context of these established premises that organizational members make decisions (March, 1958).

Organizational structure decreases ambiguity and guides decision making in organizations where employees do not agree on technology or goals. When there is a lack of administrative control to define the structure within which decisions are made, the decision-making process is ambiguous (March, 1976).

In designing the organizational structure, the mission, goals, and technical system to accomplish them should be considered. Tasks are delineated and combined into positions according to degree of specialization. Then the types and number of positions are determined for each unit. These units are grouped into more comprehensive units forming the hierarchy. Structural redesign is sometimes necessary when mission and goals change or as the technical operating system changes (Mintzberg, 1983).

Structural design affects the problem-solving process. Decision-making becomes simpler and faster when there are fewer layers in the structure. The flat organizational structure with broader span of control allows members to make more decisions and claim ownership (Peters, 1985).

Keeping the structure simple, and easily understood by organizational members, was a characteristic of the excellent companies. The structures of excellent companies make priorities clear and establish to whom and for what members should report. They appear to be reorganizing constantly making better use of task forces and project teams to make things happen. Yet the fundamental form of the organization rarely changes and is kept simple (Peters, 1982).

Mechanistic structures, characterized by rules and procedures, can lead to high performance in environments that are highly stable and relatively certain. In environments that are highly uncertain and the need to innovate exists, organismic structures, with extensive lateral communication, knowledge power base, and flexible roles, are more effective (Burns, 1966).

The ideal, efficient, and totally integrated organization can be compared to a good basketball team. The structure is not visible. Problems faced are complex occurring at rapid speed. Problems are solved by the team with a minimum of task and position specialization and no formal reporting relationships. Members understand their individual tasks and the relationship to the other tasks, so the coordination is not dictated by a formalized reporting relationship. To accomplish long-range goals and guide an organization towards cooperation, most organizations need some structure. He indicates that the structure is used as a crutch for the lapses of information and cooperativeness among members (Ouchi, 1981).

Organizational structures for dealing with uncertainty should be characterized by decentralization regarding decisions relating to uncertainty and reduced bureaucracy allowing for flexible response for those individuals dealing with environmental uncertainty. To prevent other parts of the organization from the need to make rapid adjustments, the level of internal differentiation should be increased. With internal differentiation coordination problems are created and there is a need for increased integrative efforts (Mansfield, 1986).

There may need to be two types of structures within the same organization. A bureaucracy with tight control over subordinate levels, standardized operations, conformity in operations ensured by rules, procedures, and routines is suited for handling on-going operations. Since society and the environment are constantly changing, an adaptive element is needed to react and anticipate changes located at a level to place a minimum of stress on the hierarchy. There is, however, a conflict between maintaining stability and seeking innovation. This dilemma creates tension between the two groups. Since the bureaucratic group has minimum costs and maximum output as priorities, new products, services, or practices will be resisted. An example of these dual roles is the role of faculty in a university where there is responsibility for bureaucratic elements of seminars and lectures at scheduled times, and research and program innovation representing adaptive elements. It is difficult to keep a balance between the two without stressing one and neglecting the other. Unlike universities, most organizations don't combine both elements in one employee, but in separate groups (McLaren, 1982).

Social structure of future organizations will be temporary adaptive systems. The problems to be solved will define the organization, and people with diverse professional skills will form groups to solve problems. Individuals who understand the overall problem and can link the various project groups will manage. He predicts that these groups will be conducted on organic lines, developing and adapting to problems, and those who will have influence and serve as leaders will be most capable of solving problems. He predicts that such an "organic-adaptive" structure will replace the practice of bureaucracy (Bennis, "Organizational Developments and the Date of Bureaucracy" 215).

It is anticipated that future organizational structures would be characterized as temporary and adaptive. They would form task forces to solve problems. Team members would have diverse professional skills with management serving as coordinators among the various groups. Organizational structure is an important issue to be studied according to Bennis:

> Students of organization change are correct in pointing out that many causes of organizational ineffectiveness are not found in procedures or team effectiveness or even the absence of performance goals. Rather, the fabric of the organization itself can prevent communication, decision-making, and the application of effort from being as effective as it might be under different organizational arrangements (Bennis, <u>Organization Development</u> 38).

There is a shift in business away from the traditional manufacturing to new technology and information processing. For organizations to adapt to these changes, new structural configurations must be designed (Harris, 1983).

School administrators who have knowledge of the various paradigms which have been utilized by researchers to view the organization and its structure, will not be restricted by their limited perceptions. Their study of organizational administration can give them a broader perspective of the nature of the organization and the relationships of individuals, structure, and the internal and external organizational environment (Foster, 1986).

Traditional Organizational Structure of Community Colleges

In the early 1900's junior colleges created the departmental structure. This structure has evolved into an organization of divisions consisting of several academic disciplines. Vocational programs are also located within these divisions. In large community colleges, it is common to establish departments within the divisions according to discipline (Tucker, 1984).

According to Richardson, Blocker, and Bender (1972), the current academic organization in community colleges was developed in the early 1970's. Under this divisional arrangement, faculty in arts and sciences were assigned to departments according to discipline, and faculty who taught in career programs were assigned to divisions related to their specialties. Transfer and remediation programs were distributed among several divisions.

The academic organization of the 1970's was referred to by Richardson and Simmons (1989) as an homogenized divisional structure. The authors suggest that this structure was effective for addressing the problems it was created to solve, but that with changing priorities, the structure may also need to change. Miller (1987) also establishes an interdependent relationship between strategy development in an organization and its structure. As the organizational priorities and strategies are changed, new organizational structures may evolve.

Separating disciplines along traditional departmental lines, according to Boyer and Levine (1981), encourages fragmented learning and provides a distorted view of the world. Also, the authors attribute the isolation of scholars from one another and from students to the traditional organizational structure. Other disadvantages of the traditional structure identified are the inhibition of new fields of knowledge and the narrow specialization of courses. Both are serious problems resulting from departmentalized education. According to McHenry (1977), the disciplinary department promotes specialization that diminishes the horizons of the student and the faculty. Although single discipline departments are not organized to promote interdisciplinarity, Kockelmans (1979) found that learning functions and knowledge from one area is duplicated or overlapped in other disciplines. Therefore, interdisciplinary learning is occurring in spite of the intentional departmentalization.

Structural Change And Organizational Resistance

Although traditional departmental structures were effective in promoting traditional academic goals, changes in missions of community colleges bring with them the need for structural changes. These proposed changes face resistance within the organization.

McHenry (1977) suggested that problems cross traditional academic departmental boundaries and that problem-solving should not be restricted by disciplinary boundaries. Cleveland (1985) was in agreement that problems cross disciplines but went a step further in attributing different problems of modern society to the lack of shared information among the disciplines.

According to Lippitt (1985), the results of major organizational changes can be perceived by employees as critical losses in the following areas:

1. Competence
2. Relationships
3. Power
4. Promotional Opportunities

The new roles, procedures, attitudes, and skills required by changes to the organizational structure may result in an initial deterioration in competency; however, after the implementation and learning have been accomplished, the level of competency usually increases. A revision of the organizational structure also changes the interaction patterns. Employees who are comfortable with the status quo must learn to adjust to these new relationships. Another area which causes concern is the redistribution of power. Since relative positions are altered in the hierarchy, promotional paths may be limited for some employees. These four areas of concern should be recognized and open communications maintained to ensure that there is an understanding of the reasons for the change and the benefits to the college, student, and faculty.

Faulty assumptions by faculty members constitute a problem identified by Jantsch (1980) that hinders the development and implementation of interdisciplinary programs. The belief that institutions could easily adapt interdisciplinary programs to existing curriculum was unrealistic. Since the organizational structure is reflective of the faculty's beliefs, perceptions, and skills, it is a faulty assumption to expect that institutions can easily restructure programs in interdisciplinary education. Conversely, the researcher found that external changes were resisted by faculty because they were perceived as a threat to the existing departmental structure's integrity. He identified the following factors that inhibited change:

1. Personality traits
2. Prejudices
3. Teacher training
4. Narrow-mindedness

Since these factors parallel those commonly found in all organizations, they present barriers to interdisciplinary development.

Kockelmans (1979) identified two factors that inhibited change to the structure, and both evolved from departmental autonomy. In order to maintain growth, there was a feeling that the central discipline should be fully supported. Also, faculty valued disciplinary autonomy and integrity over administrative authority, which provided resistance to interdisciplinary development. The researcher indicated that the uniqueness and substantive concerns of the disciplines must be protected to overcome the faculty resistance to interdisciplinary education.

Phillips (1991) experienced these same inhibitors identified by (Kockelmans, 1979) when he attempted to implement Electro Mechanical and Biomedical Technology interdisciplinary programs at Oklahoma State University. The university received a grant in 1968 to establish these interdisciplinary programs at Oklahoma State University. The program started in 1968 and ended in 1970, graduating two classes with Associates degrees. The intent of the grant was for OSU to implement a demonstration that could be established in community college. Although several colleges were interested in starting the program, interdisciplinary implementation problems kept them from pursuing the programs. Strong discipline barriers within departments, electronics and mechanical technology, as well as across academic departments, biomedical technology and electro mechanical technology, existed at the start of the program and continued throughout its existence. Each discipline resisted change and held on to its own methods and perceptions.

Abt (1970) identified the administrative arrangements as the major inhibitor to interdisciplinarity since they discourage the exchange of information and provide both physical and economic barriers to implementation.

Fink (1971) also describes how members of organizations respond to organizational change. Four phases of response are identified. First employees experience a sense of shock. This is caused by the perceived threat to the existing structure. Next, members react by defensive retreat during which time they cling to their old map of how the organization should be structured. This phase is followed by acknowledgment and a relinquishing of the old map. The final phase is adaption and change which results in the establishment of a new structure and a new set of values.

McCaskey (1982) suggests that there is a need for programs to be developed for managing change and ambiguity. Since an ambiguous problem is not adequately defined, people respond unpredictably. Communication and coordination within the group becomes a problem if there is not a commonly shared perception of reality. First, people must learn to recognize ambiguity and contradiction. Internal ambiguity should be identified that deals with personal patterns of handling change. Staff should be selected who possess relevant skills that are lacking. Since the organizational environment is becoming increasingly complex, interconnected, and ambiguous, frameworks need to be developed to manage change. The author asserts that acting as purely rational decision makers is not sufficient, since poorly structured problems are substantively different from those that are well-defined. Managing change requires the role of discoverer and a continuing commitment to learning. It requires a revision of expectations as a project progresses.

According to Harris (1985), in the future, organizations will need to establish more progressive practices, be more technical and humanized, and be more creative. New institutional arrangements and synergistic relationships will be required in order to serve new markets. New leaders who are concerned with the whole organization and integration of its various areas will be needed to facilitate the adaption process in a changing environment.

Mitroff (1987) observes that the organization exists in a complex, interconnected environment and suggests that its organizational structure should be matched to its environment. Although the specific organizational forms have not yet been identified, he suggests that the characteristics should include integration, shared responsibility, and fluidity. He contrasts these characteristics with the traditional organizational structures which are highly segmented and whose members do not share a common vision.

Parnell (1990) indicates that the rapid development of knowledge and technology is resulting in increased interdisciplinary work in colleges. Synergy is created through different academic disciplines and systems working together to accomplish a common goal. The author predicts that these linkages among the disciplines and interdisciplinary programs will continue to increase in numbers and impact. It is anticipated that future workers in manufacturing will be working in smaller units that integrate the system from the order through production and delivery. They will be responsible for projects from start to finish. This will require students to move from a narrow specialized focus to a general overall view of an organization with abilities to relate and integrate the various functions. In the new search for synergy, the old debate over the superiority of liberal arts or career programs will no longer be the issue. The importance of both and the need for balance will become more evident in the "technological learning age." Connectedness and applicability will be essential.

Establishing Interdisciplinary Programs

Sexson (1990) stated that higher education has reported only limited success with interdisciplinary programs. Although many colleges and universities consider interdisciplinary education as highly desirable, specialization has inhibited the integration of learning.

Cleveland (1985) identifies the organizational structure as a problem which blocks effective interdisciplinary teaching. What he believes is needed is a collegial structure in which conferring and networking are the processes utilized to accomplish goals.

The complexity of the current economic growth and advancements in technological knowledge require interdisciplinary teams (Gardiner, 1987). These new teams must learn to work in a collaborative atmosphere where traditionally they worked independently within their own disciplines.

According to Abt (1970), interdisciplinary activities involve the interaction of two or more disciplines, including communication of ideas across disciplines and the mutual integration of data, terms, methodology, and concepts. These activities link previously established academic divisions for specific purposes. He views academic disciplines as organic entities with dynamic life cycles. Abt explains that a new discipline is created when a new area of knowledge is studied in-depth, resulting in the identification of a different knowledge-producing, knowledge-transferring activity to which students will become attracted to become scholars and teachers in the area.

Conversely, the dissolution of a discipline occurs when its identity is lost through the incorporation with another discipline, or its activity is no longer relevant to the social or esthetic concern of society.

Abt identifies the following ten phases that constitute the life cycle of a discipline:

1. Demand generation - a new problem area develops which is not addressed by an existing discipline.
2. Mobilization of resources - operational support is obtained including organizational, financial, and human resources.
3. Institutionalization - the new discipline is legitimized and established as a course of study or

a department with faculty and students.

4. Deepening - the field of knowledge is refined.
5. Broadening - the scope of interests and activities is extended to the point where limited resources or boundaries of established disciplines create barriers.
6. Stabilization - internal structure is clarified in relation to external disciplinary competition.
7. Replication - discipline is duplicated at other institutions which may modify the internal structure and external boundaries.
8. Decline into formalism - discipline characterized by disseminating more knowledge than generating knowledge-producing activities; a reduction in relation to contemporary problems occurs.
9. Fractionation and disintegration - part is absorbed by expanding disciplines, linked with more popular or relevant disciplines, part is dissolved.
10. Dissolution - competition for resources by more relevant disciplines.

Abt considers interdisciplinary activities as the means by which curricula adapt to the changing societal needs. His ideal model of interdisciplinarity would not include the formalistic state, which he describes as counter-productive. Ideally, an independent new discipline would result from interdisciplinary activities and would dissolve when it is no longer relevant to current or future societal needs, allowing new interdisciplinary activities to replace it.

The following factors were found by Abt to promote interdisciplinarity:

1. Communications

2. Data integration
3. Methodological integration
4. Conceptual integration
5. Institutional changes

Whereas, the following factors created barriers:

1. Physical distance and barriers
2. Institutional disincentives
3. Unavailability of integrating data banks
4. Staff resource constraints
5. Feeling that the problem was too complex and broad to solve by any one discipline, much less two or several
6. Lack of sufficient discipline competence
7. Lack of time
8. Inadequate computer science and mathematical competence to utilize high order abstract languages to express and solve problems from diverse substantive areas
9. Perceived reduced rate of new specialized knowledge development
10. Individual preferences for working alone

Since the mission and purpose of an organization influences the organizational structure, as priorities change and the external environment creates new problems, the structure must allow for the flexibility to adapt to these changes. The traditional academic departments with community colleges separate according to disciplines. When new programs are needed to address complex interdisciplinary problems such as the integration of an entire business and manufacturing enterprise, expertise from the business, engineering, and manufacturing areas is required to develop and implement curriculum.

Computer integrated manufacturing programs are interdisciplinary programs designed to develop fundamental skills, knowledge, attitudes, and experiences relevant to employment in complex business environments which are linked together by a common data base. Curriculum crosses the traditional discipline boundaries for students to acquire a broad overview of the computer integrated enterprise, and how the functional areas relate to the whole organization. The description of the Computer Integrated Manufacturing/ Enterprise Program at Tulsa Junior College provides an example of such a program (Tulsa Junior College 1991-1992 Catalog). This program provides three specialty options to students, Management, Plant Floor Operations, and Systems Maintenance.

All three options require students to take an introductory study of concepts dealing with a computer integrated organization. Topics include the integration of functional areas, management techniques, and human resources. The Management and Plant Floor Operations Options also include a capstone course that brings together students from these options in a study of computer aided drafting (CAD), computer aided manufacturing (CAM), and computer numerical control (CNC) concepts. The focus of this course is the integration of production management, business applications, and plant floor operations.

Disciplines included in the Management Option are accounting, computer science, engineering, management, purchasing and materials management, and quality control technology. The Plant Floor Operations Option includes computer science, drafting and mechanical design technology, engineering, and numerical control/machinist technology. In the third option, Systems Maintenance, computer science, electronics technology, engineering, and robotics and automation are studied.

The complexity of the curriculum in a computer integrated program is apparent from the diversity of technical disciplines which are brought together in these interdisciplinary programs. The student must obtain a broad overview of the computer integrated manufacturing environment and understand how the various functional areas relate to each other and contribute to the whole operation of the enterprise.

The review of the literature not only identified the need for interdisciplinary education, it described the organizational changes required for implementation and the barriers the traditional structure present to accomplishing interdisciplinary programs.

CHAPTER III

PROCEDURES

This chapter outlines the procedures used to develop and implement the questionnaire to obtain information regarding the types of organizational structures currently being utilized to develop and implement Computer Integrated Manufacturing programs in community colleges. The procedures used are presented as follows:

1. Methodology
2. Selection of Sample
3. Instrument
4. Data Collection
5. Data Analysis

Methodology

The survey was intended to obtain descriptions of organizational structures, identify barriers to program development and implementation caused by the structure, and obtain recommendations for alternative structural arrangements that community colleges could utilize to facilitate the development and implementation of future CIM programs.

According to de Vaus (1986), the role of descriptive research is to describe what things are like, not to answer why they are that way. A stimulus for explanation and further research can be provided by good description. This type of research can identify problems which need to be resolved and provide the basis for theory construction. Since computer integrated manufacturing was a new concept, and community colleges were developing programs in this area, a description of the existing organizational structures and identification of problems related to the structure in the implementation of these interdisciplinary programs was the focus of this research.

Since qualitative, descriptive results were desired, a questionnaire with open-ended questions designed to elicit responses was selected.

Selection of Sample

A highly technical interdisciplinary program was identified that was currently being developed at forty community colleges nationwide. The colleges involved were members of a computer integrated manufacturing alliance with the IBM Corporation. Details regarding the obligation of each party in the alliance are contained in individual contracts between IBM and the educational institutions. The institutions were selected by the firm based upon their past history of innovative programs and cooperation with business and industry. The colleges received software and hardware from the industrial firm to facilitate the implementation of a computer integrated program. This program required the integration of entire enterprises ranging from engineering and manufacturing to accounting and marketing. Since the traditional academic departments for these disciplines are separate, an interdisciplinary approach was needed to integrate the program.

All forty community colleges in the alliance were contacted. These colleges were located throughout the United

States. Both rural and urban communities were represented. Enrollments ranged from 1,021 to 27,852 students (Torregrosa, 1990).

The individuals selected to participate were the community college representatives for CIM programs in the IBM/CIM Alliance in Higher Education. These community college representatives had first-hand knowledge of the organizational structure within their institutions, and their responsibilities for the day-to-day CIM activities made them aware of implementation problems related to the structure.

Instrument

Since mailed surveys do not allow for personal interaction with respondents, instructions on questionnaires must be clear and questions evaluated for ambiguity. The most serious limitation to this form of data collection is the relatively low response rate. Alreck (1985) indicates that a response rate of over 30 percent is rare. Since the questionnaire recipients' attitudes and interest in the topic have an effect on whether he or she completes the questionnaire, some groups may be underrepresented and others overrepresented, creating a non-response bias. However, since all recipients of the survey were representatives of the community colleges for their CIM programs, the interest level was expected to be high.

The ethics issues relating to survey questionnaires were discussed by Babbie (1973). Concerns include obtaining voluntary participation, ensuring no harm to respondents, allowing for anonymity and confidentiality. Although identification of purpose and sponsor will have some effect on completion rates and answers, the researcher should be honest with respondents. Honesty is also important to readers of the research. Analysis and reporting should include technical shortcomings of the research, disclosure of negative findings and unexpected results.

Open-ended questions can be used for nominal data, as was the form required in this survey. Advantages of this type of question are that unanticipated answers can be obtained, and a more accurate description of the respondents' views can be allowed as they are able to answer in their own words, rather than be forced to select a response from a predetermined list of possible answers (Fowler, 1988).

A copy of the "Survey Questionnaire" used to collect the primary source data appears as Appendix B.

The questions were designed to obtain descriptions of the organizational structure currently utilized for developing and implementing the Computer Integrated Manufacturing (CIM) Program. Three open-ended questions were developed to allow maximum flexibility to respondents in describing the organizational structure, identifying obstacles, and recommending alternative structural arrangements. The questions were patterned after those utilized in a survey conducted by Sexson (1990) which were designed to elicit perceptions regarding current conditions of interdisciplinarity and interdisciplinary programs in higher education.

Respondents were requested to use additional sheets if necessary to provide further explanation. Therefore, there were no constraints on the amount of information given.

To pre-test a questionnaire, it should be sent to a sample of people as similar as possible to the people who will receive the final questionnaire (Berdie, 1974). Also, questionnaire experts can be utilized to critique the questions. This may identify questions which are worded ambiguously. Also, pilot-test questionnaires should be given to respondents with no indication that they are not the final version (Sudman, 1983). After the surveys are returned, respondents are interviewed to determine whether they had any problems interpreting or answering the questions.

Other recommendations on pilot testing are obtained from de Vaus (1986). He adds that the questionnaire should be administered to a similar but smaller sample than that used in the actual study to assess the reliability and validity. The pilot-test method was selected for this study. To correct for ambiguity, the survey questions were reviewed by an IBM/CIM Manufacturing Fellow, the Division Chairman for Science and Engineering Technology, a Business Services Division faculty member, and a programmer/analyst, members of a Computer Integrated Manufacturing implementation team in a community college. They were asked to complete a questionnaire, and were interviewed to determine whether they had any problems interpreting or answering the questions. Since the questions were open-ended, a comparison of answers was made, rather than the calculation of a correlation co-efficient between the answers as is suggested for structured, closed questions. The researcher indicated that there is no ideal way of determining the validity of a measure, and that the method selected will depend on the situation. One method recommended was to define the concept and measures and give the questionnaire to a panel of judges to obtain their evaluations. This method was selected for this study. The President and Campus Provost of a community college, and a university professor in higher education administration served as the panel of judges.

Data Collection

A copy of the "Cover Letter" signed by the researcher appears as Appendix A. It stated the purpose of the survey, requested participation, assured responsibility, and offered a copy of the results to those who responded. The cover letter was sent with a blank "Survey Questionnaire" and self-addressed return envelope to survey participants.

The table used to record written responses followed the design of Sexson (1990). It contains three columns with the following headings: "Item No.," "College," and "Summary of Responses." Since individual responses were to remain anonymous, a letter of the alphabet was assigned to each college. That letter, instead of the college name, was placed next to each response.

Data Analysis

Responses to each of the three survey questions were summarized in the tables. Descriptions of organizational structures were presented and compared. Obstacles in developing and implementing the interdisciplinary program relating to the organizational structure were identified and compared. Finally, recommendations for alternative structures were presented and described.

CHAPTER IV

RESULTS

Introduction

The results of the survey and research on the organizational structures for developing and implementing computer integrated manufacturing programs in community colleges are presented and described in this chapter.

Conducting the Survey

Questionnaires were mailed to forty community colleges which were members of the CIM in Higher Education Alliance. Twenty colleges responded within two months, for a response rate of 50 percent.

Organization of the Chapter

This chapter is organized according to the survey instrument. Each question is presented along with observations and distributions according to the following sections: Colleges Surveyed; Descriptions of Organizational Structures (Appendix E); Problems with Organizational Structures (Appendix F); Recommendations For Alternative Organizational Structures (Appendix G); Unexpected Results; Summary and Results.

Colleges Surveyed

Colleges with both large and small enrollment were represented in this survey, as reflected on Table I. Questionnaires were sent to 13 colleges with 5,000 to 9,999 enrollments. Eight of these institutions responded. Ten colleges with enrollments below 5,000 were contacted with five responding. Seven colleges contacted had 10,000 to 14,999 enrollments. Only one of this group responded. There were six colleges with over 20,000 enrollments. Of this group, only three responded. Four colleges had 15,000 to 19,999 students enrolled. Three of these institutions responded to the survey.

TABLE I

ENROLLMENT OF COMMUNITY COLLEGES

Enrollment	Received Survey	Responded to Survey
Below 5,000	10	5
5,000 to 9,999	13	8
10,000 to 14,999	7	1
15,000 to 19,999	4	3
20,000 and above	6	3
	40	20

There was geographical representation throughout the United States, with the exception of the Northwest, as depicted in Table II. None of the colleges in the alliance were from this area. There were 12 colleges surveyed that were accredited by the Southern Association of Schools and Colleges, with seven responding. Twelve were accredited by the North Central Association of Schools and Colleges, with six responding. Eight institutions were accredited by the Middle States Association of Schools and Colleges. Three of these colleges participated. The Western Association of Schools and Colleges was the accrediting body for six schools, of which four responded. Two colleges were accredited by the New England Association of Schools and Colleges, with one responding.

TABLE II

REGIONAL INSTITUTIONAL ACCREDITING BODIES FOR COMMUNITY COLLEGES REPRESENTED IN THIS STUDY

Enrollment	Received Survey	Responded to Survey
New England Association of Schools and Colleges		
Connecticut	1	1
Massachusetts	1	0
	2	1
Middle States Association of Schools and Colleges		
Maryland	1	0
New Jersey	1	1
New York	4	1
Pennsylvania	2	1
	8	3

TABLE II (Continued)

Enrollment	Received Survey	Responded to Survey
North Central Association of Schools and Colleges		
Illinois	4	1
Indiana	1	1
Michigan	3	1
Ohio	1	0
Oklahoma	1	1
Wisconsin	2	2
	12	6
Southern Association of Schools and Colleges		
Florida	3	1
Georgia	1	1
Kentucky	1	0
Louisiana	1	0
North Carolina	2	1
South Carolina	3	3
Tennessee	1	1
	12	7
Western Association of Schools and Colleges		
California	6	4
Northwest Association of Schools and Colleges	0	0

Descriptions of Organizational Structures

Survey responses indicated that some organizations had a full-time employee assigned the primary responsibility for the CIM Program. Eight colleges, however, reported that responsibility for CIM was added to the duties of an existing position within the institution (see Table III, Page 37). Three colleges reported that a dean had program responsibility. In another organization, the Dean of Instructional Resources had responsibility for general oversight of the program; in another, the Dean of the Business Division and the Dean of Applied Science were co-coordinators; the third reported that the Dean of the Business Division and the Dean of Industrial Engineering Technology were co-directors. Two colleges indicated that their vice presidents were responsible for CIM. In one, the Vice President of Academic Computing controlled the project; in the other, the Vice President of Academic Affairs had overall supervisory responsibility. Two colleges reported that directors were responsible for CIM. The Director of the Technology Transfer Center provided the leadership on one organization. In another, responsibility was shared by three directors in Construction and Engineering Technology, Manufacturing Technology, and Industrial Operation Technology. Only one organization assigned responsibility for CIM to the department or division chair level. In that college, shop floor, engineering, and business chairs shared the responsibility.

TABLE III

POSITIONS TO WHICH CIM RESPONSIBILITY WAS ADDED

Position	No. of Responses
Dean	3
Vice President	2
Director	2
Division Chair	1

Six colleges reported having an employee whose primary responsibility was CIM (see Table IV). Three had the title of CIM Director, two were CIM Coordinators, and one was the CIM Manager.

TABLE IV

TITLE OF EMPLOYEE WHOSE PRIMARY RESPONSIBILITY IS CIM

Position	No. of Responses
Director	3
Coordinator	2
Manager	1

Since the questionnaire was open-ended regarding the description of the organizational structure, not all respondents chose to share this information. Among the six colleges reporting on this aspect of their organizational structure, the level to which the CIM leader reported varied. Only one college indicated that the CIM leader reported to the president (see Table V, Page 39). In two organizations, that person reported to a division or department chair; the Department Head of Engineering and Advanced Technology, and the Division Chairman of Science and Engineering Technology. Three colleges indicated that the CIM Director reported to positions at the level of vice president or dean. In one of the colleges, the CIM Director reported to the Vice President of Economic Development, and in another to the Vice President of Academic Affairs. The Dean of Academic Affairs supervised the CIM Director at the third institution.

TABLE V

SUPERVISOR OF EMPLOYEE WHOSE PRIMARY RESPONSIBILITY IS CIM

Position	No. of Responses
Vice President	2
Division Chair	2
Dean	1
President	1

Whether the CIM Director had supervision of faculty or other staff varied by college (see Table VI, Page 40). Only one college indicated that faculty reported to that position. Three colleges reported that the CIM Director supervised other staff. One CIM Director has a technical staff and academic departments that also report to a dean. These include Business Administration, Office Technology, Electrical Engineering Technology, Mechanical Engineering Technology, Civil/Construction, Automated Manufacturing, Computer Information Service, and Management/Industrial Engineering. Another college has the Programs Manager, Communications Specialist, and Project Engineers reporting to the CIM Director. The CIM Director in the third organization supervised five program directors: Accounting, Business, Engineering Technology, Computer Science, and Continuing Education.

TABLE VI

POSITIONS/AREAS REPORTING TO THE CIM DIRECTOR/COORDINATOR/MANAGER

Position	No. of Responses
Faculty	1
Technical Staff and Academic Departments	1
Program Directors	1
Programs Manager, Communications Specialist, and Project Engineers	1

Teams or committees were utilized in four of the colleges. The following six academic areas formed one committee: Continuing Education, Engineering Technology, Industrial Technology, Business Technology, Commercial Graphics Technology, and Computer Services. Another college had a committee comprised of eleven members including the President, Dean of Instruction, Dean of Continuing Education, Dean of Business Services, Public Relations Director, Director of Computer Services, and the Director of Special Training. The Business, Engineering and Technology Division Chairman, Robotics and CNC Instructor, and the Electronics Technology Instructor were also members. The third college indicated that the Mechanical Engineering Technology Instructor and two key faculty area coordinators formed the CIM team. Five committee members, the Academic Vice President, Technology Transfer Director, Academic Computers Director, Director of Business and Computer Science, and the Director of Industrial Technology were responsible for the CIM program in the other college.

The interdisciplinary aspect of computer integrated manufacturing was not emphasized in three of the colleges that reported separate divisions with independent program responsibility. The CIM program was located in the Manufacturing Technology Division of one college. Another established the program in a Center for Advanced Technology, a non-academic division. The other college had two independent programs, one in Industrial and Computerized Machining, and the other in Materials Management under the Business Division.

Problems with Organizational Structures

Respondents were requested to identify problems relating to the organizational structure. Four of the colleges reported no problems. Although fourteen problems were identified, only five could be attributed to the organizational structure. Among those not apparently related to structure were three colleges that indicated the lack of a common goal or common perspective, five with inadequate time or lack of faculty release time, and two lacked financial resources. Three responses involved the need for training, in team building or technical knowledge. Four colleges experienced resistance to supporting curricula outside the faculty's own division. Physical separation of divisions was mentioned by two colleges, with one attributing processing delays to this separation. Traditional work habits, the presence of a union, and the lack of incentives were other responses unrelated to the organizational structure.

Five problems were identified with the current organizational structures (see Table VII, Page 42). In four of the colleges, the structure did not facilitate the coordination of activities between the credit and non-credit areas. Three organizations expressed the need for additional personnel, including clerks, accountants, and a full-time CIM Director. The rigidity and inflexibility of the structure was a problem mentioned by respondents in two of the colleges. In two other organizations, the lack of involvement by individuals in upper administration indicated the absence of visible support. One respondent identified as a problem a structure which precluded the reporting by staff to the CIM Director.

TABLE VII

PROBLEMS WITH ORGANIZATIONAL STRUCTURE

Position	No. of Responses
None	4
Lack of coordination between credit and non-credit areas	4
Lack of Personnel	3
Rigidity and inflexibility	2
Lack of involvement by senior level administrators	2
Absence of supervisory responsibility in the CIM director's position	1

Recommendations for Alternative Organizational Structures

Respondents offered fourteen recommendations; however, three did not address the organizational structure. Five of the survey participants had no recommendations.

Of those recommendations not related to structure, three colleges recommended adjusting faculty schedules to allow more time for program development. Another college indicated the need for more time to be allotted for communication and participation. One respondent indicated that specific tasks and deadlines should be assigned to individuals.

Three recommendations made by five colleges involved the establishment of teams or committees. Two colleges indicated that the committee should cross the divisional boundaries within the college. One suggested that a steering committee should be co-chaired by the Academic Dean and the Dean of Continuing Education. The establishment of an industrial sector steering committee was also recommended.

Alternative placement of the CIM Program was recommended by five respondents (see Table VIII, Page 44). Two colleges recommended that the level of primary responsibility be raised to that of a dean or senior administrator. One suggestion was to establish the program under the college foundation. Another recommendation was to establish a separate legal entity for the CIM Program, so that it could be implemented and maintained outside the legal constraints of the college. Another respondent suggested keeping the existing departments and divisions for teaching CIM. Four recommendations related to the relationships among divisions. One suggested separating credit and non-credit, while another wanted to establish communications between the two areas. Involving more groups and disciplines was still another recommendation. Finally, the incorporation of continuing education for industry and business was recommended.

TABLE VIII

RECOMMENDED ALTERNATIVE ORGANIZATIONAL STRUCTURES

Position	No. of Responses
Establish teams or committees	5
Place CIM responsibility at the dean's level	2
Establish CIM under control of the college foundation	1
Establish CIM as a separate legal entity	1
Maintain existing divisions to teach CIM	1
Separate credit and non-credit areas	1
Establish communications between credit and non-credit areas	1
Involve more groups and disciplines	1
Incorporate continuing education for industry and business	1

Unexpected Results

Respondents to the survey included recommendations for development and implementation of computer integrated manufacturing programs which were not apparently related to the organizational structure. Although they were asked specifically to recommend alternative organizational structures, the problems they had experienced in the implementation of this complex interdisciplinary program caused them to focus on solutions to issues which were the most important within their organizations, including curriculum development, training, and human resources.

Problems identified included the lack of a common goal or perspective, time for program development, insufficient training, lack of incentives, and physical separation. The resistance of faculty, and their reluctance to support curricula outside their own division, the constraints stemming from union membership and traditional work habits were all problems cited as affecting college personnel and their values.

Responding to these concerns, recommendations were made to adjust faculty schedules, to allow sufficient time for communication and participation, and to establish specific tasks and deadlines for individuals.

Summary

The organizational structures of computer integrated manufacturing programs varied with respect to level of control, the degree of integration among divisions, and the supervisory span of control of the CIM Directors. These differences were reflected in the recommendations for alternative organizational structures which included raising the level of control, increasing the participation of divisions, and utilizing teams and committees to assist in program implementation.

CHAPTER V

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Richardson and Simmons (1989) described the academic organizational structure as homogenized and suggested that with changing priorities the structure may need to change. According to McHenry (1977), since problems cross academic departmental boundaries, problem-solving should not be restricted by disciplinary boundaries. Computer Integrated Manufacturing programs give rise to complex problems that cross departmental boundaries and require an interdisciplinary approach to development and implementation. This study found that some of the barriers to interdisciplinary programs identified by Abt (1970) are still present in community colleges. The factors he identified as promoting interdisciplinarity are reflected in the recommendations for alternative structures.

A survey questionnaire (Appendix B) with open-ended questions was developed to obtain descriptions of current organizational structures, identify problems with the structures, and provide recommendations for alternative organizational structures for developing and implementing Computer Integrated Manufacturing programs in community colleges. The questionnaire was mailed to forty community colleges throughout the United States who were members of the IBM/CIM Alliance in Higher Education. Respondents were the community college representatives for the Computer

Integrated Manufacturing Programs. These individuals were requested to return the questionnaires in self-addressed, stamped envelopes. Their responses to each question were summarized and recorded in Appendix E through Appendix G.

This chapter presents the findings of the research, study conclusions, and recommendations for further research.

Findings

The research was designed to identify the following: (1) characteristics of organizational structures utilized for developing and implementing Computer Integrated Manufacturing programs in community colleges, (2) problems associated with the organizational structures. An additional purpose was to obtain recommendations for alternative organizational structures for developing and implementing Computer Integrated Manufacturing programs in community colleges.

Organizational Structures

Appendix E summarizes the responses to survey Question 1: "Describe the organizational structure utilized to develop and implement the Computer Integrated Manufacturing Program at your institution. Identify the academic divisions involved. Specify the personnel by title and/or function responsible for implementing the program."

It was found that organizational structures varied in relation to level of control, integration of divisions, and supervisory span of control of the CIM Director. Three colleges reported that program responsibility was at the dean's level. In two colleges, a vice president had the program responsibility. Two colleges reported that directors were responsible for the CIM Program. Only one college indicated that program responsibility was shared at the level of division chair. Teams or committees comprised of individuals throughout the organizational hierarchy, from faculty to the college president controlled the CIM Program in four community colleges.

The divisions involved in the program and the degree of integration varied among the colleges in the survey. Three respondents indicated that the Computer Integrated Manufacturing Program was located within a single division with independent program responsibility. The business divisions and manufacturing and engineering divisions were working jointly on the program in ten of the colleges. The integration of credit and non-credit divisions was reported in three organizations.

Although six colleges indicated that they had an employee whose primary responsibility was to direct the CIM Program, only one had faculty reporting to that position. In three of the colleges, the CIM Director supervised non-faculty positions. One director had a technical staff and academic departments with dual reporting to the academic dean.

Problems with Organizational Structures

Appendix F summarizes responses to survey Question 2: "What problems have you encountered with respect to the organizational structure?" No problems were reported by four of the colleges. Five structural problems were identified by twelve respondents. Structures did not facilitate the coordination of credit and non-credit areas in four of the colleges. Lack of personnel was a problem expressed by three respondents. The rigidity and inflexibility of the organizational structure was identified in two colleges. In two institutions, the absence of high level administrators in the CIM project was perceived as a lack of support. Another respondent indicated that having a structure in which the CIM Director did not have supervisory control caused problems.

Recommendations for Alternative Organizational Structures

Appendix G summarizes the responses to survey Question 3: "If you had control over establishing the organizational structure, what would you do differently in view of the problems you have identified?" Recommendations were made to establish teams or committees, place responsibility for the program at a high level within the organizational hierarchy, and involve more divisions. Conversely, it was recommended that credit and non-credit be separated and existing departments and divisions be maintained for teaching CIM.

Unexpected Findings

Since the survey was intended to describe current organizational structures, identify problems related to them, and obtain recommendations for alternative structures, it was not anticipated that respondents would identify problems and make recommendations that were not related to the organizational structures. However, these problems and recommendations are reflective of research conducted by Abt (1970) in which he identifies factors that promote and factors that create barriers to interdisciplinary programs. Communications, methodological integration, and conceptual integration are factors he identified as promoting interdisciplinary programs. Inadequate communications among divisions and the lack of a common perspective were areas that caused problems implementing CIM. Barriers Abt identified included physical distance, institutional disincentives, lack of sufficient discipline and technical competence, and lack of time. These were all concerns shared by respondents in the CIM survey.

Study Conclusions

1. The characteristics of current organizational structures utilized to develop and implement CIM are not consistent. Organizational structures vary in relation to locus of control, the span of control, and the method of control.

2. Problems are encountered when the organizational structure is rigid and does not allow the members the flexibility to adjust their schedules and dedicate sufficient time for program development and implementation.

3. There is no agreement as to the level of position which should administer CIM; however, there is concern that the responsibility be placed at a high enough level within the hierarchy and possess the supervisory authority required to administer a program that involves the cooperation of personnel from several separate entities within the organization.

4. When a team or committee is utilized to implement CIM, members should be knowledgeable or be given training in team-building concepts to be effective in working with

members from a diversity of disciplines and hierarchial levels to implement a complex interdisciplinary program.

Recommendations

The present study was descriptive. Its purpose was to obtain descriptions of the current organizational structures utilized in community colleges for the development and implementation of an interdisciplinary program, Computer Integrated Manufacturing. Another purpose was to identify problems associated with the organizational structure and solicit recommendations for alternative organizational arrangements. Since it was a descriptive study, it was not a purpose to answer why structures exist in their current state or why specific problems occur; however, with the information obtained, a stimulus for explanation and further research was provided. Since computer integrated manufacturing is a new and complex concept in the community colleges this descriptive research identifies areas of concern for which further study is recommended.

The information obtained through the open-ended questions in the survey instrument can be used to develop a questionnaire to collect measurable statistical data from colleges and universities with computer integrated manufacturing programs. A future research study is recommended to identify the hierarchical importance of recommended characteristics of organizational structures.

The Likert Scales could be used in the survey questionnaire, with the findings of the present research serving as the dependent variables. The recommended format of the instrument is patterned after the one Sexson (1990) recommended for future research. It could be used to collect primary source, statistical data concerning the hierarchical importance of specific organizational characteristics. Respondents may rank their opinions according to the scale; strongly agree, agree, disagree, no opinion. Following is a list of suggested items:

1. The position responsible for CIM should report to a vice president.
2. The position responsible for CIM should report to a dean.
3. The position responsible for CIM should report to a division chair.
4. The position responsible for CIM should have supervisory control over the faculty in the CIM Program.
5. The position responsible for CIM should have supervisory control over non-faculty technical support staff.
6. If a committee or team is formed to implement CIM, membership should include a representative from continuing education.
7. If a committee or team is formed to implement CIM, membership should include a representative from the business academic division.
8. If a committee or team is formed to implement CIM, membership should include a representative from the manufacturing and engineering academic division.
9. If a committee or team is formed to implement CIM, membership should include a representative from the computer services administrative support area.

10. If a committee or team is formed to implement CIM, membership should include the college president.
11. If a committee or team is formed to implement CIM, membership should include academic deans.
12. If a committee or team is formed to implement CIM, membership should include academic division chairs.

The statistical results of the research would identify the hierarchical importance of specific characteristics of organizational structures, and the differences or similarities between the perceptions of representatives from community colleges and universities.

The effectiveness of utilizing committees or teams could be studied in the following areas: curriculum planning, faculty development, external relations with contributing disciplines, such as Mathematics, History, and English.

It is recommended that a future study focus on the faculty development needs within specific disciplines involved in CIM. Also, a common data base of skills and knowledge could be identified for faculty who plan to teach in a CIM curriculum. Faculty who are currently teaching in this area could be participants in identifying the appropriate skills and knowledge required in their specific disciplines.

Further research is recommended to develop in-depth case studies of existing computer integrated manufacturing programs focusing on coordination of credit and non-credit areas. The purpose of this research would be to develop a model that could be utilized by community colleges to establish new programs in which both the academic and non-credit areas would participate. In addition, case studies are recommended to identify successful methods of administering computer integrated manufacturing programs without having formal supervisory authority over faculty and staff involved in the program.

With the growing sophistication and complexity of technologies that integrate organizational functions, community colleges will be faced with the need for organizational structures that can administer programs that cross the traditional divisional and departmental boundaries. Further research involving exemplary computer integrated manufacturing programs can provide the knowledge for developing appropriate models for future program implementation.

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APPENDIXES

APPENDIX A

SURVEY COVER LETTER

Dear (name)

Each of the community colleges in the Computer Integrated Manufacturing Alliance in Higher Education is being sent the enclosed survey questionnaire. The purpose of the survey is to identify the organizational structures being utilized to develop and implement the Computer Integrated Manufacturing (CIM) Program, and to determine how the separate academic departments/divisions in which the manufacturing and business disciplines are located are being integrated into this process. More generally, another purpose is to identify the obstacles encountered with current institutional academic structures in the creation of interdisciplinary programs and to formulate recommendations for alternative organizational arrangements that could be utilized in the future for implementing programs that cross academic departmental boundaries.

Please complete the enclosed survey questionnaire within the next two weeks and return it in the postage-paid envelope for processing. Your responses will be compiled with those of the other alliance colleges and specific references will not be identified with individual institutions.

Following the completion of the survey, you will receive a summary of the findings which should be useful to you and your institution in planning future interdisciplinary programs. I am looking forward to analyzing the responses and reporting the results to you. The research will also complete dissertation requirements for the Doctor of Education Degree in Higher Education Administration at Oklahoma State University.

Your participation in this educational research effort is appreciated very much.

Flo Potts

APPENDIX B

QUESTIONNAIRE ON ORGANIZATIONAL

STRUCTURES FOR CIM

SURVEY QUESTIONNAIRE

Please respond to each question. Additional paper may be used if needed. Please indicate your name and institution. Your responses will be anonymous in the study; however, by including your name, you can be contacted by telephone to clarify responses or obtain further information. Also, you will receive a summary of the results. Your cooperation in this research endeavor is appreciated.

1. Describe the organizational structure utilized to develop and implement the Computer Integrated Manufacturing Program at your institution. Identify the academic divisions and/or departments involved. Specify the personnel by title and/or function responsible for implementing the program.

2. What problems have you encountered with respect to the organizational structure?

3. If you had control over establishing the organizational structure, what would you do differently in view of the problems you have identified?

Name

Institution

APPENDIX C

LIST OF COLLEGES THAT RECEIVED

THE CIM SURVEY

LIST OF COLLEGES THAT RECEIVED THE CIM SURVEY

Item No.	College
1	Augusta Technical Institute, Augusta, Georgia
2	Broome Community College, Binghamton, New York
3	Broward County Community College, Ft. Lauderdale, Florida
4	Camden County College, Blackwood, New Jersey
5	Catonsville Community College, Catonsville, Maryland
6	Central Piedmont Community College, Charlotte, North Carolina
7	Cerritos College, Norwalk, California
8	Chattanooga State Technical Community College, Chattanooga, Tennessee
9	Community College of Allegheny County, Pittsburgh, Pennsylvania
10	Cuyahoga Community College, Cleveland, Ohio
11	Danville Area Community College, Danville, Illinois
12	Delgado Community College, New Orleans, Louisiana
13	El Camino College, Torrance, California
14	Erie Community College, Williamsville, New York
15	Forsyth Technical College, Winston-Salem, North Carolina
16	Fox Valley Technical College, Appleton, Wisconsin
17	Grand Rapids Junior College, Grand Rapids, Michigan
18	Greenville Technical College, Greenville, South Carolina
19	Illinois Valley Community College, Ogelsby, Illinois
20	Indiana Vocational Technical College, Evansville, Indiana
21	Irvine Valley College, Irvine, California
22	Lansing Community College, Lansing, Michigan
23	Lexington Community College, Lexington, Kentucky

24 Los Angeles Southwest College, Los Angeles, California

25 Midlands Technical College, Columbia, South Carolina

26 Milwaukee Area Technical College, Milwaukee, Wisconsin

27 Monroe Community College, Rochester, New York

28 Moraine Valley Community College, Palos Hills, Illinois

29 Mt. San Antonio College, Walnut, California

30 New York City Technical College, Brooklyn, New York

31 Oakland Community College, Auburn Hills, Michigan

32 Pennsylvania College of Technology, Williamsport, Pennsylvania

33 Pensacola Junior College, Pensacola, Florida

34 Rock Valley College, Rockford, Illinois

35 Sierra College, Rocklin, California

36 Springfield Technical Community College, Springfield, Massachusetts

37 Thames Valley State Technical College, Norwich, Connecticut

38 Trident Technical College, Charleston, South Carolina

39 Tulsa Junior College, Tulsa, Oklahoma

40 Valencia Community College, Orlando, Florida

APPENDIX D

LIST OF COLLEGES THAT RESPONDED

TO THE CIM SURVEY

LIST OF COLLEGES THAT RESPONDED TO THE CIM SURVEY

Item No.	College
1	Augusta Technical Institute, Augusta, Georgia
2	Camden County College, Blackwood, New Jersey
3	Central Piedmont Community College, Charlotte, North Carolina
4	Chattanooga State Technical Community College, Chattanooga, Tennessee
5	El Camino College, Torrance, California
6	Erie Community College, Williamsville, New York
7	Fox Valley Technical College, Appleton, Wisconsin
8	Greenville Technical College, Greenville, South Carolina
9	Illinois Valley Community College, Ogelsby, Illinois
10	Indiana Vocational Technical College, Evansville, Indiana
11	Irvine Valley College, Irvine, California
12	Lansing Community College, Lansing, Michigan
13	Los Angeles Southwest College, Los Angeles, California
14	Midlands Technical College, Columbia, South Carolina
15	Milwaukee Area Technical College, Milwaukee, Wisconsin
16	Mt. San Antonio College, Walnut, California
17	Pennsylvania College of Technology, Williamsport, Pennsylvania
18	Pensacola Junior College, Pensacola, Florida
19	Trident Technical College, Charleston, South Carolina
20	Tulsa Junior College, Tulsa, Oklahoma

APPENDIX E

SUMMARY OF RESPONSES TO SURVEY QUESTION NO. 1: DESCRIPTION OF ORGANIZATIONAL STRUCTURES

NO. 1: DESCRIPTION OF ORGANIZATIONAL STRUCTURES

Item No.	College	Written Responses
1	A	CIM Director and Academic Deans report to the President. The technical staff, faculty with one-half release time, and academic departments report to the CIM Director, including Business Administration, Office Technology, Electrical Engineering Technology, Mechanical Engineering Technology, Civil/Construction Automated Manufacturing, Computer Information Service, and Management/Industrial Engineering. The academic departments also have a reporting relationship to the Academic Deans.
2	B	The CIM Manager reports as a staff position to the Vice President of Academic Affairs. The Dean of Trade and Industry, the Dean of Business Education, and Vice President of Support Services also report to the Vice President of Academic Affairs. No direct reporting to the CIM Manager.
3	C	The Dean of Instructional Resources is responsible for general oversight. Faculty in Business and Engineering teach CIM related courses in their respective schools.
4	D	All CIM related courses are offered as part of Manufacturing Technology.
5	E	The Director reports to the Vice President of Economic Development. A Programs Manager, Communications Specialist, and six Project Engineers report to the Director.
6	F	The Program Directors of Accounting, Business, Engineering Technology, Computer Science, and Continuing Education report to the CIM Coordinator. The CIM Coordinator reports to the Department Head of Engineering and Advanced Technology who reports to the Dean of Business, Health, and Technology. The Department Heads of Business, Accounting, and Computer Science are also involved in the program.
7	G	The CIM Coordinator reports directly to the Division Chairman of Science and Engineering Technology, and works with the Chairman of Business Services Division.

8	H	Program chairs in the Shop Floor, Engineering, and Business areas report to the Division Chair of Applied Science.
9	I	The CIM program is located in the Center for Advanced Technology, a non-academic division.
10	J	The Advanced Technology Department, within the School of Science and Advanced Technology, has the lead role in the organization of CIM, and includes Automated Controls, Networking, CAD/CAM, Machining, and Robotics areas. The Business Department is responsible for MAPICS and the Computer Science Department.
11	K	The Business and Industry Training Division reports to the President, and coordinates Engineering Technology, Continuing Education, and special projects.
12	L	The Vice President for Academic Computing controls the CIM project. CIM Committee members include Continuing Education, Engineering Technology, Industrial Technology, Business Technology, Commercial Graphics Technology, and Computer Services curriculum areas.
13	M	The Dean of Planning, Research, and Development who developed the CIM curriculum reports to the President. The CIM Director who implemented degree programs, reports to the Dean of Academic Affairs (he initially reported to the President).
14	N	The Dean of the Business Division and the Dean of Applied Science are Co-Coordinators of CIM.
15	O	An enterprise committee has responsibility for overall development and coordination. The Chairperson is the Associate Dean of Career Education and serves as CIM Project Director. Committee members are the President, Dean of Instruction, Dean of Continuing Education, Dean of Business Services, Public Relations Director, Director of Computer Services, Director of Special Training, Director of Manufacturing and Technology, Robotics and CNC Instructor, and Electronics Technology Instructor. (The Business Division and the Engineering and Technology Division were combined, and the Chairman serves on the CIM Committee.

16	P	The Dean of the Business Division, and the Dean of Industrial Engineering Technology Division are Co-Directors of the CIM project. They report directly to the Vice President for Educational Affairs. A CIM team lead by an instructor in the Mechanical Engineering Technology department includes two key faculty area coordinators from both academic divisions, and is responsible for the technical aspect of constructing, implementing, and evaluating CIM curricula and laboratory requirements.
17	Q	Two separate programs in the Technical Division, Industrial and Computerized Machining, and the Materials Management Program in the Business Division introduce CIM concepts.
18	R	The Vice President of Academic Affairs has overall supervisory responsibility for CIM. The Dean of Academic Affairs is responsible for program implementation. The Department Chair of Business, and the Department Chair of Math/Technology supervise instructors in Business, CAD, and Electronics. The Computer Science instructor facilitates installation of computers
19	S	Leadership is provided by the Director of the Technology Transfer Center. A Programmer Analyst and Electronic Specialist provide support. The Director of Industrial Technology is responsible for content in the instructional division. A CIM Steering Committee includes the Academic Vice President, Technology Transfer Director, Academic Computers Director, Director of Business and Computer Science, and Director of Industrial Technology.
20	T	The Director of the Construction and the Engineering Technology Department, Director of Manufacturing Technology, and the Director of Industrial Operation Technology report to the Dean of the Division of Technology and Applied Sciences.

APPENDIX F

SUMMARY OF RESPONSES TO SURVEY QUESTION

NO. 2: PROBLEMS WITH

ORGANIZATIONAL

STRUCTURES

SUMMARY OF RESPONSES TO SURVEY QUESTION

NO. 2: PROBLEMS WITH ORGANIZATIONAL STRUCTURES

Item No.	College	Written Responses
1	A	Rigid structure, union, and traditional work habits.
2	B	No direct reporting to CIM Manager, no direct involvement by Vice Presidents, dependent upon teams without teamwork training, limited resources and instructor release time.
3	C	None
4	D	Business/Management students don't look for courses under a manufacturing title, Business faculty are reluctant to support curricula outside the Business Department.
5	E	Lack of clerical and accounting support, bureaucratic constraints not conducive to innovation.
6	F	Need a full-time CIM Director, should have worked with the Dean of Continuing Education for better monitoring of all credit and non-credit activities, the credit team took over the facilities and the program.
7	G	None
8	H	Need more people and time.
9	I	Obtaining complete acceptance of the Business Division, which is using the system in limited courses.
10	J	Difficulties in generating a high degree of interdepartmental interest with a common goal, real academic support at the highest administration level is not obvious.
11	K	Divisional constraints including lack of release time, lack of incentives, and lack of current technical knowledge by the faculty.
12	L	Time conflicts between regular teaching loads and demos or seminars, academic and continuing education conflicts in scheduling facilities.

13	M	Conflicts between credit and non-credit curriculum and course development and implementation.
14	N	None
15	O	No major problems.
16	P	Physical separation, philosophical differences, different levels of understanding of manufacturing processes.
17	Q	Identification of faculty development time, and publicizing the program and opportunities to the faculty.
18	R	Delays in processing fiscal and contract documents through district office.
19	S	Potential competition between academic divisions and non-credit business/industry outreach, insufficient financial resources for development of hardware, software, and curriculum.
20	T	Lack of a common perspective for communicating CIM topics and issues, blending the needs and requirements of departments and program to accomplish a common goal or project.

APPENDIX G

SUMMARY OF RESPONSES TO SURVEY QUESTION
NO. 3: RECOMMENDATIONS FOR
ALTERNATIVE ORGANIZATIONAL
STRUCTURES

SUMMARY OF RESPONSES TO SURVEY QUESTION

NO. 3: RECOMMENDATIONS FOR ALTERNATIVE ORGANIZATIONAL STRUCTURES

Item No.	College	Written Responses
1	A	Adjust faculty schedules.
2	B	Establish a self-managing team that would cross departmental and divisional boundaries to work on CIM projects.
3	C	None
4	D	Offer CIM related courses within existing divisions/departments.
5	E	Establish legal entity with a Board of Directors and operations independent of the State, maintaining the technology transfer focus.
6	F	Create a steering committee with the Academic Dean and Dean of Continuing Education as co-chairs, with a full-time CIM Director reporting to both Deans.
7	G	None
8	H	Dedicate 75 - 100 percent faculty time to CIM project.
9	I	None
10	J	Assign responsibility to individuals for specific tasks and deadlines.
11	K	Incorporate all industry and business continuing education.
12	L	Involve more groups and disciplines, and establish communication between continuing education and curriculum.
13	M	Separate credit and non-credit, with CIM Director responsible for CIM curriculum, and factory floor operations.
14	N	None
15	O	None

16	P	Establish the Dean of Business and the Dean of Industrial and Engineering Technologies Divisions as co-directors for the CIM project, which would place primary responsibility requirements at a higher level.
17	Q	Establish a senior administrator and industrial sector steering committee.
18	R	Develop the program under the auspices of the college foundation, rather than under the district.
19	S	Establish interdisciplinary teams and increase the number of split teaching/CIM development positions to maximize the linkage between shop floor development, business/industry outreach, and instructional credit programs.
20	T	Allow for the high level and frequency of communication and participation required in CIM.

VITA 2

Flo E. Potts

Candidate for the Degree of

Doctor of Education

Thesis: A STUDY OF COMPUTER INTEGRATED MANUFACTURING PROGRAMS IN COMMUNITY COLLEGES

Major Field: Higher Education

Biographical:

Personal Data: Born in Walters, Oklahoma, March 21, 1947, the daughter of Ella Eulalia and Floy Arnold. Married Edward S. Potts, sons Geofrey and Bradley, step-son Greg.

Education: Graduated from Walters High School, Walters, Oklahoma, in May, 1965; received Bachelor of Science Degree in Business Administration from Oklahoma State University at Stillwater in May, 1969; received the Master of Science Degree in Occupational and Adult Education from Oklahoma State University in May, 1982; completed requirements for the Doctor of Education in Higher Education Administration from Oklahoma State University in May, 1992.

Professional Organizations: Vice President of Commissions for Oklahoma Association of Community and Junior Colleges (OACJC), Past Vice President of Elections for OACJC, Phi Kappa Phi, Higher Education Alumni Council of Oklahoma (HEACO), and National Council of Instructional Administrators.

Professional Experience: Dean of Instruction, Chairman Business Services Division, and Adjunct Faculty, Northeast Campus, Tulsa Junior College, 1985 to Present; Human Resources Consultant, Arthur Young and Company, 1984 to 1985.