THE SYSTEMS APPROACH TO SCHOOL CONSTRUCTION-- THE POTENTIAL BENEFITS, THE NECESSARY CONDITIONS, AND THE IMPLICATIONS FOR MICHIGAN SCHOOLS

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ABSTRACT

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This study of the systems approach to school construction consisted of three sub-studies.

The first sub-study was conducted to determine what the planners and users of systems school buildings perceived to be the potential benefits of the systems approach to school construction.

The second sub-study was conducted to determine those fundamental conditions that a select group of experts in the school plant planning field perceived to be important for the full realization of the potential benefits of the systems approach to school construction.

The third sub-study was conducted to determine the extent to which those conditions perceived to be important for the full realization of the potential benefits of the systems approach to school construction are to be found in Michigan.

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Twenty-four potential benefits were identified through the use of questionnaire data that were submitted by users and planners of systems buildings in the California School Construction Systems Development (SCSD) project, the Toronto Study of Educational Facilities (SEF) project, and the Florida Schoolhouse Systems (SSP) project.

Lower construction costs, higher quality of construction, shorter project delivery time, and more flexible school buildings are among the potential benefits that may be realized in systems school construction. The use of systems does not appear to guarantee these benefits, but it has permitted them.

Twenty conditions perceived to be important to the optimal realization of the potential benefits of the systems approach were identified through questionnaires submitted by a select group of nationally and internationally recognized experts in the school plant planning field. Many of these conditions are equally important to the traditional approach to school construction, but some are distinctive.

Systems projects that are designed to develop one or more new building systems have special requirements particularly related to the need for a large-volume market. The single-school systems approach requires subsystems already on the market.

Data used to compare the existing conditions in Michigan with those conditions perceived to be important

to systems construction were obtained through personal interviews. Sources of information included: the Michigan Department of Education, the Health Department, school administrators, the Michigan Association of School Administrators, a school attorney, architects, the Fire Marshal, and a building trades union official.

School board members and school administrators in Michigan generally are not aware of the potential benefits that may be realized through systems construction.

The Michigan Department of Education has not promoted systems construction in Michigan.

Large scale systems development projects are not feasible for Michigan at this time.

The off-the-shelf use of systems is the approach to systems construction that currently offers the greatest promise to school districts in Michigan. There are no identifiable conditions in Michigan that prevent use of this approach. At the same time, there are no indications of pressures that would hasten the widespread use of this approach.

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INTRODUCTION

A phenomenon having great significance for the American society during this period is that of people involvement--involvement of people in those affairs that are important to their social, economic, and political life styles. Involvement areas for the citizenry that appear to be high on the priority list are those few areas still remaining where individuals feel they have a voice; a voice that can be heard, and a voice that will count. This is particularly the case for activities dependent upon taxpayer support through referendum elections. The public school system of Michigan fits very neatly into this category.

Citizen involvement in public school affairs, today, is no longer comprised of electing a board of education to make the decisions for the community to support with unquestioning acquiescence. No longer is there more than a limited contentment to give free rein to school people to make any kind of decision that could impose financial obligations upon a community. Today, school patrons are looking for a greater piece of the

action. They desire a greater role in determining what will happen within the public schools; an involvement demanding programs of greater excellence and requiring accountability. With mounting demands being made upon the schools, accompanied by inflationary trends of the times, it has come to be more and more difficult to convince the taxpaying public that it is receiving a reasonable return for the many dollars it invests in the educational enterprise. The literature is replete with instances of the taxpayer revolt which gives evidence to this position. The taxpayer is not content with the return received from his tax dollar. He has balked, and it is only with increasingly fervid reluctance that he becomes willing to loosen the purse string controlling the outward cash flow. Voted dollars come directly from the taxpayer, and only to the extent of his willingness. He is not asking to be coddled, but he is demanding assurance, an assurance his dollar will purchase a dollar's value. Such assurance is not easily extended today.

School taxes account for a major proportion of the local property tax levy in Michigan. Usually the larger share of school taxes are for operational purposes, but even so, the portion of the local tax levy for construction purposes is very significant in a number of school districts. Voted construction dollars

are difficult to obtain, and even once obtained, the purchasing power is diminished at a rapid rate by the inflationary process. Supporting this observation are several salient points extracted from a national study:

1. During 1969, building costs rose 10 percent or more in many parts of the country.
2. Less than one-half the dollars requested for construction in 1969 was approved by the voters.
3. The cost of building a new school has increased by 40 percent in the last decade.
4. School building costs have increased by 133 percent since 1947.
5. On-site labor costs have increased by 63 percent since 1967.
6. Off-site labor costs have increased by 61 percent since 1967.
7. Material costs have increased by 19 percent since 1967.
8. Interest rates on some bond issues have been in excess of 8 percent.[1]

Paradoxically, school districts are confronted, it seems, with a perplexing problem of trying to obtain greater results with fewer dollars that are diminishing

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[1]Orlando F. Furno and James Doherty, "The Cost of Building in 1970: Out of Sight!" School Management (Reprint from July and August, 1970).

in purchasing power. Those school districts requiring expansion or replacement of buildings and facilities are confronted not only with gaining taxpayer acceptance of additional obligations, but in addition, they must deal with a construction cost situation that tends to soar unrestrained. The spiraling costs of school construction tend to exacerbate the growing lack of confidence taxpayers have in the financial astuteness of school officials. Thus, demands are being made for fiscal responsibility as they have never been made in the past. The challenge to school officials is clear. The demands for accountability dictate that capital outlay dollars for construction must be expended in the most educationally defensible way; in a manner that promises maximal return for the amounts invested. The need, therefore, is for educational facilities that are functional and can adapt to changes in program throughout the structural life of the facilities--buildings having reasonable initial costs and reasonable long-term costs of operation.

School buildings require sizeable investments in most communities. If school officials are to maintain any semblance of public confidence, it is essential that they be accountable to the public for wise expenditures of public funds. It becomes imperative, then, to examine current capital outlay expenditure practices to determine

if such practices can be modified in a fashion that permits better accomplishment of established objectives. To meet such a challenge, one that requires satisfying educational objectives while maintaining support of the citizenry, is none too easy a task. Yet, there appears to be no viable alternative. The challenge remains!

BACKGROUND

Early in 1970, it was reported that a method of school construction had been developed in Florida that had demonstrated "better schools could be built, that they could be built more quickly (construction time was as short as 6 months for complete elementary schools), and with fewer dollars."[2] The vehicle receiving credit for this time-cost-quality phenomenon is Systems Construction. Should this account prove to be accurate, and should the systems approach be applicable and feasible in other localities, it would behoove school officials to become acquainted with this process. The systems approach may be able to offer a great service to school construction programs and, at the same time, offer evidence to the taxpaying citizenry of a greater commitment to accountability. There may be a potential waiting to be tapped.

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[2]"Florida's System Schools, Rx for More School vs. Fewer Dollars," Council of Educational Facilities Planners Journal, January/February, 1970, p. 12.

While systems construction has been in use in Europe, Russia, Canada, and the United States, its application in school construction is not commonplace. The "grandfather" of systems schools originated in England following World War II with the development of the Consortium of Local Authorities Special Program (CLASP). Capitalizing on the CLASP experience in standardized building components, bulk bidding procedures, and new management and construction practices, the School Construction Systems Development program was begun in California in the early 1960s. This systems program was followed by Toronto's Study of Educational Facilities (SEF) and Florida's Schoolhouse Systems Project (SSP) in the middle 1960s.

The claims that are made for higher quality construction, and the declared financial savings coupled with the additional claims for reduced construction time have caused a considerable amount of discussion to be generated among school officials. Much of this discussion has been on the surface rather than in depth. There has been no concerted trend to jump onto the systems "bandwagon," but rather, caution has become the key word. Many school people who might act are inertia bound; they resist most change. For them, it is wait and see. There are those who doubt any benefits can be derived from the systems approach. There are

those who believe certain benefits are available but too many obstacles stand in the way of their attainment. And then there are those who just do not know what to think. Apparently lacking an adequate source of readily available information, and having no first-hand experience with the systems approach, perhaps the great majority of schoolmen are in a relatively poor position to make any kind of rational judgment regarding systems construction. For lack of time and sufficient opportunity to ferret out the required data, they remain uninformed.

When involved in systems discussions, one hears many questions regarding the systems approach. What do building construction systems really have to offer? Why have Michigan school districts failed to do more with the systems approach? Can a single school district, by itself, build systems schools? Will the legal structure within which schools must operate permit such practices as bulk bidding, fast-tracking, and cooperative purchasing? Is it permissible to establish consortia? How well will a systems school accommodate individualized learning, the changing role of the teacher, grouping requirements, and open-space activities? Will systems accommodate traditional as well as innovative curricular programs of instruction?

And then, how about the Department of Education, the Fire Marshal, and the construction unions? Are

they willing to cooperate in such a venture? How much "red tape" will there be? Is the systems approach advantageous or even feasible in given situations?

As questions such as these are very significant, they merit the attention of those persons charged with the responsibility of planning and expediting the construction of school plants. When questions remain unanswered, and when claims, counter-claims, and opinions are glibly offered, the school planner finds himself in a state of uncertainty, to say the least. Yet he must find his way through this quandary if he is to have reasonable confidence and assurance that he has established an appropriate position on the use or non-use of systems in meeting the construction needs of his school district.

Need for the Study

At no one point was there a sufficient gathering of information available from which one might obtain answers to his questions regarding the systems approach to school construction, and then make an educated decision. There was a need, therefore, for an overview study of systems building.

This study was initiated to determine those benefits that were perceived to be potentially available through using the systems approach, and, also, to

ascertain what were perceived to be conditions that must pertain to acquire them. Until information of this kind is made available for facilities planners to study, their ability to consider the pros and cons of systems construction will remain severely restricted.

THE PROBLEM

It is desirable that facilities planners have adequate and up-to-date information on all important technological developments in the school construction industry. It appears that systems building may be at the stage of development where school planners no longer can justify not being familiar with the systems approach and the implications it has for school construction. Familiarization with the systems approach calls for an awareness of systems technology, an awareness of new management techniques, a conversancy with systems rhetoric, and a general knowledge of what the systems approach is all about. An assemblage of data encompassing the potential benefits and the conditions under which the systems approach is applicable, will be helpful to planners who wish to make decisions regarding the possible implementation of the systems under specific circumstances and given conditions.

Statement of the Problem

The problem was to determine what the current planners and users of systems school buildings perceived to be the potential economic and educational benefits inherent in the systems approach to school construction, to determine conditions perceived by selected experts that must exist for optimal utilization of the benefits, and to test the possibility of using systems building in Michigan.

Analysis

The study was divided into three distinct sub-problems which received treatment as three separate sub-studies. Thus, the solution to the problem called for solving the three sub-problems that follow:

Sub-Problem 1

The problem was to determine what was perceived by the current planners and users of systems school buildings to be the potential economic benefits and the potential educational benefits inherent in the systems approach to school construction.

Sub-Problem 2

The problem was to determine those fundamental conditions that a select group of experts in the school plant planning area perceived to be

important for the full realization of the potential benefits inherent in the systems approach to school construction.

Sub-Problem 3

The problem was to determine the compatibility of conditions existing in Michigan school districts with those conditions perceived to be important to the full realization of the potential benefits of systems construction.

Delimitations

In order to narrow the scope of the study, the investigation to determine the perceived potential benefits in Sub-Problem 1 was limited as follows:

1. The study was confined to the School Construction Systems Development program (SCSD) in California, the Study of Educational Facilities (SEF) in Metropolitan Toronto, and the Schoolhouse Systems Project (SSP) in Florida.
2. Data for the study were obtained in March and April, 1971, and were limited to those submitted by principals in systems buildings, superintendents or directors (or their designees) of those districts having systems buildings, and from members of the system project staffs.
3. Data were limited to those obtained through a mailed questionnaire.

4. The sample was composed of forty-six building principals, twenty-nine school district administrators, and four systems project staff personnel.

The investigation to determine the fundamental conditions in Sub-Problem 2 was limited as follows:

1. The study was confined to the perceptions of twelve persons generally conceded to be among the most knowledgeable educational facilities planners in the United States. Their extensive experience and backgrounds have qualified each for a reputation of being highly competent, and their opinions in school plant matters are highly respected. Included in this select group were nationally and internationally known architects, systems program directors, and high-ranking officials from Educational Facilities Laboratories, Inc. (EFL) and the Council of Educational Facilities Planners (CEFP). In addition, this select group included key personnel from Stanford University's School Plant Planning Laboratory, California's Department of Education Bureau of School Planning, and the Facilities Development Staff of the United State Office of Education.
2. Data for the study were obtained during the months of March and April, 1971.

3. Data were limited to those obtained from respondents to the mailed questionnaire.

The investigation to compare the conditions determined in Sub-Problem 2 with those conditions under which Michigan school districts normally operate, as required in the investigation of Sub-Problem 3, was subject to the following limitations:

1. Sources of data were limited to the State of Michigan Department of Education and those state agencies that function with the Department of Education as reviewing agencies of school district building programs to the extent such data were available. Information required for the study and unavailable at the above sources was obtained in the Lansing and Detroit metropolitan areas from architectural firms, from a school attorney, from a labor representative, and from school district administrators in Tri-County areas of Macomb, Oakland, and Wayne Counties exclusive of Detroit.
2. The data for the study were collected in April and May, 1971.
3. The collection of data was limited to those obtained by personal contact with the source.
4. The investigation was confined to that which was applicable to the Tri-County area.

5. The investigation was limited to public school districts having grades kindergarten through twelve.

THEORETICAL FRAMEWORK

A basic premise upon which this study was formulated was that if rational decisions regarding use or non-use of the systems approach are to be made, the decision maker must have access to considerably more information than that which is readily available to him at this time.

There was no one source of information that included the potential benefits of, and the conditions required by the systems approach to school plant planning which incorporated facts and opinions codified for immediate use. Thus it was appropriate to assemble pertinent data from perceptions held by recognized experts--those select persons who have been closely associated with the systems approach, and those whose expertise and knowledge qualified them to make informed judgements.

Assumptions

1. The opinions of recognized experts in the field of school plant planning are valid in the absence of data that have been established experimentally.

2. Developers and users of systems programs and systems buildings have studied the problem sufficiently to make valid judgements.
3. Although differences exist among the fifty states and Canada, there is enough similarity among them that the potential benefits attributable to the SCSD, SEF, and SSP have universal applicability.
4. There are identifiable conditions that increase or decrease the advisability of using the systems approach to school plant construction.

Definitions

Literature in the school plant planning field contains numerous terms which are in common usage and generally understood by most readers of school planning literature. Such terms are in frequent use throughout this study without benefit or need of special definition. For some terms used in discussions of the systems approach to school construction there is no common understanding of their meanings. The term "system," for example, has been taken to mean a number of different things ranging from a simple construction brick to a complex school building structure. As there is no commonly recognized lexicon of systems terms to which the reader may refer, those terms requiring clarification of meaning as used in this study are defined below:

Building System or System.--The composite of interrelated and integrated component subsystems with a base of information which defines the relationships among the components, which together, or with the addition of other parts or components, form a building. Normally the components are mass-produced.

Building System, Closed.--A building system with interface requirements predetermined to the extent that only given manufacturers' components integrate exclusively with one another.

Building System, Open.--A building system with interface requirements that permit components or subsystems from different manufacturers to be used interchangeably, and thus permitting numerous options.

BSIC.--Building Systems Information Clearinghouse.

CEFP.--Council of Educational Facilities Planners.

CLASP.--Consortium of Local Authorities Special Program.

Compatibility.--The coordination between two or more components or subsystems.

Component.--A unit designed to perform a given task. A subsystem is a precoordinated building component.

Consortium.--A cooperative of school districts joined together for the purpose of pooling their requirements, receiving joint bids, and nominating successful bidders on their assumption that bulk bidding and purchasing reduces costs.

EFL.--Educational Facilities Laboratories, Inc.

Fast-tracking.--A process of overlapping certain steps in the building process to provide increased efficiency by reducing the amount of time normally required in the building process.

General Contractor.--The firm to whom a school district has awarded a contract for construction of a school building.

HVAC.--The heating, ventilating and air-conditioning subsystem.

Industrialization.--The shifting of work from the school building site to a factory or shop where the more efficient assembly line procedures can be employed in the manufacture of building parts. On-site manual labor is replaced by mechanization wherever possible to obtain the highest level of productivity and quality.

Interface.--The boundary where two subsystems join, touch or affect each other. Interfacing

compatibility involves predetermined ability of components to "mesh" as contrasted to on-the-job cutting and fitting.

Modular.--Having standardized dimensions which make for exact fit in a number of arrangements. Tinker Toys are an example of modular objects.

Off-the-Shelf.--A term describing products or components which have been developed to perform given tasks and are available for purchase, ready made.

Open-Space.--The free-flowing area within a building, usually limited in the amount of visual and acoustical separation between teaching stations or areas. Space becomes increasingly open as partitions decrease and area increases.

Performance Specification.--A construction specification based on performance criteria consisting of user needs as distinguished from a descriptive specification.

Prebidding.--The bidding of subsystems before the general contract is bid in multi-stage bidding procedures.

Regulatory Agencies.--Agencies having regulations affecting school districts, The Health Department, the Department of Education, and the Office of the Fire Marshal are regulatory agencies.

SCSD.--School Construction Systems Development.

SEF.--Study of Educational Facilities.

SSP.--Schoolhouse Systems Project.

Subcontractors.--Those contractors who contract with the general contractor to perform a specific task which is a portion of the over-all general contract.

Subsystem.--A component part of a building system. Examples of subsystems are structure, lighting-ceiling, HVAC, demountable partitions, etc. Subsystems are often referred to as systems.

Systems Approach.--The systems approach to school construction is the process used in school building "systems programs." It involves viewing the planning, construction, and building use processes as interrelated and interdependent, and as working together for the overall objectives of the whole.

Common to the approach used in systems programs are the following:

1. The preparation of user requirements.
2. The development of performance specifications based upon user requirements.
3. The industrial development of compatible components (the development may be sponsored by a

consortium) and/or off-the-shelf selection of components as a solution to the performance specifications.

4. The prebidding of compatible components (subsystems).
5. The bidding of the general contract based upon the preselected subsystems.

A basic characteristic of the systems approach is its standardization and industrialization of major components as contrasted with custom building in conventional construction programs. It implies in-factory rather than on-site construction.

Systems Building.--A building in which two or more subsystems are used, one being the structure. Also a construction process which utilizes performance specifications based on user requirements, and the integration of components or subsystems into a coordinated whole.

Systems Programs.--Examples of systems programs are the School Construction Systems Development (SCSD), the Study of Educational Facilities (SEF), and the Schoolhouse Systems Project (SSP).

User Requirements.--The needs of the building users including educational requirements, code and

regulatory agency requirements, and other needs peculiar to school districts that participate in systems building programs.

Chapter 2

REVIEW OF THE LITERATURE

Literature on construction of schools with systems methods and systems products was nearly non-existent until after World War II. In fact, the building industry in general had been characterized by its slowness to respond to modern techniques. A few years ago, Jan C. Rowan wrote that a carpenter could rise from his 18th Century grave and begin working on a contemporary construction job without drawing much attention.[1] More recently, William W. Chase wrote: "No one would think of building a little red schoolhouse today. Yet the same old-fashioned method used to build little red schoolhouses is still being used in constructing present-day schools."[2] This may all be changed by the systems approach to construction. The purpose of this chapter is to review the literature and report on the progress made by the systems approach to date.

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[1]Jan C. Rowan, "Editorial," Progressive Architecture, June, 1968, p. 93.

[2]William W. Chase, "Off-the-Shelf-Schoolhouses," American Education, January-February, 1971, p. 8. (Hereinafter referred to as "Off-the-Shelf-Schoolhouses.")

The first reported example of industrialized or systems building was that used in the construction of London's Crystal Palace in 1851. The designer, Joseph Paxton, used a method now known as "prefabrication" to build the 800,000 square-foot structure with mass-produced parts.[3]

In 1910, an article written by Walter Gropius, a German architect, proposed the industrialization of housing. It is reported that he recommended repetitive production of parts that could be "made by machine to the same standard dimension and with provision for interchangeability of parts."[4]

And in 1919 a building system was introduced in England that consisted of cast-in-place concrete walls using factory-made steel forms. It was designed to construct housing up to four stories in height. Known as Easiform, the system is still being used.[5]

After World War II, a number of countries in Europe utilized systems building in their housing industry. Among them were Czechoslovakia, England and Wales, Denmark, Germany, France, Holland, Sweden, and

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[3]"Systems Building," Engineering News-Record, October 30, 1969, p. 64. (Hereinafter referred to as "Systems Building.")

[4]Ibid.

[5]Ibid.

Russia.[6] Cost figures are reported to be rather elusive, but the United Nations study of industrialized building concludes systems have reduced building costs by 10 to 15 percent.[7]

There have been numerous articles written about systems building. But as this investigation is based upon the systems approach in school construction, the review of the literature, from this point forward, will be limited to authoritative sources that describe school building systems as they have evolved for use in the United States today. The review is presented in five categories:

1. The Consortium of Local Authorities Special Program (CLASP) in England.
2. The School Construction Systems Development (SCSD) Project in California.
3. The Study of Educational Facilities (SEF) in Metropolitan Toronto.
4. The Schoolhouse Systems Project (SSP) in Florida.
5. Individual systems projects.

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[6]Peter Barnard Associates, "The Role of the Ontario Housing Corporation in System Building" (Ontario: Ontario Housing Corporation, August, 1970), p. 53. (Mimeographed.)

[7]"Systems Building," p. 74.

The Consortium of Local Authorities Special Program (CLASP) in England

Systems construction of schools in the United States has been patterned after the CLASP program of prefabricated construction. The CLASP system of construction was developed in answer to England's post-war shortages of manpower and materials and the problem of having to provide classroom space for over a million youngsters in a seven-year period--the equivalent of over 400 new schools per year.[8]

In 1946, the County Council of Hertfordshire was responsible for the development of a school building system. Prefabricated building components were manufactured and assembled on the site with minimal labor and lowered skill requirements. Eleven schools were built from components in 1947 with twenty-one more approved for the following year. The importance of this accomplishment was that for the first time, schools had been built from components on a serial basis rather than on a one-by-one basis.[9]

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[8]School Construction Systems Development, British Prefabricated School Construction, Report Number 2 (Stanford, California: School Planning Laboratory, 1962), p. 7. (Hereinafter referred to as Prefabricated School Construction.)

[9]Ministry of Education, Building Bulletin 19: The Story of CLASP (London: Her Majesty's Stationery Office, 1961), p. 7. (Hereinafter referred to as Building Bulletin 19.)

The cost of construction was high and the rate of construction was too slow to meet the acute need. Development work had been centered around one-story elementary schools and there was need for secondary schools with several floors. A further complication was the reduction in the construction allowance per child. It is reported to have dropped by one-third from 1949 to 1951.[10]

The Ministry of Education began assisting in the development work. Efforts were made to decrease square foot costs and the amount of space per student. Standard plans were not the answer. As there had been no national standards for component development, the problem was to find suitable dimensions around which a closed system could be evolved. Early attempts resulted in systems of concrete, aluminum, steel, and combinations of steel and other materials.[11]

In 1955, the Nottinghamshire County Architect's Department and the Education Department reviewed thirteen systems of construction. They decided upon a dimension grid that could adequately meet the different structural requirements in educational buildings. None of the existing systems was completely suitable as the

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[10]School Construction Systems Development, Prefabricated School Construction, p. 7.

[11]Ministry of Education, Building Bulletin 19, p. 9.

requirement was for a system that would accommodate single-story primary buildings as well as three-story high school buildings. The system reported to be the best suited was one that had been used at Belper; a system that could be modified, and one that could remain within the cost limits set by the Ministry of Education.[12]

Working as a team to design the systems components, individual architects were assigned to each element of construction such as the steel frame, the windows, the roof, the floor slab, and others. It was the responsibility of each architect to determine specifications and to develop drawings for his own particular area. Each component had to satisfy all possible arrangements with other components in the overall system.

Nottinghamshire committed all its new schools in the 1957-58 building program to the newly developed system. Other local authorities were invited to join with Nottinghamshire and utilize the advantages that could be gained from quantity production. Seven banded together in 1957 to form the Consortium of Local Authorities Special Program which became known as CLASP.[13]

The benefits of the consortium are described below:

> The principal economic advantages of the Consortium are three-fold. First, the Consortium and its special purchasing procedure, makes it possible to build good

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[12] Ibid.

[13] Ibid., p. 15.

> schools in the CLASP system at a price well within the cost limits laid down by the Ministry of Education--buildings which give good value for money, which can be individually designed to meet the user's requirements and which provide a high standard of finishes. Secondly, the use of the CLASP system makes it possible to erect buildings more rapidly with a smaller labor force. Thirdly, the system dispenses with the need for costly special precautions against mining subsidence.[14]

The CLASP system was used on thirty-one projects in 1958-59, forty-eight projects in 1959-60, and by 1962-63, it was scheduled for a program of ninety projects--an average start of one project every four days.[15]

The School Construction Systems Development (SCSD) Program in California

The first school construction systems program in the United States was the School Construction Systems Development (SCSD) project established late in 1961. Ezra Ehrenkrantz, now the President of Building Systems Development, Inc., had studied the British systems building methods and concluded industrialized building would work in the United States. In September of 1961 at a joint national conference sponsored by the Architectural Forum and Educational Facilities Laboratories, Inc. (EFL), the plans for SCSD were laid. Ehrenkrantz, with support from

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[14] Ibid., p. 19.

[15] School Construction Systems Development, Prefabricated School Construction, p. 27.

Charles Gibson of California's State Department Bureau of School Planning, was able to convince Harold Gores and Jonathan King from Educational Facilities Laboratories, Inc. (EFL) that the time was right to give systems a try. It was agreed that if school districts could be found that were interested in using mass-produced and standardized components to find a broad variety of solutions to their construction problems, EFL would support the idea's development.[16]

Thirteen school districts were interested and participated in the development of School Construction Systems Development (SCSD) project.[17] With a grant from Educational Facilities Laboratories, and through the combined efforts of the School Planning Laboratory at Stanford University and the Department of Architecture of the University of California, Berkeley, the SCSD project was launched.[18]

The task was to prepare specifications for building components that would meet the requirements of all thirteen districts. A system was developed that used one

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[16]Educational Facilities Laboratories, Inc., SCSD: The Project and the Schools (New York: Educational Facilities Laboratories, Inc., 1967), p. 16.

[17]Ibid., p. 22.

[18]John C. Gardner, "Component Systems for Mass-Produced Schools," American School & University, April, 1970, p. 18.

set of basic building components. These components were designed to integrate exclusively with one another as a closed system. The components included: the structural-roof system, the air-conditioning and heating system, the lighting and ceiling system, and the partitions system. It was reported early in 1964 that the components accounted for one-half of the construction costs of a school building, and that the components could be obtained for $1.50 less per square foot over the same elements in a conventionally built school--a savings of 18.4 percent.[19]

The same account reported the following findings of SCSD:

1. Using components that are both modular and flexible, schools can be built to accommodate the changes in teaching programs as forseen by most educators.
2. With components, schools can also afford to build with far higher standards of lighting, acoustics, and air-conditioning.
3. A vigorous product research and development effort by manufacturers can be seeded by relatively modest outside investment to create clear-cut performance specifications.
4. Manufacturers can be brought together to design separate products that work as a single integrated system, eliminating much waste and inefficiency.
5. Components need not cramp the design freedom of architects and engineers; SCSD's choices, in fact, are architecturally "neutral" and adaptable. And they free designers of time-consuming detail for more basic planning work.

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[19]Bernard Spring, "School Costs Cut by New Components," Architectural Forum, February, 1964, p. 112.

6. School districts willing to band together can use their combined purchasing power to change traditional building procedures standing in the way of better and less costly construction techniques.[20]

The most significant contribution of SCSD, according to Boice, was the creation of a structure that organized all segments of the building industry's resources. The concept was to create a large market, to provide adequate time for industry to develop components for this market, and to offer the entire market as an incentive for industry to participate in the project.[21]

Thirteen schools grouped together and formed a market for approximately $30,000,000 in school construction.[22] Eighteen months after the first construction was begun, SCSD components were being used in over 400 buildings across the country; about half of them were schools.[23] Also, a number of other systems projects are reported to have been based on the strategies and procedures developed by the School Construction Systems Development teams. Among them are the following:

1. Toronto. Study of Educational Facilities (SEF)

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[20]Ibid., p. 113.

[21]John R. Boice, "A History and Evaluation of the School Construction Systems Development Project, 1961-1967" (Ann Arbor: University Microfilms, Ed.D. dissertation, Stanford University, 1970), p. 436.

[22]Ibid., p. 437.

[23]Ibid., p. 442.

2. Montreal. Research in School Facilities (RAS)
3. Florida. Schoolhouse Systems Project (SSP)
4. Alabama. University Construction System (UCS)
5. Detroit. Construction Systems Program (CSP)
6. University of California. University Residential Building System (URBS)
7. University of California and Indiana University. Academic Building System (ABS)
8. Boston. Boston Building System for Schools (BBS)
9. Georgia. Georgia Building System (GSSC)[24]

The scope of this study encompasses only two of the above--the Toronto and Florida Projects.

The Study of Educational Facilities (SEF) in Toronto

Metropolitan Toronto is composed of six boroughs, each with its own school board. The Metro Board is composed of members from the borough boards, and controls the building programs of the boroughs. Disturbed over spiraling construction costs, but encouraged by the California School Construction Systems Development (SCSD) project, the Metro Board created the Study of Educational Facilities (SEF). According to John Murray, Academic Director of SEF, the project received support from the Ontario Department of Education and Educational

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[24]Ibid., p. 440.

Facilities Laboratories, Inc. (EFL). The general goal of the program was to obtain more reasonably priced buildings that would reflect the needs of both the students and the teachers.[25]

The study was to direct attention to:

1. Development of systems and components specifically for school use;
2. More effective application of principals of modular construction in achievement of greater flexibility of interior design;
3. Reduction of the cost per square foot of school building construction so as to provide better value for expenditures in terms of function, initial costs, environment, and maintenance.[26]

The staff for the Study of Educational Facilities (SEF) prepared technical performance specifications for ten subsystems. These subsystems were intended to constitute about 75 percent of the total cost of a building. The subsystems were: Structure, atmosphere, lighting-ceiling, interior space division, vertical skin, plumbing, electric-electronic, casework, roofing, and interior finishes.[27]

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[25]John Murray, private interview in Ontario, December 16, 1970.

[26]Study of Educational Facilities, E3 Educational Specifications and User Requirements for Secondary Schools (Toronto: Ryerson Press, 1970), p. ix.

[27]Study of Educational Facilities, "The Study of Educational Facilities" (Printed brochure, 1970). (Hereinafter referred to as "Study of Facilities.")

Early in 1969, the Metro Board nominated ten suppliers for the subsystems. Each had the responsibility to develop and manufacture one of the ten components for the SEF program.[28] Twenty-two buildings with a total square foot area of 1,254,412 were scheduled to be built by September of 1971. The target price was $19.10 per square foot excluding equipment, site work, professional fees and escalation. An escalation clause was included in the suppliers' contracts to prevent bids from being inflated, and to protect the bidders against rising costs over the period of construction.[29]

High interest rates caused a reduced volume of local construction in the Toronto area to the point where conventionally bid construction costs remained constant or dropped. The Metro Board reported: "The escalation clause is therefore adding to SEF's costs rather than stabilizing them, and a different method of meeting this problem must be developed for the next system."[30]

In March of 1971, cost figures for the first eleven schools revealed all but one of the schools were

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[28]Velma Adams, "The Trend to School Building Systems," School Management, August, 1969, p. 26. (Hereinafter referred to as "Trend to School Building.")

[29]Study of Educational Facilities, "Study of Facilities."

[30]Ibid.

over budget. The fact that one had been built for less than the target price, it was reported, indicated the system can provide the promised savings.[31]

Reasons cited for higher costs were said to be due to lack of experience and lack of information. Cost controls have been strengthened and all schools in Phase II are reported to be under budget " . . . according to current information. It is anticipated that further strengthening of cost control procedures . . . will produce schools which have lower initial costs than can be obtained with conventional construction."[32]

The Schoolhouse Systems Project (SSP) in Florida

As a result of the achievements made in the SCSD program in California, school planners in Florida became interested in systems construction. With help from the School Construction Systems Development (SCSD) staff, meetings were held with the Department of Education and school planners from six counties to determine what to do about systems development in Florida. The meetings began early in 1966 and by September, the Florida State Board

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[31]"Costs of SEF Schools" (report prepared by the Metro Staff under the auspices of the Metropolitan Toronto School Board, March 10, 1971), p. 1. (Mimeographed.)

[32]Ibid., p. 2.

of Education had given approval to the first phase of the project. The project was to produce the following results:

1. Complete evaluation of previous experience with school construction systems in England, California and elsewhere.
2. Determine interest and support from school districts, industry, and others for a Florida project.
3. Determine the applicability of systems to different types of school buildings and school centers.
4. Outline procedures for organizing and initiating a project.
5. Develop an estimate of the cost of administering a project and recommendations for financing.[33]

With Educational Facilities Laboratories, Inc. (EFL) and the State of Florida sharing operational costs of the project on an equal basis, the first phase of the program was launched in October, 1966. Dr. Harold Cramer was named Educational Director and James Y. Bruce, AIA, was named Project Architect.[34]

The objectives of the Schoolhouse Systems Project (SSP) were basically the same as those of the California SCSD project. According to James Bruce the objectives

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[33]Schoolhouse Systems Project, First Phase Report: Florida Schoolhouse Systems Project, Floyd T. Christian, State Superintendent of Public Instruction, Tallahassee, Florida, 1967, p. 2.

[34]"Florida's Systems Schools: Rx for More Schools vs. Fewer Dollars," Council of Educational Facilities Planners Journal, January/February, 1970, p. 10. (Hereinafter referred to as "Florida's Systems Schools.")

were to build more flexible and better schools, to build them more economically, and to build them more rapidly.[35]

The Florida SSP project was sanctioned by the state education department and was therefore open to participation by all school districts within the state. Educational need was specified as the "key requirement" that formed the base of the following five-step procedure:

1. Identification of the user's requirements
2. Analysis of technical research
3. Preparation of performance requirements
4. Development of products and
5. Pre-bidding of the coordinated subsystems.[36]

An overview of Florida's Schoolhouse Systems Project (SSP) was included in the 1970 SSP report. It indicated that during the three-year period following SSP's inception in 1966, thirty projects costing more than $30,000,000 were bid. Architects and educators were reported to be in agreement that the buildings were better buildings, and that they had been built faster.[37]

The results of the first SSP program in Florida showed construction time could be reduced by as much as

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[35]James Bruce, private interview in Tallahassee, Florida, December 21, 1970. (Hereinafter referred to as private interview.)

[36]"Florida's System Schools," p. 11.

[37]Schoolhouse Systems Project, Second Phase Report: Florida Schoolhouse Systems Project, Floyd T. Christian, State Superintendent of Public Instruction, Tallahassee, Florida, 1970, p. 4.

25 percent. For this program, performance specifications had been developed for only three major subsystems: structure, ceiling-lighting, and heating-ventilating-air-conditioning (HVAC).[38]

In Program 2 of SSP, three new subsystems were added to the performance specifications. They were: carpeting, cabinets, and partitions. Comparing costs for components used in the first program with the same components in Program 2, it was found that costs were reduced by 16 percent during a period when normal costs were increased by 5 percent.[39]

Program 3 used all six of the subsystems as did Program 2. But a comparison of costs for like components that had been used in each of three programs revealed, after normal increases, a net savings of 20 percent in the third program over the first program.[40]

Leon County bid six schools in 1968. The square foot costs ranged from $13.50 to $17.30. In this case, it was found that as the percentage of systems costs increased in proportion to the total building cost, the square foot costs decreased.[41]

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[38]"Florida's Systems Schools," p. 12.

[39]Ibid.

[40]Ibid., p. 14.

[41]Ibid.

According to James Bruce, Project Architect for the Schoolhouse Systems Project (SSP), systems schools, on the average, cost $2.11 less per square foot than did non-systems schools during 1969-70. He estimates the difference between systems and non-systems costs may be as much as $4.00 or more per square foot by 1971-72.[42]

Bruce cites the Bradford Middle School in Starke, Florida, as an example of a systems school that is adaptable. Increased enrollments and changes in the school program created the need for relocating interior walls twice in two years. The only cost for this "remodeling" other than normal staff salaries, was the wages paid to several students who assisted the principal and the custodian according to Bruce.[43]

Individual Systems Projects

Systems school building in the United States began with the California School Construction Systems Development (SCSD) project and has grown to include other development projects such as Toronto's Study of Educational Facilities (SEF) and Florida's Schoolhouse Systems Project (SSP). Now, systems construction is no longer confined to large multi-school development projects. Manufacturers have exhibited an interest in

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[42]Bruce, private interview.

[43]Ibid.

researching and developing components that can be purchased off-the-shelf for the construction of single or multiple buildings. William Chase reports there presently are more than 100 manufacturers engaged in developing compatible building components for architects to use.[44] These components can be and are being used in single school projects.

As early as 1965, School Management reported on three districts in three parts of the nation that built single schools using different architects and different educational specifications, but all using the same building system--the SCSD components. The buildings included a high school in California, an elementary school in Nevada, and a middle school in Illinois.[45]

The architectural firm of Marshall Erdman and Associates, Inc. of Madison, Wisconsin has been reported by School Management as having successfully used off-the-shelf items in their construction of elementary and middle schools. The same basic materials were used in all its schools. The firm, itself, prefabricated a number of the building parts in its own factory. These

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[44]Chase, "Off-the-Shelf Schoolhouses," p. 10.

[45]"How Three Districts in Three Parts of the Nation Built Three Schools at Three Different Levels with Three Architects and Three Sets of Educational Specifications All Using One Building System," School Management, May, 1965, pp. 123-30.

were assembled later on the site. Many of the materials used were purchased in bulk quantity. The firm's "one-stop shopping" for building design, manufacture of components, and construction of buildings resulted in buildings that were constructed in five or six months according to the report. Costs were reported to be only about two-thirds the price of conventionally designed and built schools.[46]

K/M Associates, Inc. of Elkhart, Indiana is another architectural firm that has employed the use of systems to construct individual buildings. Although their system-built schools have been constructed one at a time, they report their experience has been like that reported about Florida's SSP schools--reduced planning and construction time, reduced costs, flexibility, and more adequate facilities. Through their involvement with systems building that produced more than a dozen schools, K/M found the following:

1. Using building systems, a firm can provide better buildings in less time at the same or lower costs than by conventional construction techniques.
2. An office which uses building systems effectively can use this fact to advantage when approaching potential clients.
3. Two-stage bidding is a technique which may be used effectively by an architectural office on single projects.
4. Use of performance specifications is a valuable method of bidding some components.

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[46]Adams, "Trend to School Building," p. 55.

5. An architectural office can use both the dimension and "performance" modules of building systems to advantage in design and design development.[47]

The experience of K/M with their first twelve systems-built schools has prompted Chase to comment: "The experience that K/M Associates, a relatively small independent firm, have had with the systems approach is indicative of a future trend in construction generally."[48]

Larger architectural firms have also decided to use systems components already on the market. Robert T. Scheeren, AIA, and The Perkins and Will Partnership in association with Myers and Shannon, Architects are using prebid systems components in the Armstrong School District in Pennsylvania. Four separate projects in that package total slightly less than half a million square feet.[49]

Caudill Rowlett Scott (CRS) were commissioned in 1970 by the Union Free School District No. 25, Merrick, Long Island, New York to construct additions to three elementary schools totaling 25,600 square feet of

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[47]Building Systems Information Clearinghouse, K/M Associates: A Case Study in Systems Building (Stanford, California: Systems Division, School Planning Laboratory, 1970), pp. 8-10. (Hereinafter referred to as Case Study in Systems Building.)

[48]William W. Chase, "Systems and the Single School," Construction Products and Technology, September, 1970, p. 46.

[49]Building Systems Information Clearinghouse, Case Study in Systems Building, p. 4.

construction. The Merrick project is reported to be the first systems project to use fast-track scheduling and building systems together. This combination reportedly will save time beyond that normally expected from the use of building systems.[50]

From the examples cited, the use of systems no longer seems to be limited to massive development or application construction projects. There are enough off-the-shelf items to do many things in systems building. In fact, there are over 900 schools around the country that incorporate one or more of the building components developed for the California SCSD schools.[51] What is important is that individual school districts have begun to make use of existing systems and systems techniques.

SUMMARY

As much of what has been written about one systems program is usually applicable to another, an effort was made to avoid redundancy by limiting this review to four major systems development projects and to four examples of smaller individual projects. The development projects included the experiences of several architects: Marshall

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[50] BSIC, "Newsletter," March 30, 1970, p. 1.

[51] Chase, "Off-the-Shelf-Schoolhouse," p. 43.

Erdman and Associates, Inc.; K/M Associates, Inc.; Robert T. Scheeren, AIA, and The Perkins and Will Partnership in association with Myers and Shannon; and Caudill Rowlett Scott.

The authoritative literature on each of the projects makes these points in sum:

1. The CLASP system of prefabricated schools in Britain is the forerunner of systems programs in the United States. Following World War II, England had a great classroom shortage. She lacked manpower and materials to overcome this problem through traditional building methods. Systems of prefabricated components which could be manufactured in a factory and assembled at the building site were developed. As none of the early systems was adequate to meet all needs, selection of the one "best" system was made and much effort went into its development. In 1957, seven local authorities joined to make use of this single system. The group known as the Consortium of Local Authorities Special Program (CLASP) claimed several benefits from this merger. First, they were able to get buildings that met the needs of the users on an individual basis, that looked nice, and that were within acceptable cost limits. Secondly, the buildings could be erected faster and with a smaller labor force. Finally, the type of structure

eliminated the need for precautions against mining subsidence. By 1962-63 there was an average of one CLASP project started every four days.

2. The School Construction Systems Development (SCSD) project was the first such project in the United States. With an EFL grant, and through the combined efforts of Stanford University and the University of California, Berkeley, SCSD was established in 1961. With cooperative planning among thirteen school districts, performance specifications were developed that could meet the needs of all thirteen districts. The components represented about 50 percent of a school's cost and were reported to be less expensive than their counterparts in conventionally built schools. SCSD found that flexible and modular components permitted a higher quality of construction that met program needs. Modest seed money to develop performance specifications encouraged manufacturers to research, design, and develop integrated systems that would eliminate waste and inefficiency. Further, SCSD found that components freed designers of detail work without hindering design freedom. School districts that were willing to join together could take advantage of better and less costly building techniques. At least nine major systems projects have been developed which were based on SCSD practices.

3. Toronto's Study of Educational Facilities (SEF) was created in 1965 and funded by EFL and the Ontario Department of Education. Their goal was to develop systems and components for school construction that would reduce costs and yet achieve greater flexibility of interior design. Performance specifications were developed for ten subsystems which together would constitute about 75 percent of a building's cost. In 1969, the suppliers for the ten subsystems were selected and each developed and manufactured his own component. Twenty-two buildings with an area of slightly more than one and a quarter million square feet were scheduled for completion by September of 1971.

Cost figures released in March of 1971 indicated only one of eleven completed school buildings had come in under the budget. Factors affecting the increased costs were explored. The strengthening of the cost control procedures is expected to result in schools with lower initial costs than those that can be obtained with conventional methods.

4. Florida's Schoolhouse Systems Project (SSP) was begun in 1966 with basically the same objectives as those of SCSD: to build better schools; to build them more rapidly; and to build at a lower cost. The SSP was sanctioned by and received leadership from the state department of education. Thus it was open to all

districts in the state. The purpose of SSP was to identify user requirements, analyze technical research, prepare performance specifications for the development of products, and to handle pre-bidding of coordinated subsystems.

Thirty projects totaling over $30,000,000 were bid in the first three-year period. Architects and educators agreed they were better buildings compared with conventional buildings. Figures showed a financial advantage in favor of systems which tended to increase with subsequent phases of the project. Estimates indicate savings may mount to $4.00 or more per square foot by 1972. Proof that interior walls are easily rearranged was twice demonstrated in the Bradford Middle School.

5. Systems construction is no longer confined to large development projects. More than 100 manufacturers are engaged in developing compatible building components for single-school projects. Off-the-shelf components are reported to have been in use by 1965.

Marshall Erdman and Associates, Inc. have used off-the-shelf components to construct schools in five or six months at two-thirds the price of conventionally built schools according to reports.

K/M Associates, Inc. are reported to have built twelve separate systems schools with results like those of the large SSP project: reduced planning and

construction time, reduced costs, flexibility, and more adequate facilities. It is said their experience with building systems is indicative of a future trend in construction generally.

Large architectural firms are also using systems components already on the market. The Perkins and Will Partnership are using prebid components in a Pennsylvania school construction program. Caudill Rowlett Scott (CRS) are reported to be the first to use both systems and fast-track scheduling. This combination is being used in New York to construct elementary school additions.

The use of systems no longer is limited to large development projects. There are enough off-the-shelf items to do many things in systems building. Individual schools have begun to use existing systems and systems techniques. It is reported that over 900 schools around the country incorporate building components developed for the SCSD schools in California.

Chapter 3

METHODOLOGY AND PROCEDURE

The three-fold purpose of this study was (1) to identify the potential economic and educational benefits of the systems approach to school construction as such benefits were perceived by the current users and planners of systems school buildings; (2) to identify the conditions that are important to the optimal realization of the potential economic and educational benefits of the systems approach as such conditions were perceived by authorities in the school planning field; and (3) to identify the extent to which conditions in Michigan school districts are compatible with conditions important to the application of systems techniques. This chapter describes the methods and procedures used in gathering and ordering the necessary information on each of these problems.

THE POTENTIAL ECONOMIC AND EDUCATIONAL BENEFITS

No data are available from a rigorously controlled experiment with systems building versus buildings

with more traditional approaches. But systems buildings have been built and the planners and users have had experience with both approaches. This gives special value to their perceptions of benefits obtained.

Scattered, individual examples of systems school buildings may be found, but this portion of the study focused only on those groups of occupied systems school buildings that had been constructed as a part of one of the following development projects: the School Construction Systems Development (SCSD) project in California; the Study of Educational Facilities (SEF) project in Toronto, Canada; and the Schoolhouse Systems Project (SSP) in Florida. Schools included in these projects were representative of any of those that might have been included in this study. And it was from personnel associated with these buildings that information was solicited.

The selection of the population for the study posed no problem. The building principals and their superintendents (directors of education in Canada) were in the most advantageous position to identify the potential economic and educational benefits of the systems approach, and they were selected. As both the Toronto SEF and the Florida SSP projects were still in operation, two staff members from each of the projects were included also.

Names and addresses of the principals and superintendents of the School Construction Systems Development project were secured from the Building Systems Information Clearinghouse (BSIC) in California. John Boice, the editor of that organization's newsletter, was formerly the project coordinator for the California SCSD project. Names and addresses of the principals and directors of education in Toronto Study of Educational Facilities (SEF) project schools were obtained from Dr. John Murray, SEF's Academic Director. Names and addresses of the principals and superintendents of schools in the Florida Schoolhouse Systems Project (SSP) were obtained from a list prepared by the Assistant Project Architect, James Barnes. The combined group totaled seventy-nine persons from whom data was requested.

The questionnaire method for the collection of data was determined to be the most expedient approach for obtaining the desired information. As the problem was one of identifying what were perceived to be the potential benefits of the systems approach, the requirement was for an open-ended questionnaire that listed a number of possible benefits to be judged by the recipient.

The material for the content in the body of the questionnaire was derived from several sources. First, the literature revealed a number of potential benefits. Secondly, several of the Toronto systems schools were

visited and a lengthy interview was held with Dr. John Murray, Academic Director for the Study of Educational Facilities (SEF). Finally, the systems schools in the Tallahassee, Florida area were toured. At that time, the Schoolhouse Systems Project Architect, James Yates Bruce, and his assistant, James Barnes, were interviewed. On the basis of the information gained through reading, visiting systems schools, and interviewing systems project personnel, a list of the potential benefits of systems building was developed and the questionnaire was designed.

The questionnaire was critically examined by a jury composed of a university professor, a community college professor, and a school district administrative staff member. Several items were consolidated and ambiguous language was clarified. The resulting instrument was one having twenty-two items for the respondent to assess and to indicate whether he considered each to be a potential benefit of the systems approach in school construction. It dealt with such topics as educational planning, staff performance, educational environment, trends, traffic flow, flexible space and adaptability, design time, construction time, cost-quality factors, remodeling, and expansion of facilities.

Three separate cover letters were designed to accompany the questionnaires. The first was a

mimeographed letter with typed-in name and address which went to all of the selected persons in the Toronto and Florida programs including the project staff personnel. The second letter was a fully typed letter that went only to the superintendents of the School Construction Systems Development (SCSD) project schools in California. This letter had been preceded by a previous typewritten letter that requested permission from the superintendents to use their systems schools in the study. The third letter was also typed and was designed for the California SCSD principals. The extra effort given to the cover letters to the principals and superintendents in California was intended to encourage their cooperation. The novelty of occupying a systems school had not had time to wear away in the recently constructed schools of Ontario and Florida, and this, by itself, provided adequate inducement for a satisfactory return of the questionnaires.

The questionnaires, with their accompanying cover letters and stamped self-addressed return envelopes, were mailed in March, 1970. The mailing list included the names of eleven principals and ten superintendents in California; eleven principals, six directors of education, and two SEF project officials in Metropolitan Toronto; and twenty-four principals, thirteen

superintendents, and two SSP project officials in Florida--a total of seventy-nine persons. Copies of the questionnaire and letters appear in Appendix A.

Thirty days after the questionnaires were mailed, responses had been received from fifty-three persons. Included were twenty-seven principals, twenty-two superintendents or directors of education, and four systems project officials. This was a 67 percent return and all areas were represented.

The results of the questionnaires were then tabulated and additional benefits suggested by the respondents were recorded.

THE CONDITIONS IMPORTANT TO THE OPTIMAL REALIZATION OF THE POTENTIAL BENEFITS OF THE SYSTEMS APPROACH

This portion of the study was conducted to identify the conditions that are important to the optimal realization of the potential economic and educational benefits of the systems approach as such conditions were perceived by authorities in the school planning field.

Efforts were made to identify these important conditions. Initial efforts consisted of interviewing State of Michigan Department of Education officials, architects, and school superintendents.

Discussions were held with the Director and two Supervisors in the School Management Services Division

of the Michigan Department of Education. Although none of these persons had had direct experience in systems school construction, each was able to make a contribution based on his general knowledge of the systems approach. As their roles included that of granting approval for school construction programs, their ideas regarding the matter were meaningful. Conditions which they perceived to be important were listed.

Four architects were asked what they believed to be the important conditions for the optimal realization of the potential systems benefits. Two of them were from large firms in Grand Rapids and in Lansing; the other two were from smaller firms located in Lansing and Marysville, Michigan. None of the architects had built a systems building but all were uniformly convinced that systems building would be the "coming thing" in the years ahead. All of the architects had examined systems buildings and were familiar with systems processes. Thus they contributed a list of what they believed were the important conditions that had to exist for the maximal realization of the potential systems benefits.

An attempt was made to lengthen the list of items by contacting school district superintendents and obtaining their views. It was found that superintendents, as a group, had little opportunity to become acquainted

with the systems approach to school construction, and that they had given very little serious thought to the matter. They were unable to add any items to the list.

After the preliminary investigation with the Management Services Division personnel, the architects, and the superintendents of schools, it was decided to make the study more global. There did not appear to be enough people in Michigan that could speak authoritatively about the systems approach. But there were people around the country that could speak authoritatively. Some of them could be identified and their perceptions could be obtained by means of a questionnaire.

On the basis of the information obtained from the Department of Education and the architects, an open-ended questionnaire was designed. The questionnaire listed the items suggested by these advisors and provided that each item be rated according to its importance to the success of systems school construction projects. This questionnaire was examined by the same three-person jury that examined the "perceived benefit" questionnaire and was modified according to their recommendations.

The finished questionnaire contained twenty items to be rated in importance. Included among them were such factors as volume purchasing, joint bidding, size of the systems program, consortiums, building codes,

and financial considerations. Also included were items involving the school district architect, the school staff, the school administration and board of education, the community, and labor unions. The questionnaire invited comments regarding the items and suggested that any additional factors perceived to be important should be added.

Twelve persons in the United States were selected to be recipients of the questionnaire. Their reputations are especially respected by their peers in the field of educational plant planning. Their backgrounds represented a wide range of expertise; they were nationally and internationally known experts. The twelve were: Harold L. Cramer, Administrator of the Florida Schoolhouse Systems Project (SSP); Wallace B. Cleland, Technical Director of Detroit's Construction Systems Program(CSP); John R. Boice, Coordinator of the former School Construction Systems Development (SCSD) project and now Editor of the Building Systems Information Clearinghouse (BSIC) newsletter; Ezra Ehrenkrantz, Project Architect for the former School Construction Systems Development (SCSD) project, and now President of Building Systems Development, Inc.; Harold B. Gores, President of Educational Facilities Laboratories, Inc.; William W. Chase, Deputy Director of the Facilities Development Staff, U.S. Office of Education; John Lyon Reid, FAIA,

eminent architect and former advisor of the School Construction Systems Development (SCSD) project; William W. Caudill, FAIA, internationally renowned architect and Director of the Rice Institute School of Architecture; James D. MacConnell, Director of the Stanford University School Planning Laboratory and former advisor to the California SCSD project; Frank Brunetti, Associate Director of the Stanford University School Planning Laboratory; Dwayne Gardner, Executive Secretary, Council of Educational Facilities Planners (CEFP); and Floyd Parker, President-elect of the Council of Educational Facilities Planners.

Letters to each of the above persons were typed on Michigan State University letterheads over the signature of Dr. Archibald B. Shaw, Chairman of the investigator's Doctoral Committee. The questionnaires with cover letters and stamped, self-addressed return envelopes were mailed in mid-March, 1971.

Copies of the cover letter and questionnaire appear in Appendix B.

Thirty days after the questionnaires were mailed, responses had been received from all persons. There had been a complete return and the responses were tabulated and the comments included with them were recorded.

MICHIGAN COMPARED

There have been no studies made in Michigan to identify the extent that conditions in Michigan school districts are compatible with those conditions that are perceived to be important for the optimal realization of the potential economic and educational benefits of the systems approach to school construction. The purpose of this study was to test the conditions identified by experts as being important, against the relevant conditions currently prevailing in Michigan.

The responses made by the twelve widely recognized experts to the questionnaire above, served as a test basis. In order to test these conditions against the status quo, existing conditions in Michigan were identified.

The areas of concern (there were twenty conditions perceived to be important) required gathering data from a number of sources. Much was obtained by personal contact with officials in the Michigan Department of Education. A school attorney furnished information on Michigan laws. A sanitarian gave information on practices of health departments. Six school administrators and an officer of the Michigan Association of School Administrators gave other professional information. Four Detroit area architects, the Fire Marshal Division

of the Michigan State Police, and the American Federation of Labor Building Trades Council were contacted and additional data were obtained from them. All these data were secured in May, 1971, by means of direct personal interviews, some of which were by telephone.

The data were categorized according to each of the twenty important conditions, and an item-by-item comparison was then made between the status quo and that which had been perceived to be important.

SUMMARY

This chapter described the procedures used to obtain information necessary to this study. The study was divided into three separate sub-studies. Briefly, the sub-studies were conducted to identify: (1) the perceived potential benefits of the systems approach to school construction, (2) the conditions perceived to be important for the optimal realization of these benefits, and (3) the extent to which conditions in Michigan are related to those perceived to be important to the systems approach.

The perceived potential benefits were identified, through the use of a questionnaire, by users and planners of school buildings in the California School Construction Systems Development (SCSD) project, the Toronto Study of

Educational Facilities (SEF) project, and the Florida Schoolhouse Systems Project (SSP).

The conditions perceived to be important for the optimal realization of the potential benefits of the systems approach were identified through questionnaires by an authoritative group of experts who are widely recognized for their reputations in the school plant planning field, both nationally and internationally.

Data used to compare existing conditions in Michigan with those perceived to be important to the systems approach were obtained by personal interviews. Sources of information included the Department of Education, the health department, school administrators, the Michigan Association of School Administrators, a school attorney, architects, the Fire Marshal, and a building trades union official.

The next chapter reports the findings from these investigations.

Chapter 4

ANALYSIS OF DATA

Data gathered by the methods described in Chapter 3 are presented and analyzed in this chapter. They are presented in three general areas that correspond to the subproblems: (1) the identification of the potential economic and educational benefits of the systems approach to school construction as such benefits were perceived by the current planners and users of systems school buildings, (2) the identification of the conditions that are important to the optimal realization of the potential economic and educational benefits of the systems approach as such conditions were perceived by authorities in the school planning field, and (3) the identification of the extent to which conditions in Michigan school districts are compatible with conditions important to systems techniques.

THE POTENTIAL ECONOMIC AND EDUCATIONAL BENEFITS

The investigation entailed obtaining perceptions from planners and users of systems buildings. A questionnaire was sent to three classifications of persons:

Principals of systems schools; Superintendents of schools (or Directors) of districts within which are systems schools; and staff of current systems projects. All persons in each of the three classifications have been associated with systems building. Table 1 lists the numbers of questionnaires on the potential benefits of systems buildings that were sent and the number returned classified according to the role of the planners and users.

Questionnaires were sent to the principals of all of the schools in the three development projects. Eleven were sent to principals of California's School Construction Systems Development (SCSD) schools; 11 were sent to principals of Toronto's Study of Educational Facilities (SEF) schools; and 24 were sent to principals of Florida's Schoolhouse Systems Project (SSP) schools. Altogether 46 school principals were polled.

The superintendents of schools (or directors) of the districts in which the same schools are located also were sent questionnaires. By development project, they included: SCSD, 10 superintendents; SEF, 6 directors; and SSP, 13 superintendents--a total of 29.

Only two of the development projects had staffs at the time of the investigation--SEF and SSP--and questionnaires were sent to two members of each of their staffs for a total of 4.

Table 1

Numbers of Questionnaires on the Potential Benefits of Systems Building Sent and Returned, by Classification

Classification	Project	Number sent	Number returned	Percent returned
1. Principals of systems schools	SCSD	11	7	64
	SEF	11	7	64
	SSP	24	13	54
	All three	46	27	59
2. Superintendents of schools (or directors) of districts within which are systems schools	SCSD	10	10	100
	SEF	6	5	83
	SSP	13	7	54
	All three	29	22	76
3. Staff of current systems projects	SCSD*	0	0	0
	SEF	2	2	100
	SSP	2	2	100
	Both	4	4	100
4. Totals for each Project	SCSD	21	17	81
	SEF	19	14	74
	SSP	39	22	56
	All three	79	53	67

*SCSD has no staff.

By project, the selected persons included 21 SCSD contacts, 19 SEF contacts, and 39 SSP contacts. Altogether there were 79 questionnaires disseminated.

The percentage of return was satisfactorily high. One hundred percent return was made by the SEF and SSP project staffs. As a group, the superintendents and the directors scored next highest in the rate of return. All SCSD superintendents and all but one of the SEF directors replied. The SSP superintendents ranked lowest within the group with slightly more than half the questionnaires returned. In total for the group, 22 of the 29 requests were honored which accounted for a 76 percent return.

Principals scored lowest of the three groups in the rate of responses. SCSD and SEF returns were identical in number (seven out of eleven) with a percentage of 64. The SSP principals responded 10 percent less well than their peers although in absolute numbers, their response was greater than that received from any other group. In total, the school principals returned 27 of the 46 questionnaires. This was a 59 percent return.

In sum, there were 53 responses or a 67 percent return. By project, the percentages of return were: SCSD, 81; SEF, 74; and SSP, 56. The returns were great enough to provide the data needed to determine the potential economic and educational benefits of systems buildings as they were perceived by those most directly experienced.

The purpose of the questionnaire was to obtain the perceptions of selected people regarding the potential benefits of the systems approach in school construction. Twenty-two statements of potential benefits had been developed on the basis of information gained from reading, visiting systems schools, and interviewing project staff personnel. The questionnaire sought to determine the extent of agreement to each statement by the respondents. The data was tabulated by project (SCSD, SEF, and SSP) in Table 2 and by Classification (Principals, Superintendents or Directors, and Project Staff) in Table 3. An analysis of the data in Table 2 follows:

A number of persons did not respond to some of the questions. Some persons indicated that they did not know or were uncertain. Others did not respond to one or more of the statements. All such responses were classified not usable. Only the usable responses were used in determining the amount of agreement.

Opportunity was given to the respondents to add to the statements of potential benefits. Three persons chose to do so. One said, "Obsolescence of subsystems can be designed in and substitution of obsolete subsystems may be accomplished without disturbing other systems." Two others, in substance said that off-site

fabrication contributes to quality as the factory assures a better product.

Table 2 revealed that there was an overwhelming combined majority agreement with every statement of potential benefit. Everyone surveyed agreed that systems buildings are generally well adapted to accommodate new trends in education as seen by the teaching staff (statement 5) and that space flexibility will be increasingly valuable in the long-range use of systems buildings (statement 10).

Toronto's SEF respondents were also in complete agreement that systems buildings provide maximal flexibility to meet educational needs (statement 3); that built-in adaptability of the systems school may add to the life of the building (statement 9); that an adaptable systems building will tend to encourage innovation in the curriculum (statement 11); that reduced construction time in the systems approach helps to solve over-crowding problems by permitting earlier occupancy (statement 14); that the systems approach is better adapted to make use of fast-tracking procedures than is the traditional approach (statement 17); and that expansion of systems facilities can be accommodated in an orderly fashion with minimal demolition (statement 22).

The Florida SSP respondents were in strong agreement with the above.

Table 2

The Extent of Agreement Among Select Planners and Users of Systems Buildings With Statements of the Potential Benefits of Systems Building, by Project

	Statement	Replies by project	Agreement		Not Usable
			Yes	No	
1.	The systems approach encourages the educational planning team to make a thorough study of the educational program and how it may need to be changed.	SCSD	15	2	0
		SEF	12	1	1
		SSP	18	2	2
		All three	45	5	3
2.	Systems building with performance specifications, requires the staff to become more precise in stating their needs and developing user requirements.	SCSD	12	5	0
		SEF	12	1	1
		SSP	17	4	1
		All three	41	10	2
3.	Systems buildings provide maximal flexibility to meet educational change.	SCSD	15	1	1
		SEF	13	0	1
		SSP	15	6	1
		All three	43	7	3
4.	Systems buildings provide a learning environment for current needs as well as, or better than, do non-systems buildings.	SCSD	12	3	2
		SEF	11	1	2
		SSP	13	5	4
		All three	36	9	8
5.	Systems buildings are generally well adapted to accommodate new trends in education as seen by the teaching staff.	SCSD	17	0	0
		SEF	13	0	1
		SSP	19	0	3
		All three	49	0	4
6.	Systems buildings are more responsive to the total student environment needs than are conventional buildings.	SCSD	13	2	2
		SEF	10	2	2
		SSP	15	4	3
		All three	38	8	7

Table 2 (continued)

	Statement	Replies by project	Agreement Yes	Agreement No	Not Usable
7.	Traffic flow in systems buildings is more easily accommodated than in traditional buildings.	SCSD	10	5	2
		SEF	8	4	2
		SSP	13	4	5
		All three	31	13	9
8.	Systems' built-in flexibility permits interior space to be altered easily and inexpensively.	SCSD	12	5	0
		SEF	12	1	1
		SSP	19	2	1
		All three	43	8	2
9.	The built-in adaptability of the systems school may add to the useful life of the building.	SCSD	14	2	1
		SEF	13	0	1
		SSP	19	2	1
		All three	46	4	3
10.	Space flexibility will be increasingly valuable in the long-range use of the systems buildings.	SCSD	17	0	0
		SEF	13	0	1
		SSP	18	0	4
		All three	48	0	5
11.	An adaptable systems building will tend to encourage innovation in the curriculum.	SCSD	14	2	1
		SEF	13	0	1
		SSP	17	1	4
		All three	44	3	6
12.	Design time can be reduced by using standardized components or subsystems in systems construction.	SCSD	8	6	3
		SEF	12	0	2
		SSP	15	2	5
		All three	35	8	10
13.	Systems building generally reduces on-site construction time which results in a reduced project delivery time.	SCSD	7	6	4
		SEF	14	0	0
		SSP	15	5	2
		All three	36	11	6

Table 2 (continued)

	Statement	Replies by project	Agreement Yes	Agreement No	Not Usable
14.	Reduced construction time in the systems approach helps to solve over-crowding problems by permitting earlier occupancy.	SCSD	6	8	3
		SEF	13	0	1
		SSP	13	5	4
		All three	32	13	8
15.	Reduced constructional time in the systems approach assists curriculum development by permitting educational programs to become operational sooner.	SCSD	6	8	3
		SEF	9	1	4
		SSP	13	7	2
		All three	28	16	9
16.	Volume market, off-site fabrication, and efficient field assembly help systems building costs to approximate or remain below conventional construction costs.	SCSD	12	4	1
		SEF	8	4	2
		SSP	16	5	1
		All three	36	13	4
17.	The systems approach is better adapted to make use of fast-tracking procedures than is the traditional approach.	SCSD	8	3	6
		SEF	11	0	3
		SSP	11	6	5
		All three	30	9	14
18.	It is difficult, if not impossible, to build non-systems schools at a lower cost than systems schools if the educational requirements, quality of materials, and learning environment are kept at equal levels.	SCSD	10	5	2
		SEF	7	4	3
		SSP	12	7	3
		All three	29	16	8

Table 2 (continued)

	Statement	Replies by project	Agreement: Yes	Agreement: No	Not Usable
19.	With systems, construction costs for like quality are less.	SCSD	11	5	1
		SEF	9	1	4
		SSP	10	7	5
		All three	30	13	10
20.	The economy in systems involves reasonable initial costs and low long-term costs of operation and remodeling.	SCSD	11	4	2
		SEF	7	1	6
		SSP	13	4	5
		All three	31	9	13
21.	The more subsystems in a building, the easier it is to predict costs of the total building.	SCSD	9	4	4
		SEF	7	1	6
		SSP	15	4	3
		All three	31	9	13
22.	Expansion of systems facilities can be accommodated in an orderly fashion with minimal demolition.	SCSD	13	1	3
		SEF	10	0	4
		SSP	17	4	1
		All three	40	5	8

The California SCSD group was barely in agreement that systems building reduces on-site construction time and delivery time. Less than half of them agreed that systems would permit earlier occupancy and thus relieve over-crowding. The California SCSD group barely agreed design time can be reduced by using standardized components or subsystems in systems construction (statement 12). They barely disagreed that reduced construction time in the systems approach assists curriculum development by permitting educational programs to become operational sooner (statement 15).

By contrast there was complete agreement by the SEF respondents, and nearly complete agreement among the SSP groups that use of components will cut design time. Both SEF and SSP respondents were in strong agreement with the statement that reduced construction time assists curriculum development.

Statements 1 and 2 which dealt with such potential benefits as educational planning and the development of user requirements averaged an agreement approaching 90 percent.

There was approximately an 80 percent agreement among those polled that student environmental needs and traffic flow were better met in systems buildings than in conventional buildings, and that systems' built-in

flexibility permits easy and inexpensive alterations to interior space (statements 6, 7, and 8).

On the average, about three-fourths of the respondents were in agreement with the cost benefit items which included such factors as lower costs than conventional construction, lower costs for comparable quality, lower initial and long-term costs, and better predictability of the total building costs when systems are used (statements 16, 18, 19, 20, and 21).

At least 63 percent or more of the respondents agreed with every statement. And in the majority of cases, more than 80 percent of the respondents agreed that the statements were, indeed, statements of potential benefits.

Every statement elicited one or more unusable responses. The range of not usable responses numbered from 2 to 14. The three statements that had the greatest number of unusable responses were: the systems approach is better adapted to make use of fast-tracking procedures than is the traditional approach (statement 17); the economy in systems involves reasonable initial costs and long-term costs of operation and remodeling (statement 20); and the more subsystems in a building, the easier it is to predict the costs of the total building (statement 21). All other statements had 10 or fewer not usable responses.

Table 3 was developed to illustrate the extent of agreement among principals, superintendents and directors, and systems project staff with statements of potential benefits of systems building, by classification.

The four project staff members were in complete agreement with all of the statements of potential benefits with one exception: one staff member was uncertain that reduced construction time in the systems approach assists curriculum development by permitting educational programs to become operational sooner (statement 15).

Both the superintendent and the principal groups judged all of the statements to be statements of potential benefits although just over half of the superintendents agreed it is difficult, if not impossible, to build non-systems schools at a lower cost than systems schools if the educational requirements, quality of materials, and learning environment are kept at equal levels (statement 18).

As a group, principals tended to submit the fewest usable responses to statements 17 through 21 which dealt with fast-tracking and construction costs. For these five statements, the principals submitted only about 60 to 70 percent usable responses.

Superintendents tended to respond with usable replies to more statements than did the principals. Because of this, superintendents tended individually to

Table 3

The Extent of Agreement Among Select Planners and Users of Systems Buildings With Statements of the Potential Benefits of Systems Building, by Classification

	Statement	Replies by classification	Agreement		Not Usable
			Yes	No	
1.	The systems approach encourages the educational planning team to make a thorough study of the educational program and how it may need to be changed.	Principals	24	1	2
		Supts.	17	4	1
		Proj. staff	4	0	0
		All three	45	5	3
2.	Systems building with performance specifications, requires the staff to become more precise in stating their needs and developing user requirements.	Principals	20	6	1
		Supts.	17	4	1
		Proj. staff	4	0	0
		All three	41	10	2
3.	Systems building provide maximal flexibility to meet educational change.	Principals	22	4	1
		Supts.	17	3	2
		Proj. staff	4	0	0
		All three	43	7	3
4.	Systems buildings provide a learning environment for current needs as well as, or better than, do non-systems buildings.	Principals	18	5	4
		Supts.	14	4	4
		Proj. staff	4	0	0
		All three	36	9	8
5.	Systems building are generally well adapted to accommodate new trends in education as seen by the teaching staff.	Principals	25	0	2
		Supts.	20	0	2
		Proj. staff	4	0	0
		All three	49	0	4

Table 3 (continued)

	Statement	Replies by classification	Agreement Yes	Agreement No	Not Usable
6.	Systems buildings are more responsive to the total student environmental needs than are conventional buildings.	Principals	18	5	4
		Supts.	16	3	3
		Proj. staff	4	0	0
		All three	38	8	7
7.	Traffic flow in systems buildings is more easily accommodated than in traditional buildings.	Principals	14	7	6
		Supts.	13	6	3
		Proj. staff	4	0	0
		All three	31	13	9
8.	Systems' built-in flexibility permits interior space to be altered easily and inexpensively.	Principals	24	2	1
		Supts.	15	6	1
		Proj. staff	4	0	0
		All three	43	8	2
9.	The built-in adaptability of the systems school may add to the useful life of the building.	Principals	24	1	2
		Supts.	18	3	1
		Proj. staff	4	0	0
		All three	46	4	3
10.	Space flexibility will be increasingly valuable in the long-range use of systems buildings.	Principals	24	0	3
		Supts.	20	0	2
		Proj. staff	4	0	0
		All three	48	0	5
11.	An adaptable systems building will tend to encourage innovation in the curriculum.	Principals	21	2	4
		Supts.	19	1	2
		Proj. staff	4	0	0
		All three	44	3	6
12.	Design time can be reduced by using standardized components or subsystems in systems construction.	Principals	19	3	5
		Supts.	12	5	5
		Proj. staff	4	0	0
		All three	35	8	10

Table 3 (continued)

	Statement	Replies by classification	Agreement Yes	Agreement No	Not Usable
13.	Systems building generally reduces on-site construction time which results in reduced project delivery time.	Principals	18	6	3
		Supts.	14	5	3
		Proj. staff	4	0	0
		All three	36	11	6
14.	Reduced construction time in the systems approach helps to solve over-crowding problems by permitting earlier occupancy.	Principals	16	6	5
		Supts.	12	7	3
		Proj. staff	4	0	0
		All three	32	13	8
15.	Reduced construction time in the systems approach assists curriculum development by permitting educational programs to become operational sooner.	Principals	14	8	5
		Supts.	11	8	3
		Proj. staff	3	0	1
		All three	28	16	9
16.	Volume market, off-site fabrication, and efficient field assembly help systems buildings costs to approximate or remain below conventional construction costs.	Principals	17	6	4
		Supts.	15	7	0
		Proj. staff	4	0	0
		All three	36	13	4
17.	The systems approach is better adapted to make use of fast tracking procedures than is the traditional approach.	Principals	11	6	10
		Supts.	15	3	4
		Proj. staff	4	0	0
		All three	30	9	14

Table 3 (continued)

	Statement	Replies by classification	Agreement Yes	Agreement No	Not Usable
18.	It is difficult, if not impossible, to build non-systems schools at a lower cost than systems schools if the educational requirements, quality of materials, and learning environment are kept at equal levels.	Principals	13	6	8
		Supts.	12	10	0
		Proj. staff	4	0	0
		All three	29	16	8
19.	With systems, construction costs for like quality are less.	Principals	13	4	10
		Supts.	13	9	0
		Proj. staff	4	0	0
		All three	30	13	10
20.	The economy in systems involves reasonable initial costs and low long-term costs of operation and remodeling.	Principals	13	5	9
		Supts.	14	4	4
		Proj. staff	4	0	0
		All three	31	9	13
21.	The more subsystems in a building, the easier it is to predict costs of the total building.	Principals	11	5	11
		Supts.	16	4	2
		Proj. staff	4	0	0
		All three	31	9	13
22.	Expansion of systems facilities can be accommodated in an orderly fashion with minimal demolition.	Principals	19	2	6
		Supts.	17	3	2
		Proj. staff	4	0	0
		All three	40	5	8

make both more yes and more no responses than individual principals made. The highest non-usable response by the superintendents was to the statement that design time can be reduced by using standardized components or subsystems in systems construction (statement 12). There were five unusable responses to this one statement. By comparison, the principals had five or more unusable responses to twelve statements.

Summing the responses across all three classifications, there was substantial majority agreement that the statements included in the questionnaire were perceived to be reasonable reports of the potential benefits of systems building for schools.

THE CONDITIONS IMPORTANT TO THE OPTIMAL REALIZATION OF THE POTENTIAL BENEFITS

The investigation entailed identifying the conditions that are important to the optimal realization of the potential economic and educational benefits of the systems approach to school construction. The conditions were identified through the combined efforts of twelve nationally and internationally recognized authorities in the school plant planning field. The background of this select group represented a wide range of expertise and each member is generally conceded to be among the nation's most informed school planners.

Questionnaires were sent to each of the twelve authorities to obtain their perceptions regarding the conditions that are said to be critically important to the success of systems school construction projects. On the basis of information obtained from architects and the Michigan Department of Education, twenty presumed conditions were listed and included in an open-ended questionnaire. The experts were asked to rate each of the items according to its importance to the success of systems school construction projects; and to suggest any additional conditions that were perceived to be important to full realization of the potential benefits inherent in systems construction.

All twelve of the group responded to the questionnaire. One person responded in the form of a letter and his responses could not be tabulated but certain of his comments have been included in the text of this report. One other person elected to respond to the questionnaire from three approaches. He rated each item based on whether the systems project was a development project, a large-scale application project, or a single or multiple building project. Where variation occurred among the three approaches, only one was tabulated--the development project approach. His other two ratings are reflected among the comments that are included in the text.

Table 4 lists the extent of importance accorded to statements of conditions said to be important to the full realization of the potential benefits inherent in systems construction as perceived by the selected authorities in the school planning field.

Fourteen of the twenty statements were rated by a majority of the experts to be statements of very important conditions necessary for the success of systems construction. Six of the twenty statements were rated lower in importance as fewer than half of the experts perceived them to be very important. In no case did any statement receive more than two not important ratings. All of the twenty statements were perceived to be either somewhat or very important by the majority of those polled.

Ten of the authorities agreed it was very important, and one agreed somewhat important, that reviewing agencies have a willingness to adjust approval schedules to accommodate systems construction programs as needed. One of the authorities commented that this is especially true when fast-tracking is extensive (item 7). Rated equally in importance was that the construction manager should have skill and authority to resolve conflicts over interface difficulties and contract fulfillment. One person suggested that some other responsible agent could perform this function. A second person indicated the faster the schedule, the greater the need for such authority. A

Table 4

The Extent of Importance Accorded to Statements of Conditions Said to be Important to the Full Realization of the Potential Benefits Inherent in Systems Construction as Perceived by Selected Authorities in the School Plant Planning Field

Conditions Said to be Important	Degree of Importance			
	Very	Some	None	Don't Know*
1. Volume purchasing capability is a must.	5	4	2	-
2. Joint bidding practices are permitted within the framework of the law.	8	2	-	1
3. The program size will fall somewhere within an ideal range of half a million to one million square feet of construction.	3	6	2	-
4. Consortiums may be formed to generate adequate volume for joint bidding and bulk purchasing.	4	5	1	1
5. An umbrella authority is available to perform the following services for the consortium:				
a. Administer the systems program.	8	1	-	2
b. Furnish financial aid.	7	-	-	4
6. There are no local building codes that seriously hamper the consortium's ability to develop performance specifications.	5	2	1	3

Table 4 (continued)

	Conditions Said to be Important	Degree of Importance			
		Very	Some	None	Don't Know*
7.	There is a willingness on the part of the reviewing agencies (Department of Education, Fire Marshal, Health Department, etc.) to adjust approval schedules, as needed, to accommodate systems construction programs.	10	1	-	-
8.	The State School Office views the systems approach with favor, is knowledgeable in the area of systems construction, and renders assistance to school districts interested in the systems approach.	8	3	-	-
9.	Capital outlay assistance programs of the state do not exclude systems buildings.	10	-	-	1
10.	The school district architect:				
	a. is willing to do research in areas involving uncertainty;	9	1	1	-
	b. views systems as a means of providing greater service rather than restricted service to his client;	7	3	1	-

Table 4 (continued)

Conditions Said to be Important	Degree of Importance			
	Very	Some	None	Don't Know*
c. has conceptual skills in systems methodology;	7	2	1	1
d. is skillful in converting user requirements into performance specifications.	7	2	2	-
11. The school district staff is willing and capable of defining the objectives of the district, and of developing user requirements.	10	-	1	-
12. The school Administration has knowledge of the potential existing in the systems approach.	9	1	1	-
13. The Administration is not inertia bound and is responsive to changing conditions.	9	2	-	-
14. The Board of Education possesses conceptual skills that permit competent decision making in systems programs.	7	2	1	1
15. The Board of Education has the capacity to expedite frequent decisions, and on short notice.	7	3	1	-

Table 4 (continued)

	Conditions Said to be Important	Degree of Importance			
		Very	Some	None	Don't Know*
16.	The Board of Education is willing to adjust the architect's fee schedule to compensate him at a level commensurate with his services.	4	4	1	2
17.	The Board has involved the community in the planning of facilities.	6	4	1	-
18.	A competent construction manager is assigned to the systems project and is responsible for its management.	7	4	-	-
19.	The construction manager has the skill and authority to resolve conflicts arising from interface difficulties and non-fulfillment of contractor obligations.	10	1	-	-
20.	The construction unions are cooperative and endeavor to resolve issues prior to their becoming serious problems.	9	2	-	-

*The Don't Know column includes non-answered statements.

third person pointed out that the skill of the construction manager is important in any case whether or not systems are used in the construction (item 19).

Capital outlay assistance programs of the state that do not exclude systems building were perceived to be a very important consideration by ten of the eleven experts. The one person did not know but supposed this could be an important consideration for some owners (item 9).

Ten respondents believed that it is very important for the school district staff to be willing and capable of defining the objectives of the district, and developing user requirements. One person believed this was not important. Another person commented that this was a necessary condition regardless of the use of building systems (item 11).

Nine persons believed it is important, and one person believed somewhat important, that the Administration not be inertia bound but responsive to changing conditions (item 13).

The cooperation of the union was considered to be very important by nine persons and somewhat important by two. It was pointed out by one person that unions cooperate in direct proportion to the economic benefits involved in their particular union, and in most cases they are not unduly affected one way or another. A

project official indicated that when construction unions are informed in advance, they are willing to settle jurisdictional problems. Another project official suggested that precoordination of construction components tends to reduce jurisdictional disputes, and consequently the need for union involvement (item 20).

That the school Administration has knowledge of the potential existing in the systems approach was believed to be very important by nine of the experts and somewhat important by one. One other person did not believe this was an important condition (item 12).

No one disagreed that it was important to have the State School Office look with favor on the systems approach and render assistance as needed although three of the group thought this to be only somewhat an important consideration (item 8).

That joint bidding practices are permitted under the law was considered very important by eight and somewhat important by two persons. One person did not know. A suggestion was made that such bidding practices should be permitted to cross county lines and without need for contiguity. One person who thought joint bidding was very important indicated it was only somewhat important in non-development projects. Another who had been directly associated with a development project said it was quite unnecessary to join school districts together

to achieve a large volume unless one wanted to develop a subsystem or group of subsystems (item 2).

Eight persons rated very important the umbrella authority to administer the systems program for the consortium. One person indicated this to be only somewhat important. Seven persons indicated the furnishing of financial aid by an umbrella authority was very important. One person commented that an umbrella authority should also sponsor research. Another person pointed out that it was not important to have an umbrella authority for single or multiple building projects, and that it was only somewhat important to have such an authority for large-scale application of existing systems (item 5).

Everyone was agreed that a competent construction manager assigned to a systems project and responsible for its management was an important condition for the success of systems projects, although four persons of the eleven rated the item in the category of somewhat important. A systems architect said the most important single factor is the need for someone who "feels the call" and has the ability to push the project through. A systems project staff coordinator related that the use of a construction manager depends on local conditions and is not a prerequisite for systems. He indicated the importance of a construction manager was dependent upon local conditions. By contrast another systems architect stated all projects

require competent management; sometimes architects provide it and sometimes contractors provide it. A fourth person declared this was a function of the general contractor in the systems project he directed (item 18).

Conditions involving the board of education were rated as very important or somewhat important by all but one person rating the need of the board for conceptual skills, the capacity of the board to expedite frequent decisions on short notice, and the involvement by the board of the community in the planning of facilities (items 14, 15, and 17). One person stated the capacity of the board to expedite frequent decisions was even more important for speed in non-systems projects. With reference to the decision making, another respondent believed every board has the capacity to accomplish the various tasks required of them, but whether they have the will is another question. Commenting on community involvement, one person related such involvement is always important. Another related that community involvement would not affect or be affected by systems per se. A third person cautioned against using the community to make decisions on details by means of public opinion.

Ten of the eleven respondents indicated it was either very or somewhat important that the architect be willing to do research in areas involving uncertainty,

and that he viewed systems as a means of providing greater service (rather than restricted service) to his client. Nine of ten agreed the architect needs conceptual skills in systems methodology, and nine of the eleven agreed the architect should be skillful in transforming user requirements into performance specifications. One project director noted the importance of architects and engineers understanding the system in order to utilize the potential of systems. He also indicated the importance of the architect being able to analyze and modify existing performance specifications relative to user need. An authority at the federal level stressed the importance of the architect's willingness to work with contractors and others in pre-bid planning and design. A project architect concluded that a helpful architect is important, but a strong owner authority is more important (item 10).

Fewer than half the persons polled agree that it is very important to have volume purchasing capability. One project director summed the statements made by four others. In essence he said volume purchasing is very important for development projects but may have no relevance at all for single school use of existing components. Another planner indicated the range of systems components on the market now allow school-by-school development without volume (item 1).

Freedom from building codes that hamper a consortium's ability to develop performance specifications was considered very important by five respondents, somewhat important by only two persons, and not important by one. Three persons did not know. One architect said most codes hamper and another said codes are important but they may have an equal effect on prescriptive specifications. Updated codes appropriate to the style of construction was suggested by one respondent. Another expert said there could be standardization to meet local codes but it is easier to meet only one interpretation (item 6).

Only four of the eleven experts concurred that it is very important that consortiums may be formed to generate adequate volume for joint bidding and bulk purchasing. And only three persons agreed it was very important that program size would range between half a million and a million square feet. One person said he felt too much emphasis was being placed on volume building to justify systems construction, and if owners and architects are willing to work at it, the job can be done regardless of size. An architect said he had carried out the systems approach on low volume work using tried SCSD subsystems and it worked fine. Another architect submitted that while the volume of construction in the package can be small--it must be representative

of much more outside the package. One respondent indicated the project size is dependent upon the amount of development required. Several other comments in essence declared that components on the market now allow systems construction without volume or consortiums as prerequisites (items 3 and 4).

While four persons thought it was somewhat important that the board of education be willing to adjust the architect's fee to compensate him at a level commensurate with his services, only four rated this item as very important. Two persons did not know and one other indicated this was unimportant. An authority from Florida maintained this was not important in his state unless the architect took over the general contractor's responsibility for construction management. An expert from another state could see no reason either to raise or lower architect fees for systems work. One planner said he felt fees over and above regular fees should be requested by the architect on evidence of extra work anticipated or performed (item 16).

It was noteworthy that fourteen of the twenty items were considered by the majority of experts to be statements of conditions that are very important to the full realization of the potential benefits of systems construction. Further, it was noteworthy that while all twenty items were judged to be very important or

somewhat important by a majority of the experts, five of them were perceived to be very important by only a minority, and a sixth statement was considered very important by only half of those polled. Three of the five statements dealt with program size, volume purchasing, and consortiums. The tenor of the comments relating to these three items suggests a movement away from development projects and a movement toward systems construction through the application of existing components that are now being marketed.

CONDITIONS IN MICHIGAN COMPARED FOR COMPATIBILITY WITH CONDITIONS IMPORTANT TO SYSTEMS TECHNIQUES

The purpose of this portion of the study was to determine to what extent conditions in Michigan school districts are compatible with those conditions that are perceived to be important for the optimal realization of the potential economic and educational benefits of the systems approach to school construction.

The investigation consisted of gathering information by means of personal interviews with school administrators, architects, Michigan Department of Education officials, officials in the Health Department, the office of the Fire Marshal, a professional administrator association, and from a school attorney.

An interview was conducted with the Supervisor of the School Plant Planning Section of the Michigan

Department of Education. Figures were obtained for the total square footage area of complete school buildings that had been approved for construction in Michigan during the five-year period from 1965-66 through 1969-70. In round numbers the figures were: 5,066,000 square feet in 1965-66; 4,722,000 square feet in 1966-67; 5,261,000 square feet in 1967-68; 4,217,000 square feet in 1968-69; and 3,775,000 square feet in 1969-70. These figures are exclusive of building additions. On the average, the Department of Education approved more than 4,600,000 square feet of construction during each of the five years. The average annual cost of this construction approached $100 million. An annual market of this magnitude would be conducive to volume purchasing. Therefore the condition that "volume purchasing capability is a must" can be met. (See Table 4, item 1.)

About one-tenth to one-fifth of the total annual school construction in Michigan falls within the limits set by the condition that "the program size will fall somewhere within an ideal range of half a million to one million square feet of construction. (See Table 4, item 3.)

A school attorney was interviewed to obtain an opinion on such practices as joint bidding by several school districts, the formation of a consortium for the purpose of joint bidding and bulk purchasing, and to

determine if any public authority is available to administer and furnish financial aid to a systems program.

The attorney explained that school districts and boards of education have only those powers that have been expressly granted or necessarily implied by statute; and it is only within this framework that school districts and boards of education may function. There are no inherent powers belonging to school districts. By statute, districts of the third and fourth class must take competitive bids on all labor and materials required for the complete construction of any school building (or addition) when such costs exceed $2,000.00. The bids are required before any construction commences. Districts of the first and second class are not required to but may take competitive bids. The Inter-Governmental Contract Act (Act 35, P.A. 1951) permits school districts to join and to perform jointly any act which each would have the power to perform separately. The Inter-Governmental Contract Act would satisfy the condition that "joint bidding practices are permitted within the framework of the law." (See Table 4, item 2.)

The condition that "consortiums may be formed to generate adequate volume for joint bidding and bulk purchasing practices" can also be met under the language of the Inter-Governmental Contract Act. (See Table 4, item 4.)

The attorney was able to cite one statute that would permit an umbrella authority to be established over several school districts. The statute found in Michigan Statutes Annotated 5.301 as amended, authorizes school districts to incorporate on not more than a countywide basis for the purpose of acquiring and maintaining school buildings. Buildings under such an authority are financed through the sale of revenue bonds by the authority. The buildings are completely owned by the authority, and school districts would pay rent to the authority for the use of such buildings. No such authority of school districts has been established to date. On this basis the condition has not been met that "an umbrella authority is available to administer the systems program (and) furnish financial aid." (See Table 4, item 5.)

The attorney went on to state that to build schools under such an authority would be very costly, and the amount of legal entanglement and overhead costs would make such an operation unfeasible.

Michigan school districts singly or in a consortium are not subject to local building codes. In 1956, Attorney General Kavanagh in Opinion No. 2792 established that townships have no control over school construction. And in 1959, Attorney General Paul Adams in Opinion No. 3156 established that cities have no control over school construction. The one exception to

this is in the case of the City of Detroit whose codes are said to be more strict than state codes and whose codes supercede state codes.

Michigan statutes do not say anything about building codes for school construction but the Department of Education policy requires electrical and plumbing installations to be installed under master electricians and master plumbers, and under permits obtained at either the state or local level. With the option of either state or local installation permits, no code restrictions need to result at the local level according to the Department of Education Plant Supervisor. He pointed out, however, that where services tie in to the building outside of the perimeter walls of the building, local connection codes must be observed. He did not believe this would "seriously hamper the consortium's ability to develop performance specifications." Thus the condition that local building codes do not hamper has been met. (See Table 4, item 6.)

Michigan has three major reviewing agencies that review and approve school construction plans prior to the time any construction is permitted. They are the Office of the State Fire Marshal, the local health department, and the Department of Education. The procedure for the approval, according to the supervisor in the school plant section of the Department of Education is set by Act 306,

P.A. of 1937, as amended. Under this act, he is required to obtain the written approval of school construction plans from the Fire Marshal and from the local health department before he can give his approval for construction to begin. Procedures used in systems projects often involve partial construction (i.e., foundations and subsystems) before the construction plans have been completed. To follow this systems procedure in Michigan, piecemeal approval would be required.

The Ingham County Sanitarian was interviewed and asked if health departments have any position on piecemeal approval of construction plans. He said the Ingham County Health Department makes no exception to the requirement that complete plans must be submitted for approval. He could not speak for other health departments however. A Lansing area architectural firm that claims to have built school buildings in 70 percent or more of the counties of Michigan was contacted. The person whose job it is to obtain construction approvals from the reviewing agencies said that every county health department from which he had sought approval had required complete working documents. On the basis of this information it appears to be a standard practice that health departments require complete sets of plans upon which to base their approval.

An officer of the Fire Marshal Division of the Michigan State Police in Lansing was interviewed. He explained that law requires that construction plans be submitted in completed form for approval, and that no exception to this law would be made. He said that piecemeal approval may be given in the case of hospital construction and that this in turn may someday lead to a change in the law affecting school construction.

Because the approval for construction from the Department of Education is contingent upon the approval from the State Fire Marshal and the health department, there can be no approval by these reviewing agencies for construction of schools in Michigan prior to the submission and approval of complete working drawings. Thus, the condition that "there is a willingness on the part of the reviewing agencies to adjust approval schedules, as needed, to accommodate systems programs" cannot be met under existing conditions. (See Table 4, item 7.)

The Supervisor of the School Plant Planning Section of the Michigan Department of Education was interviewed to determine what the Department attitude is toward systems building, to determine if there is an awareness of that which has transpired to date in systems building, and to determine if the Department could render assistance to school districts that are interested in the systems approach.

The Supervisor indicated that he has always viewed the systems approach with favor and that he is not averse to its expanded use in Michigan. He said he would object, however, to any type of building process that would promote standardized building plans and a statewide curriculum with standardized instruction. He did not believe systems would lead to such standardization. Nor did he believe systems building was a panacea for all construction problems. His interests were to keep building costs down so more money could be spent for materials and equipment within the building.

He judged himself to be very knowledgeable in the area of systems building. He had done considerable reading on the subject; he had toured systems buildings in Chicago, Stanford, and Toronto; and he had attended numerous conferences where systems building had been the topic for discussion. In addition, he is serving as a member of the Advisory Board of the Detroit Construction Systems Program (CSP).

The Department of Education, according to the Supervisor, has a policy of not promoting a given curriculum nor a preferred method of school construction. Consequently, there has been no literature originating with the Department that has promoted the systems concept in school building. There appears to be a willingness to work with architects and school people and to direct them

to sources of information that relate to the systems approach. The State School Office in Michigan is the Department of Education. The relevant agency within the Department that deals with school construction is the Plant Planning Division. As that division is represented by the Supervisor, the condition is met that requires the State School Office to view "the systems approach with favor," to be "knowledgeable in the area of systems construction," and to render "assistance to school districts interested in the systems approach." (See Table 4, item 8.)

The only funded capital outlay program for assisting Michigan schools with construction costs is the Michigan School Bond Loan Program. School districts whose bonds qualify under the rules of the School Bond Loan Program may elect to borrow a portion of any debt service required beyond seven mills tax effort. The money may be borrowed from the Bond Loan Fund at a low rate of interest. Repayment to the Fund is required only to the extent that a seven mill levy will produce an amount of money in excess of that required to meet principal and interest payments on the qualified bonds in a given tax year. The net effect of the School Bond Loan Program is that it makes possible a reduced debt service levy during the borrowing stage of participation in the program.

According to the Supervisor of the School Bond Loan Section of the Department of Education, systems buildings qualify for inclusion in this assistance program. The major requirement is that the anticipated life of the building be not less than the life of the bond issue. Therefore, the condition that "capital outlay assistance programs of the state do not exclude systems buildings" has been adequately met. (See Table 4, item 9.)

Four Metropolitan Detroit architects were interviewed to determine to what extent they believed Michigan architects are willing to do research in areas involving uncertainty, to determine if systems are viewed by architects as a means of providing greater service, to determine if architects understand systems methodology, and to determine if they have skills required in converting user requirements into performance specifications.

The general consensus was that architects are divided into two camps--those who are up-to-date on systems and those who are not. They believed that larger firms were more knowledgeable than smaller firms, and that aggressive architects were more knowledgeable than conservative ones. In other words, some architects are said to be aware and some are said not to be at all versed on systems techniques. Those who are knowledgeable, it was believed, are currently

carrying on research in systems materials and methodology. Some of these architects are using both systems methods and materials. One architect said there may be a fear among some architects that mass-produced components may restrict design. It was agreed by all that there is a lot of potential in the systems approach and if it is properly used, greater service can be provided by the architect. It was believed that performance specifications may begin to replace prescriptive specifications. Also it was believed that knowledgeable architects have the skills required to convert user requirements into performance specifications. On the basis of the above, some architects in Michigan can or do meet the condition that they are "willing to do research," they view systems "as a means of providing greater service," they have "conceptual skills in systems methodology," and they have the skills required to convert user requirements into performance specifications. (See Table 4, item 10.)

Six school district administrators and four architects were asked if they believed that school staff members were willing and capable of defining school district objectives and of developing user requirements. As a group, the administrators thought their staffs were anxious to participate in the planning of new facilities to any extent that they were asked, provided

there was a healthy relationship between the staff and the administration of the school.

The architects said they want as complete a set of user requirements as can be obtained. Some of the districts, in their experience, had done quite well in developing user requirements; others had been lax. In general they believed staffs were eager to assist, had much to contribute, and would do a good job in developing user requirements--particularly if release time were provided for that purpose. Based upon the above, the condition has been met that requires the school staff to be "willing and capable of defining the objectives of the district, and of developing user requirements." (See Table 4, item 11.)

The six school administrators were asked how much they knew about the systems schools in California, Canada, and Florida and what they knew about systems building in general. Three of the six said they did not know a thing about systems building. One said he had seen several articles but was not familiar with any of it. Another said he was trying to find information about "modular building" which he had just learned about. Only one of the six administrators indicated that he was knowledgeable about systems and had discussed the systems approach with his architect and with his board of education.

The consensus of the four architects was that most superintendents and other administrators know very little about systems building. They believed administrators may be somewhat conscious of some systems materials or techniques but they really do not know what systems are all about. And it was their opinion that boards of education know even less than their administrators about systems building. The discussion above indicates two conditions are not being met as of this date. They are the conditions that require the administration to have "knowledge of the potential existing in the systems approach" and that the board of education possess "conceptual skills that permit competent decision making in systems programs." (See Table 4, items 12 and 14.)

Inertia or the indisposition to change is a prime factor in maintaining the status quo. The Executive Secretary of the Michigan Association of School Administrators (MASA) was interviewed to determine how responsive to change he believed Michigan administrators to be. His opinion, he said, would necessarily have to be subjective, but from his experience working with several hundred administrators throughout the years, he believed that Michigan administrators were very aggressive and responsive to change.

An official from the Michigan Department of Education was asked how much of the lack of systems building

in Michigan would he attribute to the inertia of administrators. He judged that the average administrator would not know a systems building if he met one on the street, and until systems building is promoted in Michigan, he probably will not exhibit too much concern. He likened the situation to that of labor relations within the schools. Ten years ago few administrators had given much thought or study to the negotiation process, he said, while today most administrators view themselves as having at least modest expertise in that area.

One of the architects who furnished information for this investigation believed the systems approach should have been used in a recent building program with which he had been associated. He said the board and the administration were so set in their ways that he finally gave up on trying to convince them that systems was the route to take. This architect believed his firm was more ready to adopt the systems approach than were most of the clients.

Thus, three points of view have been suggested: (1) administrators are ready to respond to change, (2) only when change has been promoted will administrators change, and (3) administrators will not respond to change, even when urged. It is not at all clear that the condition that requires that the "administration is

not inertia bound and is responsive to changing conditions" has been met. (See Table 4, item 13.)

According to the school attorney, school districts in Michigan are relatively flexible in the number of board meetings they may have. By law each school district must have a regular meeting once each month. Fourth class districts may call special meetings by placing proper notice in the mail at least seventy-two hours in advance of the meeting or by delivering notice of the meeting to a member of the household at the board member's residence twenty-four hours in advance of the board meeting. First, second, and third class districts can adopt by-laws that will permit them to hold board meetings in accordance with such by-laws. Thus it is within the power of school boards to hold frequent meetings and to expedite frequent decisions on short notice. Whether "the board of education has the capacity to expedite frequent decisions, and on short notice," is dependent upon the will of the board. (See Table 4, item 15.)

The four architects who were interviewed were asked if they believed there was a need to modify the standard architectural fee schedule that had been established for conventional building programs. They were agreed that they could operate within the same fee schedule in the construction of systems buildings

provided the construction management aspect of the building program would remain with the general contractor as it usually does with conventional building. They believed most architects would share this same thought. Insofar as the above is true, there does not appear a need in Michigan for the condition that "the board of education is willing to adjust the architect's fee schedule to compensate him at a level commensurate with his services." The fee appears adequate. (See Table 4, item 16.)

Administrators in six school districts were interviewed to determine if there was community involvement in the planning of school facilities. Five of the six administrators indicated that their respective school districts use citizen committees to help with the planning of school building programs. The sixth district, according to one of its administrators, keeps a constant flow of information from the district to the community. The information is intended to explain what is being done and why. The district then uses the community as a sounding board and reacts to the feedback that is generated. It was the opinion of these administrators that all school districts involve the community to some extent in the planning of school buildings. Thus the condition that "the board of education has involved the community in the planning of facilities" is already being met. (See Table 4, item 17.)

According to the four architects that were interviewed, the general contractor usually serves as the building construction manager. This proved to be the case in the school districts of the six administrators who were interviewed. Three of the four architects indicated that an entirely new field in the area of construction management is beginning to develop. For a fee, a management firm performs all the management services normally performed by the general contractor. In addition it may provide the machinery for fast-tracking and other time-or costs-saving devices. A management firm may be paid a flat fee for its services, and in addition be given 25 percent of any savings it could effect on behalf of the owner upon the approval of the architect and owner.

The architects were agreed that regardless of who was responsible for "ram-rodding" the job, the management of the construction is important. There are competent construction managers. Whether a "competent construction manager is assigned to the systems project and is responsible for its management" is a matter of decision. This condition can be met. (See Table 4, item 18.)

The architects were in full agreement that there is no substitute for a competent construction manager who knows how to manage materials and people who work

with the materials. If he is to have authority to resolve conflicts on the job there must be either a single contract or else the several contracts must be assigned to him to manage. The "big club" that he holds is his ability to approve or withhold payment from the contractors. The tighter the construction schedule, the greater is the need for his skill in directing the job. On this basis, authority can be assigned to the construction manager by the board of education. The skill requirements of the construction manager can also be set by the board. Therefore, it was the opinion of the architects that the following condition could be met: "The construction manager has the skill and authority to resolve conflicts arising from interface difficulties and non-fulfillment of contractor obligations." (See Table 4, item 19.)

An interview was held with the Assistant to the Executive Secretary of the Detroit Building Trades Council which is located in Detroit and services Wayne, Oakland, and Macomb, and St. Clair Counties. The purpose of the interview was to determine the attitude held by the building trades unions toward the systems construction program in Detroit and industrialized systems buildings in general. The officer interviewed said systems building presents no conflict with the unions in Michigan as long as the components are manufactured

by union labor. He said he thought the only kind of dispute that might come about would be between the different unions over jurisdictional rights. He said this could be prevented by working with the unions in advance of construction. He could see no reason why there should be any serious problems with the unions in Michigan because of systems construction. It seems there would not be difficulty meeting the condition that "the construction unions are cooperative and endeavor to resolve issues prior to their becoming serious problems. (See Table 4, item 20.)

SUMMARY

This chapter dealt with three phases of the study: the potential economic and educational benefits; the conditions important to the optimal realization of the potential benefits; and the conditions in Michigan compared for compatibility with conditions important to systems techniques.

Each of the principals and superintendents (and four project staff members) of all of the SCSD, SEF, and SSP project schools were queried by questionnaires to determine what they perceived to be the potential economic and educational benefits of the systems approach to school construction. Altogether there were seventy-nine questionnaires disseminated. Fifty-three

questionnaires (67 percent) were returned. Respectively, the project staff and principals had the highest proportion and lowest proportion of returns. The more recent the project, the lower was the rate of returns.

There was an overwhelming majority agreement with each of the twenty-two statements of potential benefits that appeared in the questionnaire. Everyone was agreed that systems buildings are generally adaptable and that their flexibility will be increasingly valuable. As a group, the California SCSD respondents did not agree that systems building would permit earlier occupancy and earlier curriculum development. But the other two groups did. Agreement with the other benefits ranged somewhere between these two extremes. Two additional benefits were suggested by respondents: (1) obsolescence of subsystems can be designed in and substitution of obsolete subsystems may be accomplished without disturbing other systems, and (2) off-site fabrication contributes to quality as the factory assures a better product.

The four project staff members were virtually in agreement with every suggested benefit. The principals tended to submit fewer usable responses to the statements than did the superintendents. This was particularly true with items concerning costs. Summing the responses across all categories, there was substantial majority

agreement that the statements included in the questionnaire were perceived to be reasonable reports of the potential benefits of systems building for schools.

Twelve nationally and internationally recognized authorities in the school planning field were asked to identify the conditions that are important to the optimal realization of the potential economic and educational benefits of the systems approach to school construction. A twenty-statement questionnaire was developed and the experts rated each item according to its importance to the success of systems school construction. Fourteen of the twenty statements of conditions were rated to be very important by a majority of the experts. Six statements were rated either important or somewhat important. No statement was rated not important by more than two persons. Based upon the ratings, very high priority was given to the condition that reviewing agencies have a willingness to adjust their approval schedules to accommodate systems construction; also that the construction manager be skillful and have authority required to resolve conflicts. High priority was given to the conditions that: state programs of capital outlay do not exclude systems construction; the staff is willing and capable of developing user requirements; the union is cooperative; and the school Administration is free of inertia and understands the potential in systems.

Of somewhat lesser importance were the conditions that: the state school office looks with favor on the systems approach; joint bidding practices are permitted; an umbrella authority is available; a competent construction manager be assigned to the job; and the board of education be versed in systems concepts, be capable of making frequent decisions, and be involved with the community in planning school facilities. The attitude of the architect and his ability were considered relatively important.

Although each of the twenty conditions were considered to be of some importance, the least amount of emphasis was placed on the need for consortiums of school districts to obtain large programs for volume purchasing, the requirement that boards of education are willing to adjust the architect's fee schedule, and on the condition that local building codes do not seriously hamper the consortium's ability to develop performance specifications.

There appears to be a movement away from development projects and a movement toward systems construction through the application of existing components that are now on the market.

An investigation was conducted to determine if conditions in Michigan were compatible with those

conditions that are said to be important to the success of systems projects. The investigation revealed:

1. The near $100 million annual construction market will permit volume purchasing.
2. About one-tenth to one-fifth of the annual construction volume would meet the ideal program size.
3. The Inter-Governmental Contract Act permits joint bidding.
4. Consortiums may be formed.
5. An umbrella authority is not available to administer or to furnish aid to systems programs.
6. Local building codes do not apply to school construction outside of Detroit.
7. Reviewing agencies are unable to adjust their approval schedules to a piecemeal basis.
8. The Department of Education is knowledgeable about systems techniques, views the systems approach with favor, and will render assistance to school districts that are interested in the systems approach.
9. Systems school buildings may be included in Michigan's capital outlay assistance program (School Bond Loan Fund).

10. Some architects do (some do not) meet the requirements said to be important for them to function adequately in systems programs.
11. School staffs have the ability and are willing to define objectives and develop user requirements.
12. Administrators generally do not have widespread knowledge of the potential benefits in systems construction.
13. It is not clear that school administrators readily overcome inertia and respond to changing conditions.
14. Boards of Education generally do not have conceptual skills that permit competent decision making in systems programs.
15. Boards of education have the power to make frequent decisions and on short notice. Their capacity to do so is dependent upon their will.
16. There is no apparent need to adjust architectural fees to accommodate systems building.
17. Boards of education do involve their communities in the planning of facilities.
18. It is a matter of decision whether a competent construction manager is employed and assigned to a systems project.

19. Skill requirements of the construction manager and the amount of authority vested in him are set by the board of education.
20. Construction unions appear to be cooperative and willing to resolve issues prior to their becoming serious problems.

Chapter 5

SUMMARY AND RECOMMENDATIONS

This study of the systems approach to school construction consisted of a composite of three sub-studies.

The purpose of this chapter is to present a review of these sub-studies, to discuss the findings, to present the major conclusions of the study , and to present recommendations.

SUMMARY

The first phase of the investigation was conducted to determine what the planners and users of systems school buildings perceived to be the potential benefits of the systems approach to school construction.

The second phase of the investigation was conducted to determine those fundamental conditions that a select group of experts in the school plant planning area perceived to be important for the full realization of the potential benefits of the systems approach to school construction.

The third phase of the investigation was conducted to determine the compatibility of the conditions existing

in Michigan school districts with those conditions that are perceived to be important to the full realization of the potential benefits of systems construction.

The Potential Benefits

The planners and users of systems buildings in three major systems development projects were polled by questionnaire to determine what they perceived to be the potential economic and educational benefits of the systems approach to school construction. Included in the survey were all the systems schools of the following systems projects: School Construction Systems Development (SCSD) in California; Study of Educational Facilities (SEF) in Toronto, Ontario; and Schoolhouse Systems Project (SSP) in Florida.

Two-thirds of the persons polled responded to the request for data. The highest rate of response was from the project staff members of the SEF and SSP staffs, and from superintendents of the SCSD project schools. All persons in the above categories responded.

The lowest rate of response was that of the principals and superintendents of the SSP project schools. Nearly half of this group failed to respond to the request for data.

An analysis of the responses to the twenty-two statement questionnaire revealed the following:

1. Two potential benefits of systems construction not posed in the questionnaire were advanced by respondents. They were: (1) the replacement of obsolete subsystems may be accomplished without disturbing other systems; and (2) the off-site fabrication of components contributes to quality as the factory assures a better product.
2. An overwhelming majority of the questionnaire respondents were in agreement with the entire listing of potential benefits that had been developed from the literature, from visitations to systems school buildings, and from interviews with systems project personnel.
3. The systems project personnel who responded to the questionnaire were in virtual agreement with the entire listing of potential benefits.
4. The California SCSD respondents, as a group, were conspicuous by their lack of agreement that a savings in design and construction time is effected by using the systems approach. As a result of this general position, they disagree that systems construction offers solutions to over-crowding problems or that systems assist curriculum development by permitting earlier building occupancy.

5. As a group, the Toronto SEF respondents were in unanimous or near unanimous agreement with all but three statements of the potential benefits that had been proposed. About one-third of this group was not agreed that cost and quality benefits favored systems construction over conventional construction, and they were not agreed that traffic flow is more easily accommodated in systems buildings than in conventional buildings.
6. The Florida SSP group was less vigorously in support of the cost and quality potential benefits of systems construction than were the California and Toronto groups.
7. Respondents from each of the three development project schools were in strong agreement that systems construction has a high potential for flexibility and adaptability in school construction.
8. Principals and superintendents as groups were generally consistent in their responses except that the principals tended to respond less well than did superintendents with usable answers to statements of potential benefits involving construction costs.

On the basis of the findings it seems safe to conclude that the list of potential benefits acquired

from the literature and from visits to systems schools are in fact those perceived by planners and users of systems schools to be the potential benefits of the systems approach to school construction.

Conditions Important to Systems Building

Twelve widely recognized authorities in the school plant planning field were asked to identify the conditions that are important to the optimal realization of the potential economic and educational benefits of the systems approach to School construction. Through their responses to a questionnaire, they rated twenty statements of conditions presumed to be important to the success of systems building.

All twelve of the plant planning experts reacted to these statements of conditions. On the basis of the information they supplied, the following observations were made:

1. The twenty questionnaire statements that were assumed to be statements of conditions that are important to the success of systems building were rated by a substantial majority of the plant experts as either very important or somewhat important to the optimal realization of the potential economic and educational benefits of the systems approach to school construction.

2. The study was unable to identify any conditions other than those listed in the questionnaire that were perceived by the experts to be conditions that are important to the optimal utilization of the potential benefits of systems construction.
3. Perceived to be of prime importance to the success of systems construction are the conditions that: (a) capital outlay assistance programs of the state do not exclude systems-constructed buildings; (b) the reviewing agencies of the state (Department of Education, Fire Marshal, Health Department, etc.) are willing to adjust approval schedules to accommodate the needs of systems construction programs; (c) there is a willingness and capability on the part of the school staff to define the objectives of the district and to develop user requirements; (d) the school administration has knowledge of the potential in the systems approach to school construction and is able to overcome inertia and respond to changing conditions; (e) the construction unions are cooperative and endeavor to resolve issues before they can become serious problems; and (f) the construction manager who is assigned to the

systems project is competent and has skill and authority to resolve conflicts arising from interface difficulties and non-fulfillment of contractor obligations.

4. Important to the success of systems construction but perceived to be of less importance than those conditions listed above is a middle ordering that includes the conditions that: (a) the State School Office has both knowledge and a positive attitude regarding systems building and it renders assistance to school districts that are interested in the systems approach to school construction; (b) the law permits joint bidding practices; (c) an umbrella authority is available to administer the systems program and furnish financial aid to the consortium; (d) the architect for the school district is willing to research areas of uncertainty, views systems as a means of providing greater service to his clients, and possesses understanding and skills in systems methodology and techniques; (e) the board of education has the capacity to expedite frequent decisions on short notice and has the conceptual skills to expedite competent decision making in systems programs; and (f) the board of education has involved the community in the planning of school facilities.

5. Volume purchasing capability is important to projects that are designed to develop new systems. But volume purchasing is only somewhat important or not at all relevant to single-school use of existing components.
6. The formation of consortiums to increase program size and to generate volume for joint bidding and bulk purchasing is very important only to systems projects where development is a consideration. Components that are now on the market allow systems construction without either large volume or multi-district consortiums as prerequisites.
7. That local building codes do not seriously hamper the consortium's ability to develop performance specifications is a condition deprived of practical significance excepting for projects where development is a consideration. As such, it ranks relatively low in the orderings of the important conditions.
8. There is no strong support for the position that it is very important for the board of education to be willing to adjust the architect's fee schedule to compensate him specifically for presumed extra services required in planning systems building.

The Compatibility of Conditions in Michigan

School district administrators, architects, and officials of those organizations that have first-hand knowledge of conditions in Michigan were interviewed to determine the extent of compatibility of the conditions in Michigan with those conditions that are perceived to be important to the full realization of the potential benefits of systems construction.

The investigation revealed the following salient points about conditions in Michigan:

1. The School Bond Loan Program is the only funded capital outlay assistance program of the State of Michigan. Systems buildings qualify for inclusion under this program.
2. Agencies that review school construction plans and grant their approvals for construction include the Department of Education, the Fire Marshal, and the Health Department. School building construction may not be started prior to the approval of complete sets of working drawings by these agencies. The legal framework within which these reviewing agencies function prohibits the granting of piecemeal approval. Therefore there can be no approval of systems projects that involve partial construction before

all of the working drawings have been completed, under present law and custom.

3. School district staffs in Michigan are both willing and capable of defining the objectives of the school district and of developing user requirements.
4. As a group, school administrators in Michigan are not generally knowledgeable as to the potential existing in the systems approach to school construction.
5. There was no definitive evidence on whether in fact school administrators in Michigan are or are not inertia bound and are or are not responsive to changing conditions.
6. Labor unions in Michigan exhibit no opposition to systems construction per se. They are willing to discuss and resolve issues peculiar to systems construction prior to their becoming serious problems.
7. There are competent construction managers who have adequate skills to manage systems building programs. Whether such a manager is assigned to the systems project is a matter for decision by the board of education. The skill requirements and the amount of authority vested in such a manager is also a matter for decision by the board of education.

8. The School Plant Planning Section of the Michigan Department of Education views systems building with favor. As a matter of policy it promotes neither systems nor conventional building. The Department has the requisite knowledge and willingness to work with school districts that are interested in systems construction of school facilities.
9. The Inter-Governmental Contract Act of Michigan authorizes school districts to form consortiums for the purpose of promoting joint bidding and bulk purchasing practices.
10. There is no umbrella authority in Michigan that can furnish administrative and financial services to a consortium. Under existing laws it would be difficult and costly to establish such an umbrella authority over several school districts.
11. There are architects in Michigan who possess those skills that are said to be important for an architect to have in order to function adequately in a systems construction program.
12. As a group, boards of education in Michigan generally seem not to possess conceptual skills in the area of systems construction.
13. No definitive evidence was found on the question of whether boards of education in Michigan have

the capacity to expedite the making of frequent decisions. But under existing laws, they have the power to meet often and upon short notice to make such decisions.

14. It is common practice in Michigan for boards of education to involve their communities in the planning of school facilities.
15. One half a million to one million square feet of construction in a one-package building program would be the equivalent of between one-tenth to one-fifth of Michigan's total annual school construction projects.
16. Michigan school districts, other than in the city of Detroit, are not bound by local construction codes.
17. There does not appear to be a need in Michigan for fee schedules of architects to be adjusted to accommodate systems construction as the fee schedules for conventional construction seems to be adequate.

DISCUSSION

The planners and users of systems school buildings are in an excellent position to compare their systems buildings with other school buildings that have been built through more traditional approaches. Their

position is unique insofar as they have had experiences with both systems constructed school buildings and non-systems buildings. Such planners and users of systems buildings are in general agreement that certain economic and educational benefits may be realized as a result utilizing the systems approach to school construction.

One of the objectives of this investigation was to determine what the planners and users of systems buildings think are the potential benefits of the systems approach to school construction. On the basis of data submitted to this investigator, the potential benefits that can be achieved through the systems approach were identified. These potential benefits can be categorized into four general groupings as follows:

1. Systems construction can result in lower construction costs than traditional school building construction.
2. Systems construction can result in higher quality construction than traditional school building construction.
3. Systems construction can result in shorter project delivery time than traditional school construction.
4. Systems construction can result in flexible school buildings that are more adaptable to

changing educational requirements than are traditionally constructed schools.

The amount of success that can be attributed to a systems project is judged according to the extent the project is able to realize one or more of the potential benefits in the four major areas. There is no precise measuring instrument that can be used in making such a judgment. Therefore the determination of success must be made on the basis of how well the end results of the systems project compare with the typical end results of a non-systems school of similar size and purpose. In other words, a comparison is made between the systems school and a comparable school that might have resulted from traditional building procedures. Out of necessity, such judgments must be both subjective and relative.

Another objective of this investigation was to identify those conditions that are generally important to the success of systems school construction projects. This was accomplished on the basis of expert opinions submitted to this investigator. Some of the conditions that were identified seem on examination not to be exclusive to the success of systems construction, but they are important to the success of traditional approaches to construction as well. For example, the involvement of the school staff and the school community in planning school buildings is as important to one

approach as it is to the other. Likewise it seems equally important to each approach that the decision makers--architects, administrators, school boards, and construction managers--have the requisite attitudes, knowledges, skills, and authority to function at levels commensurate with their responsibilities. As with systems construction, healthy labor relations with and among the construction unions is important to the traditional approach too. It seems evident that conditions such as these are not tied only to systems construction. Nevertheless, these conditions are an important consideration to the success of systems construction programs. While ideal conditions do not guarantee success to a systems project, the lack of such conditions can only hinder the achievement of optimal results. It is important, therefore, that the conditions be as nearly ideal as possible.

Not all systems projects require that the same conditions pertain. Development projects such as SCSD, SEF, and SSP require some conditions quite different from those required of an off-the-shelf program. The role of the development systems architect is an expanded one. It includes consultation and interaction with the manufacturers during the subsystem development stages of the program. This consultation is helpful to the manufacturers, but it is essential to the architect

whose job it may be to evaluate and make recommendations from among components that have yet to be field tested.

Very important to the development project is the ability of the project to generate a large volume of construction. Large volume of construction serves to stimulate industry to develop new products that satisfy the performance specifications set by the user. Some school districts have formed consortiums to achieve a program size that would motivate industry to develop new systems. Under such an arrangement, the economic advantages of cooperative bidding and purchasing can be sought and likely achieved.

It is common for an existing umbrella authority (or a specially developed public agency) to administer the development project and to provide funds for the purpose of developing performance specifications. The performance specifications reflect the common user requirements of the school districts comprising the consortium.

The development systems project is one, then, that requires large size to promote the development of new products.

The building industry over the years has developed a vast inventory of school building materials. The range of components on the market now allows systems construction of school buildings without regard for high

volume purchasing, consortiums, umbrella authorities, and those procedures that are peculiar to the development systems projects. Thus, it may be quite unnecessary to join school districts together in systems projects except as there is need to develop subsystems.

Off-the-shelf components have met with successful use in low volume projects. Educational Facilities Laboratories, Inc. (EFL) has ceased supporting new major development projects. On this basis, it seems that there no longer is an immediate need for extensive subsystem development projects beyond those currently in progress. It appears that the high volume development project approach to systems building will give way more and more to low volume single school application of systems. Therefore the conditions of large project size, volume purchasing, and the like that were of extreme importance to development projects will become less important. Perhaps the size of projects will be hardly at all relevant to systems construction in the next few years.

How rapidly or to what extent systems building will replace traditional building is a matter for conjecture. Undoubtedly inertia is among the greatest deterrents to change. The exploration of new ideas and the willingness to change are conditioned by forces within the school district and at the state

level. The potential benefits of the systems approach will remain untapped to the extent that local school planners fail to recognize them and fail to seek them out.

A favorable atmosphere at the state level is important to systems construction. The laws, policies, and attitudes of the state and its officials have been developed slowly throughout the years. They accommodate tradition rather well but often they do not encourage the kinds of change suggested by systems building. Multi-stage bidding and fast-tracking operations are relatively new techniques in systems construction and they may be crucial in terms of effecting economies in time and money. But to the extent that the legal structure of the state precludes these or other facets of the systems approach, the choice of construction remains limited to more traditional methods.

This research has revealed some conditions in Michigan that are not conducive to the adoption of systems construction. First and among the foremost is the discovery that boards of education and administrators are not generally knowledgeable about the potential benefits of the systems approach. While officials in the Michigan Department of Education have done nothing directly to discourage the use of systems building, by the same token they have done little to

encourage school districts to explore such an approach. Architects in Michigan as a class are not known for their efforts to pioneer in systems construction. They do not have any systems school buildings within the state that have served as showpieces to stimulate further systems construction. In sum, it seems that school people and school architects in Michigan are generally neither knowledgeable nor concerned about systems construction. And at this time there do not appear to be any forces operating to change this.

A deterrent to the adoption of systems construction in Michigan is the requirement that school building construction plans be completed in their entirety before the reviewing agencies (Department of Education, Fire Marshal, and Health Department) will grant their approvals for construction. This restraint effectively eliminates the possibility of fast-tracking and any construction phase of systems building that could logically be started sooner if piecemeal approval were granted.

The competitive bidding requirement in Michigan affects third and fourth class school districts in the same way. This includes most school districts in Michigan. All such districts are required by law to take competitive bids on all labor and materials required for the construction of school buildings.

As the construction bids must be taken before commencing any construction, the law effectively prevents fast-tracking procedures, such as pouring footings or constructing components before all bidding has been completed.

Thus, between the restrictions imposed by the reviewing agencies and those which are set by the law on bidding practices, one of the more attractive procedures of the systems approach to school construction has been thwarted. The potential gain in savings of time, and subsequently money, by telescoping the bidding and building procedures is a benefit that cannot be attained under existing conditions.

It is not likely that large-scale development system projects will be attractive to Michigan school districts as a solution to their school building problems. At present, there are seemingly too many problems with this approach. Those problems cited above still hold.

Large-scale systems projects involving systems development by a consortium of school districts are confronted with more problems. First, it has been standard procedure for large-scale projects such as the SCSD, SEF, and SSP to operate under an umbrella authority. Such an authority is important to development projects for administrative and financial aid purposes. In the

event school districts in Michigan decided to develop a new building system, they too would require the same kinds of services as have been required and available to school districts that have participated in development projects in other areas. The problem is that there is no ready-made public agency that may serve as an umbrella authority over a proposed consortium of school districts. Therefore if a development project were to be initiated by a group of school districts in Michigan, a new public authority would need to be created.

At this point in time, Michigan school districts have not joined for the purpose of building local schools. How to set up a school building authority and operate within its confines is a major problem. There is no established pattern to follow but certain constraints are given. Under existing law a school building authority would hold title to all of the school buildings constructed within its jurisdiction. Funds for construction would be limited to those received from the sale of revenue bonds. Local school districts would be required to lease from the authority all of those buildings constructed thereunder. And the rent would be used to retire the revenue bonds and to pay for the operation of the school building authority.

It is likely that much time and legal effort would have to be expended in the development of a

school building authority and in making it operable. As the revenue bonds would be paid off from local rental monies, school districts would have to devise a method that would guarantee that the prescribed rental funds would be available throughout the years. Not only would the guarantee need to be sufficient to satisfy the building authority, but it would have to be of such magnitude that the lack of risk would make the bonds attractive to brokerage firms.

Presently, school districts in Michigan may borrow from the School Bond Loan Fund nearly all of the debt service requirement beyond that which can be realized from a seven mill levy. In effect this permits many school districts to finance their building construction with lower tax levies than otherwise would be required. It also places the faith and credit of the state behind their bonds. Under existing law, a school building authority does not qualify for financial assistance from the School Bond Loan Fund. This condition, alone, is enough to discourage school districts from forming a building authority. The formation of a building authority at this time would tend to create more problems than it would solve. Thus it is not likely that school districts in the state will elect to join together in a development systems project.

This study originated with the notion that the systems approach to school construction in Michigan would offer great advantages to school planners. The goals of systems construction--lower costs, higher quality, shorter construction time, and greater adaptability--are important considerations to any school construction program and theoretically the systems approach is a big step forward in that direction. In practice, however, this may not be the case.

Not all systems schools are individually as high in quality of construction as similar schools that have been constructed by traditional methods. Nor have they always been lower in cost. For varying reasons, systems projects may have a greater project delivery time than conventional projects.

The attainment of the potential educational advantages of a flexible building will be dependent upon the ability of the students, teachers, and administrators to utilize the environment that has been created. A systems building aimed toward open space could very well result in being as inflexibly open as traditional buildings have been inflexibly closed.

That which happens within a building is a function of planning. A systems building cannot promise that it will house a good curriculum, but a flexible systems building need not stand in the way of the

curriculum. It can be adapted to accommodate change. To a great extent, its flexibility will likely be dependent upon the flexibility of its users.

Some users of systems buildings have had unhappy experiences with their systems building programs. Although such people were found to be in a minority on the basis of this study, their experiences contradicted the advantages they sought. On the other hand there are systems school buildings whose users claim to have realized to some degree all of the benefits of cost, quality, time, and flexibility.

The point to be made is that the use of systems construction is not a guarantee that better buildings will be built for less money in shorter periods of time and that they will be more flexible than traditional buildings. There is only that potential.

Implications for Michigan

It seems reasonable to conclude that the time is not right for development systems projects to make any major inroads in Michigan's school construction field. The amount of research and development in systems construction already completed or in progress precludes the necessity or desirability for Michigan school districts to become involved in new development systems projects; at least for the immediate future. If at a more distant time it should be found desirable for

Michigan school districts to participate in a development project, its formation would be greatly eased by legislation designed to create and fund a commission specifically designed to serve the project.

The use of off-the-shelf building systems has proven to be successful in both single and multiple school construction projects in other states. There are no conditions that have been identified by this study that would prevent the similar use of ready-made systems in Michigan. The off-the-shelf method of systems construction affords access to the same potential benefits as does the massive development projects with the exception of component development. At the same time it does not impose any of the restraints imposed by a consortium or by a building authority. But the general lack of systems knowledge on the part of school administrators and school boards, and the general disinclination on the part of architects to promote systems building are not encouraging signs of any trend toward systems construction in Michigan.

Fast-tracking is a relatively new management technique that has been designed to reduce project delivery time. The planning for decreased project delivery time can be an important consideration for traditional building programs as well as for programs that use systems. Fast-tracking and systems construction

can go hand in hand. A combination of the two may result in greater time savings than that which can be realized from the use of systems alone. Because of the spiralling costs in the construction industry, savings in time has come to mean savings in money. Therefore it is important that school building programs in Michigan have access to the fast-tracking procedure. But Michigan school districts cannot fast-track a building program insofar as it would require partial construction of the building before all the construction plans had been completed and bids had been taken on the entire project. Minor amendments to existing law would permit Michigan school districts to fast-track.

The Michigan Department of Education has been characterized by its desire to furnish school people with the kinds of services that promote better education for the boys and girls in the schools of Michigan. It has been the intent of the school plant planning section of the Department to furnish school planners with a source of information necessary to the planning and processing of school building projects. In view of what is currently happening and that which has happened in the area of systems construction, an opportunity exists for the Department of Education to prepare a publication to so inform boards of education, administrators, and the community. Publications of the Department, to this date,

have only alluded to systems building and have failed to inform the public and school officials of the potential benefits that may be realized by a systems approach to construction. Each school in Michigan must judge for itself which building approach to take, but each district should be stimulated to reexamine traditional procedures in light of what is available. This suggests a new opportunity for the state to be of service to its people.

CONCLUSIONS

1. In systems development projects where the major task was one of developing new building systems, it has been feasible to combine several school districts in order to create a program size that would generate a volume market and thereby stimulate industry to manufacture new building components.
2. As a result of the extensive development of systems building components in such major development projects as SCSD, SEF, and SSP, massive building programs are no longer required in order to make use of the existing systems now on the market. Off-the-shelf systems are available for use in individual school construction projects.

3. Lower construction costs, higher quality of construction, shorter project delivery time, and more flexible school buildings are the potential benefits that may be realized in systems school construction.
4. Systems construction has not always resulted in the realization of all of the potential benefits of this approach to school building construction. The use of systems does not guarantee these benefits, but it has permitted them.
5. The conditions under which systems projects are undertaken can affect their success to a remarkable extent. Many of the conditions that are important to the systems approach to school construction are the same conditions that are important to the traditional approach to school construction.
6. There are conditions that are important to school districts that undertake large-scale development projects but that are of little consequence to school districts participating in individual systems projects. These conditions include having the sponsorship of an agency that furnishes financial aid and administers the project, and having the ability to develop a volume market demand for the construction system developed by the project.

7. It is important to the success of systems projects that those persons who play a major role in the building process (administrators, school board members, and architects) have knowledge of the potential existing in the systems approach and understand what it is all about.
8. It is important to the success of systems projects that they qualify for financial aid and moral support from the state to the same degree as do traditional building programs.
9. It is important to the success of systems projects that there not be legal restrictions that discourage or prevent the use of systems processes.
10. School board members and school administrators in Michigan generally are not aware of the potential benefits that may be realized through the use of systems construction. This has not encouraged school officials to give due consideration to the use of systems in school construction.
11. The Michigan Department of Education has not given enthusiastic encouragement to school planners to consider the use of systems in their school construction. The absence of such encouragement has not helped school planners to become knowledgeable in the area of systems and to compare the potential benefits of systems construction with those of traditional construction.

12. Laws in Michigan prohibit fast-tracking procedures that involve the partial construction of a school building prior to such time as: (1) all of the construction plans have been completed and approved by the reviewing agencies and (2) competitive bids have been taken on all labor and materials required for the construction of the complete building (in third and fourth class school districts). These restrictions deter the use of the systems approach in Michigan insofar as they prohibit such procedures as pouring footings or constructing components before the completion of the construction plans and before the taking of all bids.
13. The volume of school construction in Michigan is sufficient to permit a new large-scale development project similar to the School Construction Systems Development project in California; but such a development project is not feasible in Michigan at this time. First, there is no demand for such a project in Michigan. Secondly, there is no building authority to service such an operation. And finally, the anticipated problems that would be encountered in setting up such an authority and operating within its confines far outweigh the anticipated advantages.

14. Off-the-shelf use of systems is the approach to systems building that currently offers the most promise to school districts in Michigan. There are no identified conditions in Michigan that prevent the use of this approach. At the same time, there are no obvious forces that are pushing forward in that direction.

RECOMMENDATIONS

1. School administrators and boards of education in Michigan should be encouraged to investigate the potential benefits that may be realized through the use of building systems in their future building programs.
2. Because there has been little effort expended by the state to inform school officials about systems building and its potential advantages, the Michigan Department of Education should be encouraged to develop and maintain an active file of systems information that is applicable to school construction in Michigan. A digest of such information and an authoritative bibliography of systems information should be published and made available to school district officials and others who participate in the school planning process.

3. Reduced project delivery time is a consideration that is important to most school construction projects. Fast-tracking is a construction management tool whose purpose it is to reduce project delivery time. Fast-tracking cannot be used in Michigan school construction projects to the extent that it requires construction to be commenced prior to the completion and approval of the construction plans, and to the extent that it requires construction prior to the taking of competitive bids on the complete construction project. A study should be conducted to determine the feasibility of fully accommodating fast-tracking procedures by the amending of the law to authorize construction to be started (1) on the basis of piecemeal approval of construction plans by the reviewing agencies and (2) on the basis of sequential piecemeal bidding of the construction project.
4. An important aspect of quality construction is its relative freedom from unduly high operating and maintenance expenses. A study should be conducted to determine the long-term costs of operation and maintenance of building subsystems and of systems buildings.

5. Taxpayers have become increasingly reluctant to vote tax dollars for school construction and school operation. A study should be made in school districts that have employed systems construction to determine if voter attitude has been changed because of the use of systems construction.
6. The experiences of the Detroit Construction Systems Program (CSP) are of interest to school planners in general and particularly to school planners in Michigan. Until a major CSP report is published for nationwide use, provision should be made for periodic interim reports to be made available to school officials in Michigan to apprise them of what is happening in systems construction within their own state.

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APPENDICES

APPENDIX A

REQUEST FOR INFORMATION WHICH WAS SENT TO THE PLANNERS AND USERS OF SYSTEMS SCHOOLS

MICHIGAN STATE UNIVERSITY EAST LANSING · MICHIGAN 48823

COLLEGE OF EDUCATION · DEPARTMENT OF ADMINISTRATION AND HIGHER EDUCATION
ERICKSON HALL

March 1, 1971

Dear

I am taking a year off, after seventeen years in administration, to complete required course work and a dissertation in the area of systems school construction. My work is being done under the direction of Dr. Archibald Shaw who is chairman of my Graduate Committee at Michigan State University.

The dissertation will be concerned with determining the potential economic and educational benefits of the systems approach in school construction and those conditions that are requisite to obtaining these benefits. One purpose of this study is to assist those in the school plant planning field to determine if the systems approach may be feasible in their given situations.

I am requesting permission from you to have your SCSD school(s) represented in the study. This would require the principal in the systems school, and one member of your staff, to complete a short questionnaire. They would not be identified in the study. At the completion of the study, copies of the abstract will be available to the participating schools.

I hope you will be able to see your way clear to grant this permission as I would like to include all the SCSD schools in the study. A self-addressed, stamped envelope has been enclosed for your convenience. An early reply will be appreciated.

Sincerely,

Gordon E. Peckham

Enclosure

Permission is granted to include our school(s) in the study.

School_____ Supt._____

School_____ Date_____

637 OWEN GRADUATE CENTER-EAST
MICHIGAN STATE UNIVERSITY
East Lansing, Michigan
48823

March 8, 1971

Dear

Please find enclosed the questionnaire referred to in my letter of March 1, 1971. The purpose of the questionnaire is to verify and/or determine the potential economic and educational benefits of the systems approach in school construction.

I am very anxious to get your opinion on the questionnaire items as there is such a great need for this kind of information and only a very few people like yourself have this knowledge.

Please complete the enclosed questionnaire and return it to me in the self-addressed, stamped envelope. Your prompt attention will facilitate the gathering of information to complete my study.

Thank you.

Sincerely,

Gordon E. Peckham

Enclosures

MICHIGAN STATE UNIVERSITY EAST LANSING · MICHIGAN 48823

COLLEGE OF EDUCATION · DEPARTMENT OF ADMINISTRATION AND HIGHER EDUCATION
ERICKSON HALL

March, 1971

Dear

I am conducting a study of the economic and educational benefits of the systems approach in school plant planning, and the conditions necessary to obtain these benefits. The information will become part of my doctoral dissertation at Michigan State University. I hope this study will be helpful to administrators in determining whether the systems approach is feasible in their given situations.

I have requested permission from your superintendent to include your school in this study and hope that I may have your cooperation.

I am very eager to get your opinion as there is such a wide demand for this kind of information, but only a very few people like yourself have this knowledge.

Please complete the enclosed questionnaire and return it to me in the self-addressed, stamped envelope. Your identity and that of your school will be kept confidential as all data will be grouped.

May I thank you in advance for your cooperation. Your prompt attention will facilitate the gathering of information to complete this project.

Sincerely,

Gordon E. Peckham

Enclosures

637 OWEN GRADUATE CENTER-EAST
Michigan State University
East Lansing, Michigan 48823
March, 1971

Dear

I am taking a year off, after seventeen years in administration, to complete required course work and a dissertation in the area of systems school construction. My work is being done under the direction of Dr. Archibald Shaw who is chairman of my Graduate Committee at Michigan State University.

The dissertation will be concerned with determining the potential economic and educational benefits of the systems approach in school construction and those conditions that are requisite to obtaining these benefits. One purpose of this study is to assist those in the school plant planning field to determine if the systems approach may be feasible in their given situations.

It is very important to include your views in this study as there is a very great need for this kind of information, but only a very few persons, like yourself, have this knowledge. Your identity and that of your school will be kept confidential. At the completion of the study, copies of the abstract will be available to participating schools.

Please complete the enclosed questionnaire and return it to me in the self-addressed, stamped envelope. Your prompt attention will facilitate the gathering of information to complete this project. May I thank you in advance for your cooperation.

Sincerely,

Gordon E. Peckham

Enclosures

637 OWEN GRADUATE CENTER-EAST
MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48823

Instructions:

The purpose of this questionnaire is to obtain your perceptions regarding the potential benefits of the systems approach in school construction. Please examine the items shown herein. If you agree an item is a potential benefit, please place a mark (x) in the column headed YES. If you disagree with the item, mark the NO column.

If you would like to comment on any of the items, or have comments on areas not covered in this questionnaire, please be free to do so in the margins or on the back of the sheet.

After completing the questionnaire, please return it to the sender in the enclosed envelope.

Thank you.

Part A - General Information

Name of Person Reporting_____

Title of Person Reporting_____

Your Address_____Phone_____

Please check (X) the subsystems used in your program:

Structure_____ Interior Space Division_____

Atmosphere_____ Casework_____

Lighting-Ceiling_____ Roofing_____

Vertical Skin_____ Interior Finishes_____

Electric-Electronic_____ Plumbing_____

Other - Please Specify:_____

Part B - Potential Benefits

		YES	NO
1.	The systems approach encourages the educational planning team to make a thorough study of the educational program and how it may need to be changed.	____	____
2.	Systems building, with performance specifications, requires the staff to become more precise in stating their needs and developing user requirements.	____	____
3.	Systems buildings provide maximal flexibility to meet educational change.	____	____
4.	Systems buildings provide a learning environment for current needs as well as, or better than, do non-systems buildings.	____	____
5.	Systems buildings are generally well adapted to accommodate new trends in education as seen by the teaching staff.	____	____
6.	Systems buildings are more responsive to the total student environmental needs than are conventional buildings.	____	____
7.	Traffic flow in systems buildings is more easily accommodated than in traditional buildings.	____	____
8.	Systems' built-in flexibility permits interior space to be altered easily and inexpensively.	____	____
9.	The built-in adaptability of the systems school may add to the useful life of the building.	____	____
10.	Space flexibility will be increasingly valuable in the long range use of the systems buildings.	____	____
11.	An adaptable systems building will tend to encourage innovation in the curriculum.	____	____
12.	Design time can be reduced by using standardized components or subsystems in systems construction.	____	____
13.	Systems building generally reduces on-site construction time which results in a reduced project delivery time.	____	____

	YES	NO
14. Reduced construction time in the systems approach helps to solve over-crowding problems by permitting earlier occupancy.	____	____
15. Reduced construction time in the systems approach assists curriculum development by permitting educational programs to become operational sooner.	____	____
16. Volume market, off-site fabrication, and efficient field assembly help systems building costs to approximate or remain below conventional construction costs.	____	____
17. The systems approach is better adapted to make use of fast tracking procedures than is the traditional approach.	____	____
18. It is difficult, if not impossible, to build non-system schools at a lower cost than systems schools if the educational requirements, quality of materials, and learning environment are kept at equal levels.	____	____
19. With systems, construction costs for like quality are less.	____	____
20. The economy in systems involves reasonable initial costs and low long term costs of operation and remodeling.	____	____
21. The more subsystems in a building, the easier it is to predict costs of the total building.	____	____
22. Expansion of systems facilities can be accommodated in an orderly fashion with minimal demolition.	____	____

Please list any additional potential benefit you perceive to be applicable to the systems approach to school construction.

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Part B - **Potential Benefits** 161

		YES	NO
1.	The systems approach encourages the educational planning team to make a thorough study of the educational program and how it may need to be changed.	____	____
2.	Systems building, with performance specifications, requires the staff to become more precise in stating their needs and developing user requirements.	____	____
3.	Systems buildings provide maximal flexibility to meet educational change.	____	____
4.	Systems buildings provide a learning environment for current needs as well as, or better than, do non-systems buildings.	____	____
5.	Systems buildings are generally well adapted to accommodate new trends in education as seen by the teaching staff.	____	____
6.	Systems buildings are more responsive to the total student environmental needs than are conventional buildings.	____	____
7.	Traffic flow in systems buildings is more easily accommodated than in traditional buildings.	____	____
8.	Systems' built-in flexibility permits interior space to be altered easily and inexpensively.	____	____
9.	The built-in adaptability of the systems school may add to the useful life of the building.	____	____
10.	Space flexibility will be increasingly valuable in the long range use of the systems buildings.	____	____
11.	An adaptable systems building will tend to encourage innovation in the curriculum.	____	____
12.	Design time can be reduced by using standardized components or subsystems in systems construction.	____	____
13.	Systems building generally reduces on-site construction time which results in a reduced project delivery time.	____	____

	YES	NO
14. Reduced construction time in the systems approach helps to solve over-crowding problems by permitting earlier occupancy.	____	____
15. Reduced construction time in the systems approach assists curriculum development by permitting educational programs to become operational sooner.	____	____
16. Volume market, off-site fabrication, and efficient field assembly help systems building costs to approximate or remain below conventional construction costs.	____	____
17. The systems approach is better adapted to make use of fast tracking procedures than is the traditional approach.	____	____
18. It is difficult, if not impossible, to build non-system schools at a lower cost than systems schools if the educational requirements, quality of materials, and learning environment are kept at equal levels.	____	____
19. With systems, construction costs for like quality are less.	____	____
20. The economy in systems involves reasonable initial costs and low long term costs of operation and remodeling.	____	____
21. The more subsystems in a building, the easier it is to predict costs of the total building.	____	____
22. Expansion of systems facilities can be accommodated in an orderly fashion with minimal demolition.	____	____

Please list any additional potential benefit you perceive to be applicable to the systems approach to school construction.

_____

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APPENDIX B

REQUEST FOR INFORMATION WHICH WAS SENT TO RECOGNIZED EXPERTS IN THE SCHOOL PLANT PLANNING FIELD

MICHIGAN STATE UNIVERSITY EAST LANSING · MICHIGAN 48823

COLLEGE OF EDUCATION · DEPARTMENT OF ADMINISTRATION AND HIGHER EDUCATION
ERICKSON HALL

March 16, 1971

Dear

One of my doctoral students, Gordon Peckham, has a keen interest in the systems approach to school construction. He is developing a study that aims to identify the potential benefits inherent in the systems approach and the special conditions that are necessary for the realization of these benefits. His study should have value for architects and school men generally, and may lead to specific benefit here in Michigan.

We have selected twelve people in the United States whose reputation and experience will lend great weight to their value judgments, and whose generosity may get us their attention and time (fifteen minutes) for our project. You are one of that group.

Mr. Peckham is trying to identify the significant conditions that a state education department, a school system or an architectural firm can refer to in judging whether the systems approach is advantageous or even feasible in a particular setting. The list of conditions that has been suggested by a small group of advisors is enclosed. We need your help in validating and extending this list.

From the ratings and comments you and the others give, he will put together a revised list against which he expects to test the possibilities in present school districts and particularly in Michigan.

Will you please check over these twenty items, giving a rating to each, and then add any others you feel are important? Any comments you make will be welcomed, too.

Thanks very much for your help.

Cordially,

Archibald B. Shaw
Professor of Education

ABS:jm
Enclosures

637 OWEN GRADUATE CENTER-EAST
MICHIGAN STATE UNIVERSITY
East Lansing, Michigan 48823

Instructions:

The purpose of this questionnaire is to obtain your perception regarding certain fundamental conditions that are said to be critically important to the success of systems school construction projects. Please examine each of the items shown herein and classify it according to its relative importance to the systems program. A mark (X) should be placed in the column whose category most nearly indicates your opinion. The categories are:

VI - Very Important
SI - Somewhat Important
NI - Not Important
DK - Don't Know

Your comments on any item will be appreciated. Please suggest any other additional conditions you perceive to be important for the full realization of the potential benefits inherent in the systems approach to school construction. You may write directly on these sheets.

After you have completed the marking of this questionnaire, please place it in the enclosed self-addressed, stamped envelope and mail it to the sender.

Thank you.

Gordon E. Peckham

Date_____

Name of Person Reporting_____

Title of Person Reporting_____

Your Address_____

_____

_____Phone_____

_____ Check here if you would like a copy of the results.

VI - Very Important
SI - Somewhat Important
NI - Not Important
DK - Don't Know

	VI	SI	NI	DK
Conditions Important to the Success of Systems Schools:				
1. Volume purchasing capability is a must.	____	____	____	____
2. Joint bidding practices are permitted within the framework of the law.	____	____	____	____
3. The program size will fall somewhere within an ideal range of half a million to one million square feet of construction.	____	____	____	____
4. Consortiums may be formed to generate adequate volume for joint bidding and bulk purchasing practices.	____	____	____	____
5. An umbrella authority is available to perform the following services for the consortium:				
a. Administer the systems program	____	____	____	____
b. Furnish financial aid	____	____	____	____
6. There are no local building codes that seriously hamper the consortium's ability to develop performance specifications.	____	____	____	____
7. There is a willingness on the parts of the reviewing agencies (Department of Education, Fire Marshal, Health Department, etc.) to adjust approval schedules, as needed, to accommodate systems construction programs.	____	____	____	____
8. The State School Office views the systems approach with favor, is knowledgeable in the area of systems construction, and renders assistance to school districts interested in the systems approach.	____	____	____	____
9. Capital outlay assistance programs of the state do not exclude systems buildings.	____	____	____	____

VI - Very Important
SI - Somewhat Important

NI - Not Important
DK- Don't Know

	VI	SI	NI	DK
10. The school district architect:				
a. is willing to do research in areas involving uncertainty:	____	____	____	____
b. views systems as a means of providing greater service rather than restricted service to his client:	____	____	____	____
c. has conceptual skills in systems Methodology:	____	____	____	____
d. is skillful in converting user requirements into performance specifications:	____	____	____	____
11. The school district Staff is willing and capable of defining the objectives of the district, and of developing user requirements.	____	____	____	____
12. The school Administration has knowledge of the potential existing in the systems approach.	____	____	____	____
13. The Administration is not inertia bound and is responsive to changing conditions.	____	____	____	____
14. The Board of Education possesses conceptual skills that permit competent decision making in systems programs.	____	____	____	____
15. The Board of Education has the capacity to expedite frequent decisions, and on short notice.	____	____	____	____
16. The Board of Education is willing to adjust the architect's fee schedule to compensate him at a level commensurate with his services.	____	____	____	____
17. The Board has involved the community in the planning of facilities.	____	____	____	____
18. A competent construction manager is assigned to the systems project and is responsible for its management.	____	____	____	____

VI - Very Important
SI - Somewhat Important
NI - Not Important
DK- Don't Know

	VI	SI	NI	DK
19. The construction manager has the skill and authority to resolve conflicts arising from interface difficulties and non-fulfillment of contractor obligations.	____	____	____	____
20. The construction unions are cooperative and endeavor to resolve issues prior to their becoming serious problems.	____	____	____	____

Please list additional conditions you perceive to be important to obtain the maximal potential benefits of the systems approach to school construction.

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