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ABSTRACT

The Management and Information System for Occupational Education (MISOE) is a system designed to provide appropriate decision-related data for local, regional, and State managers within Massachusetts who are responsible for resource allocation over: (1) social agencies, (2) education, and (3) occupational education. The two general types of information constituting the system include information which accounts for or describes present and past occupational education phenomena, and information which offers estimates of future outcomes from current decision alternatives. The major purpose of this paper is to present a closing statement about MISOE's static space, including educational impact space, input space, student space, process space, and product space. Section one of the paper deals with those parts of the educational systems space that are decided upon by State policy makers, while section two deals with those parts that are within the decision-making realm of the educator. A related paper, available as VT 016 943 in this issue, discusses the analysis requirements of MISOE. (SB)

OCCASIONAL PAPER #5

DELINEATION OF MISOE'S STATIC SPACE

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INTRODUCTION

TO OCCASIONAL PAPERS #5 and #6

The purpose of this introductory overview of Occasional Papers #5 and #6 is to briefly specify the purposes and boundaries of MISOE as a basis for dealing with the content of these papers. These papers were designed to document MISOE development at this point in time, and, in addition, Occasional Paper #6 was purposefully constructed to offer a clear picture of analysis requirements, since analysis specifications by the consultant staff is the next step in development (Occasional Papers #7, #8 and #9). Together, these papers provide a comprehensive view of MISOE in development, while much of the system design work that remains is to focus components on the clear targets which are emerging. This introduction is largely concerned with establishing a sense of direction for Occasional Papers #5 and #6, as well as for Occasional Papers #7, #8 and #9.

The MISOE Model

MISOE is indeed a management and information system for all those within Massachusetts responsible for occupational education. MISOE is being designed so that people with management responsibilities at all levels can be connected to an integrated information system. The information system is integrated in that it provides appropriate decision-related data for management at all levels, i.e., state, regional and local. Two general information types constitute the information system: (1) information which accounts for or describes present and past occupational education phenomena; and (2) information which offers estimates of future outcomes from current decision alternatives. The feedback of descriptive information provides a basis for forecasting at the state, regional and local level. If MISOE is to be supportive of better management practice, both the management and information system must be integrated across geographical, political and administrative levels. It is not the purpose of these developmental papers to specify these necessary relationships, although it is important to keep this requirement in mind while reading these papers. This issue has been discussed in Monograph 1 and will be treated in detail in Monograph 2 (Summer of 1972), which will fit the components of the information system to an integrated management system.

Even though the specification of the integrated information related management system is not an immediate task, it is useful to stipulate the three separate levels of management to be served by the MISOE information system:

1) Managers responsible for resource allocation over social agencies, including education. These managers include the Legislature and the Governor's Office (when appropriate).

2) Managers responsible for resource allocation over all education. These managers include school boards and administrative agencies.

3) Managers responsible for resource allocation for occupational education. These managers include school boards and administrative agencies. Role incumbents within these agencies include administrators at the state and regional level, and administrators and teachers at the local level.

MISOE Information Sources

There are fundamentally three (3) sources of information for the information system. The first source is census data from all agencies responsible for administering occupational education in Massachusetts and described in detail in these papers. The second source is a random sample of agencies offering occupational education by program within Massachusetts. Both of these information sources describe the inputs, process, product and impact of occupational education, however, the sample provides for a detailed description of these elements and relationships among them. The third information source includes research based educational process knowledge and descriptive information estimating the societal state of affairs. Research based educational process knowledge will be useful in forecasting alternative outcomes of various occupational education process mixes, while societal information (like the census and manpower information) is useful in goal and impact determination for occupational education.

An important consideration for MISOE development is to format MISOE information such that it meets the requirements for description and forecasting. Since it has been determined that forecasting or prediction will be modeled on the dynamic simulation model initiated by Forrester, it is necessary to specify constant analysis procedures for all MISOE information types so that all descriptive information can be used for forecasting. More specifically, it is vital that analysis procedures be established for MISOE so that descriptive and inferential statistics can be converted to the equations required by dynamic simulation and that the procedures become standardized tools for the MISOE information system, equally useful to all information sources. This is really the task of Occasional Papers #7, #8 and #9 by Messrs. Tiedeman, Creager and Kaufman.

MISOE Subsections

As a final section to this brief introduction, it is useful to think of the MISOE information system as divided into three major subsections, one for managers over all social agencies, the second for managers over all education and the third for managers of occupational education.

The first MISOE information subsection is based on product-impact analysis, and principally is geared for managers over social agencies who are concerned with differences between education and non-education products and impacts on social goals; the second subsection is for managers over all education who are concerned with differences between education and occupational education, focused on impacts for societal goals; and the third subsection is of major interest to the managers of occupational education, who are responsible for determining least cost product and process mixes for occupational education, in light of desired impacts on societal goals. All management is responsible for determining the optimum mix of elements to attain specified goals. For the over social agency manager, the mix is among social agencies, including education; for the over all education manager, the mix is among educational programs; and for the occupational education manager, the mix is within occupational education. MISOE offers a procedure for describing the outcomes of historical mixes at all levels in a way that allows for probing or estimating outcomes of new mixes at future points in time for decisions at each level. Although the focus is occupational education, it is anticipated that MISOE will structure a prototype management and information system for all education.

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INTRODUCTION

The major purpose of Occasional Paper #5 is to present a closing statement about MISOE's static space. Occasional Papers #2 and #4 dealt with individual aspects of MISOE's static space; this paper deals with the integrated entity of static space in accordance with our delineation of it. Static space is really the universe of MISOE standing still in time. This paper classifies parts of the total space in a way that is consistent with MISOE's purpose, such that MISOE elements can be referenced by common symbols. One could think of this as a set of definitions. Occasional Paper #6 deals with MISOE in motion, but Occasional Paper #5 is a prerequisite to future development.

There have been several changes in our previous thinking concerning individual aspects of MISOE's static space notably in regard to process space. The decision-making hierarchy described in Occasional Paper #4 has been extended to all parts of the system. This will be discussed in greater detail in Occasional Paper #6. A good deal of new thinking is evident in the product space and impact space sections of this paper. The concept of input space has been more clearly defined in this paper.

Finally, it should be pointed out that prescribed functions for role incumbents stipulated in this paper are suggestive. Determinations will be made during the Summer of 1972, and will reflect the opinion of existing role incumbents.

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PREFACE

A Revised Delineation of Static Systems Space*

In Occasional Paper #2 we distinguished between four separate spaces within the entity of educational systems space, input space, process space, product space and impact space. At this point in time we feel that some redefinitions of static systems space are in order. Although we originally depicted educational space as being separate from societal space (see Occasional Paper #2, p. 20) except for linkages to societal inputs and impacts, we now feel that it would be more accurate to refer to educational space as a subset of societal space. Educational space and societal space are described as follows:

A. Educational space can be subdivided into four component subspaces.

1. Educational resources space consists of the economic and human resources which are removed from societal space through decisions of societal policy makers at the state level and placed into educational space. (State policy makers' decisions concerning educational inputs are developed in conjunction with their decisions concerning educational impact goals. The process by which this occurs is fully explained in a later section of this paper). Educational economic resources consists of the tax revenues which are made available by the state to educational space.

*Figure I is a "tuck in", so that it can be referenced by the reader while sorting through this section. It will help.

Once the tax revenues are placed into educational space they become educational capital and constitute educational capital space. Educational decision makers can then make decisions about allocating this capital within educational space. Human resources consist of those persons in societal space who are designated as inputs into educational space. Once the human inputs actually become a part of educational space (e.g., are within the optional realm of the educational decision maker), they constitute the human educational resource, i.e., students. The educational decision makers then regroup the human inputs along dimensions which they consider relevant in terms of achieving those educational impact goals (a concept which is discussed at a later point in this paper) which have been specified to them by the state policy makers. Student space consists of data which describes student mixes and the student characteristics and descriptions of which they are composed. Thus, the elements of which educational resources space is composed (e.g., the educational inputs) are determined by policy makers external to the educational space. The educational decision maker, however, operates on these elements once they are placed in educational space.

2. Process space consists of data which describes various educational process mixes and their component elements (process space elements are fully described in a later section of this paper). Educators assign student mixes to process mixes in order to produce an educational product that upon re-entry into societal space will have specified impacts on societal variables in accordance with the educational impact goals stipulated by state policy makers.

3. Product space consists of data which describes the outcomes of an educational experience or process within educational space (e.g., the measurable results of the assignment of various student mixes to various educational processes). A particular configuration of product data constitutes a product mix. Educational managers make determinations about product mixes in light of the measurable effects (impacts) which a particular educational output (e.g., the educational product upon re-entry into societal space) is likely to have upon certain specified societal variables. The societal variables which the educational output is expected to impact upon, and the desired extent of these impacts constitute educational impact goals. Educational impact goals are decided by non-education policy makers within societal space and thus represent "givens" or constraints to the educational decision maker in terms of available resources and expected impacts of the educational product.

4. Educational decision maker's space consists of descriptions of the decisions made by educational decision makers within each of the three subspaces of which educational space is composed:

    a) Decisions on arrangement or allocation of designated input elements (e.g., educational resource space decisions). As previously mentioned, the actual educational inputs and the educational impact goals are "givens" or constraints to educators.

    b) Process space configuration decisions.

    c) Product space configuration decisions.

It should be noted that the IPPI model of education developed in Occasional Paper #2 is still a valid representation of systems space from the educator's perspective. The educator, given specified inputs (students) and impact goals, makes decisions determining educational process and product. Those parts of static systems space which are directly related to education (e.g., the IPPI model) are referred to as educational systems space.

B. Societal space consists of all space which is external to educational space and, of course, includes educational space. Several component subset spaces within societal space, but external to educational space, can be identified:

1. Societal resources space consists of information which describes the economic and human resources available within societal space. Social service agencies like Education, Housing, Welfare, Prisons, etc., receive their inputs from these societal resources, usually through decision of state level societal policy makers.

   a) Educational economic input space consists of descriptions of the economic resources (e.g., tax revenues) made available by state policy makers to education. As previously mentioned, once these economic resources are placed within educational space they become educational capital.

   b) Educational human input space consists of data which describes those persons in societal space who are designated by policy makers to be placed into educational space. Educational input decisions are determined in societal space by societal policy makers. In some cases the state policy makers decide to let the educators make input decisions, but the decision to allow educators to be selective is still a state level input decision. As previously mentioned, human resources which are placed into educational space are referred to as students.

Thus, educational input space consists of descriptions of the economic and human resources within societal space which are made available to educational space by societal policy makers.

2. Societal policy maker's space contains subspaces which describe the societal and agency impact goal decisions made by policy makers at the state level in societal space. These decisions and the component subspaces in which they are contained are as follows:

   a) Determination of societal goals - state policy makers set goals for the society (e.g., determine desirable levels of high priority societal variables) which are consistent with related societal values. These goals, which are in fact the state policy makers own goals for the society are called societal goals. (The process by which this occurs is explained in detail at a later point in this paper). Societal goal space consists of information which describes the policy makers determinations of desirable levels of societal variables.

   b) Determination of agency impact goals - state policy makers stipulate to social service agencies (which have potential impacts on various segments of societal variables) exactly which variables they are expected to impact upon and the expected amount of impact (e.g., the desirable levels of specified variables). This information is contained in agency impact goal space and constitutes impact goals to decision makers in social service agencies; thus, impact goals are those parts of societal goals which social service agencies are paid to achieve. (In some cases an impact goal might be equivalent to a societal goal). The state may assign several agencies impact goals which are related to the achievement of one societal goal (e.g., several agencies might be told to produce a product which will impact upon the existing crime rate). As previously mentioned, educational impact goals are that subset of agency impact goals which consist of the desirable levels of those societal variables upon which education is expected to impact. This information is contained in educational impact goal space.

3. Societal variables space consists of information which describes the levels and rates of societal variables for which societal and impact goals have been established prior to being impacted upon (e.g., the existing state of the system) and after having been impacted upon (e.g., the resultant "new" state of the system). Thus, societal variables space consists of two subspaces:

a) Pre-impact space - the existing (pre-impact) levels and rates of societal variables.

b) Post-impact space - the actual levels and rates of societal variables after being impacted upon by the various social service agencies. When the actual impacts equal the specified impact goals the information in impact goal space equals the information in impact space. Educational impact space is that subset of impact space which contains the actual levels and rates of societal variables which education has impacted upon. Thus, the impact of education consists of the aggregate of the measurable effects which the educational product exerts on societal variables; this aggregate represents the selling point of education as a social service.

The first part of this paper will deal almost exclusively with those parts of educational systems space that are decided upon by state policy makers in societal space (e.g., educational input space and educational impact space). In the interest of continuity, educational resources space will be discussed in conjunction with educational input space, even though this area of systems space is within the realm of the educational decision maker.

The second part of this paper will deal with those parts of educational systems space (with the exception of educational resources space) that are within the decision-making realm of the educator (e.g., process space and product space.

Section I, Part I

EDUCATIONAL IMPACT SPACE

As previously mentioned, those persons removed from societal space and placed into educational space (e.g., the educational inputs who once in educational space become students) eventually re-enter society. However, as a result of their experiences in educational space they re-enter societal space as different persons. The educational product (e.g., the successful program completor) is then in a position, by virtue of his newly acquired skills, to exert a measurable effect (e.g., an impact) on the existing level of one or more societal or personal variables. The existing levels and rates of those societal variables upon which the educational product can potentially impact are stored in educational pre-impact space. Each measurable effect which the educational product exerts on societal or personal variables is defined as an impact of education. (The aggregate of the individual educational impacts equals the total impact of education on society). Educational impact space is that space in which information concerning the actual impacts of the educational product on societal variables is stored (e.g., the new levels and rates of those variables).

A distinction is commonly made between personal or direct educational impacts and societal or indirect educational impacts. Those measurable effects of the educational product which exert a direct effect on the recipient of the education (e.g., an increase in earning power, ability to find a job, etc.) are considered to be direct personal education impacts. Measurable effects of the educational product on societal variables are considered to be indirect societal educational impacts in that they actually represent a spillover of the direct, personal effects. Educational impacts on personal or societal variables which are considered to be favorable are referred to respectively as personal or direct educational benefits and societal or indirect educational benefits. As previously mentioned, the aggregate of these educational benefits represents the selling point of education as a social service. A simplified example of an impact of education on the existing level of a societal variable is as follows: In a given community there are currently ten automobile mechanics; the people in this community decide that they would like to have five more automobile mechanics in the community because the current number is inadequate to handle the work load. The Vocational Technical High School is made aware of this need and petitions for additional funds to train more automobile mechanics. This request is granted and the school trains an additional number of automotive mechanics, some of whom remain in the community, thus raising the number of automobile mechanics in the community to thirteen.

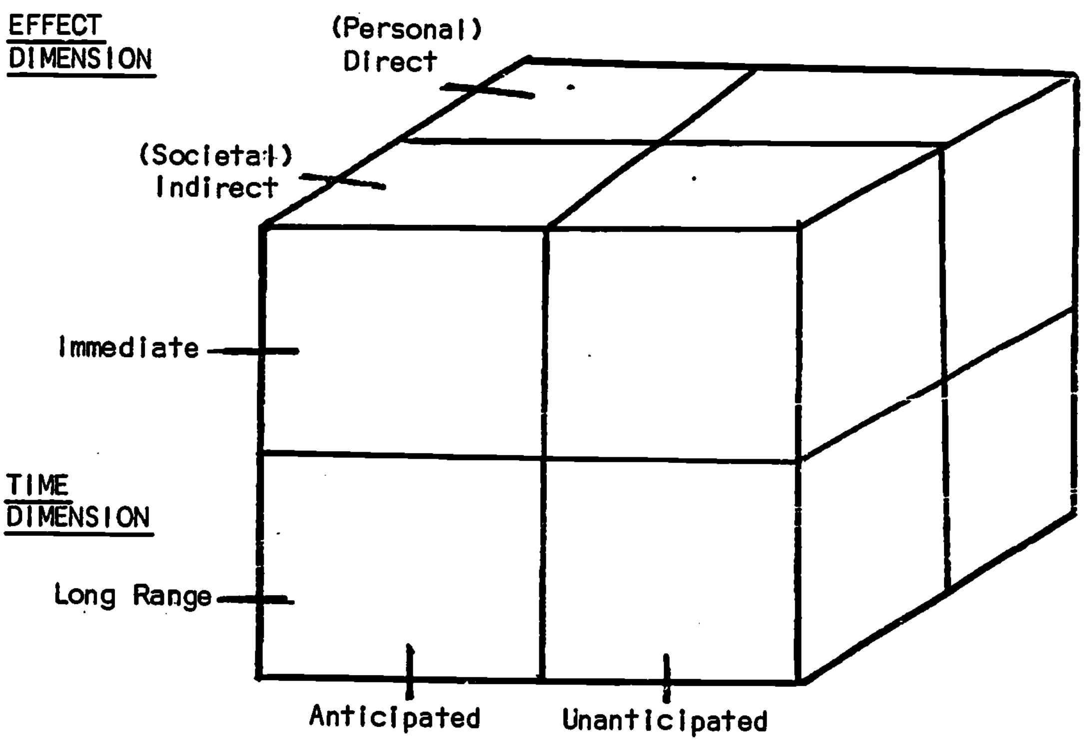
This simple example demonstrates the impact that an educational product can have on a societal variable. The impact of the educational product was a change in the level of the societal variable "number of automobile mechanics in the community" from ten to thirteen. The increase in number of automobile mechanics was an anticipated educational impact in that the educational product was purposely produced in order to achieve a stated educational impact goal. In our example the stated educational impact goal was to increase the number of automotive mechanics in the community from ten to fifteen. (This impact goal would contribute to the achievement of a related societal goal such as increasing the overall work force in that community by 15 per cent). An impact goal then can be defined from the viewpoint of a specified social service agency as being that specified level of a societal variable which a societal policy maker decides would be desirable. (Note that in our example the actual impact of the educational product (thirteen automobile mechanics) fell somewhat short of the societally stated impact goal (fifteen automobile mechanics).

The practice of setting societal goals and related impact goals which contribute to their achievement according to perceived desirable levels of societal variables raises the question of societal values: What is the "desirable level" of a societal variable and how is the desirable level decided upon? Ideally, a societal policy maker's determination of the "desirable level" of a societal variable (e.g., the societal or impact goal) should be related to an underlying societal value, (e.g., an implicit or stated preference or feeling of worth for some things rather than others by the members of a given society). The relationship between impact goals and societal values will be more fully discussed at a later point.

In addition to anticipated educational impacts (e.g., those educational impacts which are related to specific educational impact goals), the educational product may produce unanticipated impacts (e.g., changes in levels of societal variables which are not goal-related). An unanticipated impact of the additional number of automobile mechanics described in our example might be a decrease in the societal variable "wages paid to automobile mechanics" in that community. The more mechanics available, the greater the resulting competition for customers. Garages might lower the automobile mechanics' wages in order to reduce prices and thereby attract more customers. The automobile mechanics in the community might then leave that community for another in which they could receive higher wages. This unanticipated impact on automobile mechanics' wages would then be antithetical to the stated impact goal of increasing the number of automobile mechanics in the community. It is obvious that a large number of unanticipated impacts are clearly undesirable in a rationally managed system in that they represent a failure to account for important variables.

Anticipated and unanticipated educational impacts both deal with the effects of the end product of the educational process on societal variables. These effects are not evident until after the educational product leaves educational space and returns to societal space; in this sense, they can be considered long-range educational impacts. The removal of certain persons from societal space and the allocation of funds to the educational process (e.g., the educational input) have some immediate educational impacts on societal space. For example, those persons who are temporarily removed from societal space into educational space are no longer an actual or potential part of the labor force, nor are they "out on the streets" for a good part of the day; funds which are allocated to education are no longer available for other uses. Thus, educational impacts can be classified in the following ways: (1) anticipated or unanticipated, (2) immediate or long range, and (3) personal or societal. A suggested system for classifying different kinds of educational impacts is shown in Figure 2. Although these immediate impacts of the educational process on societal space occasionally are equivalent to the actual educational impact goals, for the most part societal decision makers are concerned with the long range, anticipated impacts of the end product of the educational process on societal variables space. They are also interested in how the educators' achievement of educational impact goals will

FIGURE 2: A System For Classifying Impacts Along Three Dimensions



PLANNING DIMENSION

contribute to the achievement of societal goals.

II. The Process of Establishing Value-Related Impact Goals

In a rationally managed system the impacts of education do not occur haphazardly. Instead, they represent the culmination of carefully planned, explicitly stated, impact goals. At the state level of government, the members of the state legislature establish societal goals in the form of "desirable levels" of specified societal variables. The legislators then decide which social service agency or agencies are likely to effect (e.g., impact upon) the existing levels and rates of those variables. The state provides funds for that agency or those agencies and indicates exactly which societal variables are to be impacted and the extent of the impact by providing the agency or agencies with specific impact goals. The process by which educational impact goals are set is a crucial aspect of the educational management information feedback system.

As previously mentioned, the setting of societal and agency specific impact goals must be viewed in the context of the underlying societal values upon which these goals are based. Every society operates on the basis of certain fundamental values (e.g., ideas or objects which members of that society consider to be of worth). It is assumed that elected officials will act in ways which are consistent with these values. Thus, when state legislators allocate money to certain social services in order to achieve certain stated societal goals, these goals ideally represent the legislature's perceptions of the ways in which society should be changed so that societal conditions will be more consistent with what the society has implicitly or explicitly indicated that it values.

Thus, a prerequisite in the state legislature's setting of societal goals and related impact goals is an awareness of those things which are of value to members of the society. Some things are of direct value to the individual members of society (e.g., an adequate income); these are referred to as personal values. Other things are of value to the society as a whole (e.g., a low unemployment rate) and are referred to as societal values. Societal values are often summations of personal values. However, the distinction is useful for classification purposes. Once personal and societal values have been identified, decisions must be made as to which values are of paramount importance at a particular time. Legislators must prioritize values because funds are limited and therefore their allocation must be carefully planned so that the most important issues are sure to be dealt with. The decision about which personal or societal values should assume priority at a particular time is made on the basis of an examination of the existing levels of personal or societal variables. The legislators decide whether the existing conditions are consistent with their perceptions of societal values. When societal or personal values are jeopardized by existing conditions, they are likely to assume priority.

We have classified societal values into four categories:*

1) Political societal and personal values consist of those values which concern the way in which the society and persons living in it are governed. Examples of political values are: equalitarianism; freedom of the individual; a democratic form of government, etc.

*Personal values are not listed separately as they are considered a subset of societal values.

2) Social societal and personal values consist of those values concerned with socially desirable behaviors and interactions of societal members as a group or individually. Examples of social values are: social consciousness; tolerance; cooperativeness; achievement; morality; etc.

3) Cultural personal and societal values consist of those values concerned with the tradition, maintenance and advancement of the person or society. Examples of cultural values are: the worthiness of knowledge; health and safety; the importance of leisure time; the importance of culture, etc.

4) Economic societal and personal values consist of those values which concern the financial aspects of personal or societal life. Examples of economic values are: economic security; economic stability; economic equity, etc.

As previously mentioned, legislators are expected to act in ways which protect, maintain and promote these societal and personal values. Therefore, if important personal or societal values are jeopardized by existing levels of societal variables, citizens expect that their elected representatives, the legislators, will take measures (e.g., allocate funds) in order to achieve those levels of societal and personal variables which are consistent with related underlying values. Within the suggested categories of societal values stipulated above, Table I contains related societal goals and related, impactable societal variables.*

After legislators have prioritized personal and/or societal values (e.g., made decisions as to which values are most important at a particular time), they must then make decisions about which societal variables should be

*Since Table I would not fit in this Section where it belongs, we have made it a "tuck-in". It should be studied at this time.

TABLE I

TABLE I: Representative Classes of Value-Related Societal Goals and Related Impactible Societal Variables

Types of Values	Societal Values	Related Societal Goals	Existing Levels of Societal Variables (Impactible Variables)
POLITICAL	Egalitarianism	Reduce inequalities in opportunity due to discrimination	Levels and rates of minority group education, employment, salary, vertical mobility; attitudes towards minority groups
	Individual Rights	Insurance of personal freedoms	Numbers of Civil Rights complaints over a period of time
	Representative Government	A concerned and knowledgeable citizenship Citizen participation in the running of government Proportionate representation in government Power in the hands of the elected officials	Levels and rates of voting by community citizens and state citizens Rate of citizen membership on governmental and local committees Literacy rate
	Orderly Society	Law-abiding citizens Safety in the streets	Crime rate; Attitudes towards law enforcement by citizens
SOCIAL	Social Consciousness	Public-spirited citizenship	Rate of participation in socially-oriented institutions or groups Rate of community volunteer work Rate of donations to charities
	Social Pluralism	Acceptance of diversity and change within the society Tolerance of cultural and ethic differences (Melting pot society)	Citizen's attitudes towards diversity and change Level of acceptance of minority group members
	Cooperativeness (Social Order)	Citizens who adhere to societal norms Citizens who live and work well together Avoidance of social disorganization (anomie)	An index of social disorder in the community or state (e.g., misdemeanor rate; rate of arrests for drunken driving, etc.) Divorce Rate
	Achievement (Self-Realization)	Citizens who make the most of themselves	Comparison of ability vs. achievement of citizens (e.g., educational level and job level compatibility)
	Satisfaction Recognition	Citizens who are happy at home and at work Recognition of the achievements of citizens	Attitudes towards self and work Adequacy of existing incentive and reward systems
CULTURAL	Knowledge	Citizens who value knowledge (education) Availability of knowledge and information	Attitudes towards education, research, etc. Availability of libraries and other information sources in state (e.g., # of libraries; # volumes per library, etc., by community.
	Culture	Maintenance and transmission of culture Availability of cultural resources	Willingness to support cultural activities by citizens Numbers and types of available cultural resources Rate of participation in social institutions - i.e., church membership, and cultural institutions - i.e., museums
	Health and Safety	A mentally and physically healthy citizenship Citizens who are concerned and knowledgeable about health and safety	Rate of mental illness in the state, by community Attitudes towards cleanliness, health, safety, etc. Number of health and safety information sources available
	Constructive Use of Leisure Time	Adequate leisure time Citizens who use their leisure time in beneficial ways	Adequacy of current amount of leisure time Numbers and types of activities engaged in during leisure time
	Activity (Protestant Ethic)	Citizens who value work and are active	Attitudes towards work Behavior on the job - i.e., absenteeism rate; tardiness rate, rate, etc.
	Morality	Citizens who are moral in their behavior (i.e., honest) in accordance with societal values	Attitudes towards honesty Rate of cheating on income tax returns in the state, etc.

Type of Values	Societal Values	Related Societal Goals (Desired Levels of Variables)	Existing Level of Societal Variables	Source of Information
ECONOMIC	Economic Growth	Increase return on education to individuals above existing rates by making education more efficient. (i.e., X%). This in turn will increase the economic efficiency of the economy.	Estimates suggest that 30%-50% of national income represents a return to education in the labor force.	T. W. Schultz, "Investment in Human Capital", Amer. Econ. Rev., (1961), p. 1-17.
		Income differential of X dollars exist between yearly incomes of graduate compared to non-graduate. (Direct financial return to received of education).	Census Bureau data show direct relationship between the level of income and the level of education. Generally the more education an individual receives, the higher his income.	1960 and 1970 Census Data
	Economic Opportunity	Does the occupational training provided in Massachusetts allow labor market mobility? Intergenerational changes in occupation - Workers will tend to move towards high wage occupations.	Studies show that movements occur between occupations during a given worker's lifetime and also that intergenerational changes in occupation occur. Improved labor mobility improves the overall pattern of resource allocation whereas intergenerational changes increase the economic opportunities available to individuals.	L. Galloway, p. 55-64. and U. S. Department of Commerce, Bureau of Census. "Lifetime Occupational Mobility of Adult Males", March, 1962, Table 1.
		Reduce educational gap of 2 years between white and non-white to zero.	Coleman Study shows non-white has median level of education (2) two years less than whites. Also, one year's education for non-whites is equivalent to about 3/4 year of education for whites.	Coleman, et. al., Equality of Educational Opportunity, U. S. Office of Ed., 1966.
		Provide graduate the opportunity to continue on to higher education and additional $ of income (financial option return to received of education).	Education provides the opportunity for graduates to obtain still further education and the reward accompanying it.	Ibid.
		Make people receive more general training and less specific training so they may be more adaptable to technical change. (Hedging option to adjust to technical change).	Education may be thought of as a hedge against technological displacement of skills.	Same as 1.
	Economic Efficiency	Reduce Massachusetts unemployment rate to at least that of the national average (i.e., by 1.1%).	Federal Reserve figures indicate that unemployment in Massachusetts as of December 1971 was 7.2% compared to a national average of 6.1%.	Ibid., p. 11.
		Reduce unemployment rate in selected areas within state to that of the state average - by approximately 1.5%.	Federal Reserve figures indicate that New Bedford (8.3%), Springfield (8.9%), and Lowell (9.0%) have unemployment rates substantially above the state average unemployment rate.	Ibid., p. 11.
		Reduce teenage unemployment rate to X% through investment in education.	Teenage unemployment rate was 11.2% in 1966 and is estimated to be 15% by 1980 compared to a national average of 4.5%.	L. Galloway, p. 117.
	Economic Equity	Close average hourly earning gap between Massachusetts and U. S. (i.e., $.17) by making the future Massachusetts labor force better educated and thereby more efficient.	Federal Reserve figures show that average hourly earnings in Massachusetts are $3.52 compared to $3.69 for the United States as of December, 1971.	New England Economic Indicators, Federal Reserve Bank of Boston, Feb. 1972, p.9.
		Reduce poverty in Massachusetts (currently X% of families) by investments in education which will teach marketable skills.	Poverty in the U. S. is usually defined as inability of a family to obtain a level of money income in excess of approximately $3,000 per year (in 1957-59 prices). Poverty is partly due to lack of marketable skills due to technological change and lack of educational opportunities.	L. Galloway, Manpower Economics, Irwin, 1971, pp. 9-11.
		Reduce income gap and unemployment rate between negroes and whites in Massachusetts through investment in education to this group.	Unemployment rate of negroes to whites is 2:1 thus causing an income gap between negroes and whites. Basic causes are lack of educational opportunity, discrimination, etc.	L. Galloway, Op. Cit., p. 9.
	Economic Stability	Reduce rate of inflation in Massachusetts to that of the national average (i.e., approximately 2%). A more efficient labor market brought about through investment in education will tend to produce a lower level of unemployment, a higher level of output and presumably a lower level of inflation.	Consumer Price Index for Boston, Massachusetts, tends to be above the national average. For instance, in October 1971, CPI for Boston was 124.5 compared to 122.4 for U. S.	Ibid., p. 17.

manipulated (e.g., impacted upon) in order to bring existing levels and rates of high priority societal variables into harmony with related societal values. Ideally, then, legislators set goals for the society on the basis of underlying societal values. Two types of decisions can be made about the existing level of a societal variable: (a) it is consistent with related underlying societal values; or (b) it is not consistent with related underlying societal values. Legislators establish societal goals on the basis of these decisions; specific impact goals are assigned to various social service agencies in order to achieve these societal goals.

If certain existing societal conditions are deemed consistent with related underlying societal values, the legislators might establish as their societal goal the maintenance of the existing levels and rates of those societal variables. The explicitly stated impact goal which the legislators would then pass on to the social services agency or agencies in order to produce impacts on those variables is to produce a product which will have "zero impact" on those variables. If the legislators decide that the existing levels or rates of certain societal variables are not consistent with related underlying societal values of high priority they might decide that the existing levels or rates of those societal variables should be changed (e.g., either increased or decreased). The new level of the societal variable or variables which they explicitly state that they wish to attain would constitute a societal goal. Explicitly stated impact goals would then be passed on to those social service agencies which the legislators decide are best equipped to produce at least cost the desired impacts on the existing levels of those variables such that societal goals are achieved.

Although our previous examples have only dealt with the potential impacts of the educational product on societal variables, many other social services or agencies can have impacts on societal variables. Legislators must decide, on the basis of information made available to them, which social service agency or agencies to allocate money to in order to get the best results in terms of achievement of specific impact goals and related societal goals at the least cost. The legislature, in effect, purchases the services of the social service agency or agencies which are most likely to contribute to the achievement of their specific societal goals.

The importance of explicitly stated impact goals on the part of the legislature is evident at this point. The particular social service agency which has been chosen to achieve the desired impacts can only act rationally (e.g., in accordance with those goals) if they are aware of them. Furthermore, the legislature can hold the chosen social service agency or agencies accountable for their progress in achieving the specified impact goals only if the agency or agencies have been made aware of what is expected of them in terms of impact goals.

In addition to stating specific impact goals for social service agencies, the legislature also specifies the particular persons in societal space who are to be involved in the fulfillment of these goals. The societal members involved in or effected by the fulfillment of a societal or related impact goal are actually an integral part of the stated goal. Thus, in effect the legislature states as its societal goal and a social service agency's related impact goal that it wants specific outcomes for certain people in order to achieve this change in the existing level of a particular societal variable or societal variables. In terms of education then, the legislators (i.e., policy makers at the state level) determine both the educational inputs (e.g., which members of societal space should be exposed to the educational process in order to achieve a specified impact goal) and the particular impact goals which the educational product is expected to achieve (e.g., the educational product's effects on society). Educators, given educational inputs and impact goals, then decide upon the product and process mix that will achieve the desired impacts.

The process by which impact goals related to the achievement of societal goals are established can be summarized in the following series of events:

(1) societal policy makers become aware of societal values.

(2) societal policy makers make decisions about which of these values are most important (prioritization of values).

(3) societal policy makers examine existing levels of societal variables and decide whether these existing levels are consistent with related underlying societal values.

  (a) yes they are

  (b) no they are not

(4) societal policy makers determine explicit value-related societal goals on the basis of the acceptability of the existing level of societal variables.

  (a) if the existing levels of value-related societal variables are not considered acceptable, the societal goal would either be an increase or decrease in the existing levels of those variables.

(5) societal policy makers decide which social service agency or agencies are most likely, at least cost, to produce desired impacts upon societal variables so as to contribute to the achievement of societal goals and allocate funds to that agency or those agencies.

(6) societal policy makers explicitly state impact goals (including those persons in societal space who must be involved in order to achieve these goals) to the particular social service agency or agencies which have been chosen to contribute to the attainment of societal goals through their achievement of the specified impact goals.

(7) the chosen social service agency or agencies given the specific impact goals and the related human and economic resources necessary to achieve this goal, then decide upon the process and product mix that will achieve the specified impact goals and produce this product.

(8) societal policy makers then evaluate the particular social service agency or agencies on the basis of their achievement of the stated impact goals, and their corresponding ability to contribute to the achievement of related societal goals.

(9) If the social service agency has satisfactorily achieved the specified impact goal, the societal policy makers can turn their attention to the achievement of other impact goals which could contribute to achievement of related societal goals. If the impact goal has not been achieved, the societal policy makers might decide to assign the impact goal to a different social service agency; the entire process would begin again.

The structure of the process for establishing and assigning impact goals which contribute to the achievement of value-related societal goals is depicted in Table 2.* The example of the process by which the number of automobile mechanics in the previously described community was changed in accordance with a specified impact goal that contributed to the achievement of a value-related societal goal is provided in order to illustrate this process.

The following is an example of the process by which impact goals contribute to the achievement of value-related societal goals. At a given time the citizens of the state complain about the increasing incidence of robberies. The citizens of the state place a high value on being able to walk safely on their streets; they now feel that their societal value "law and order" is being seriously jeopardized by the high crime rate in their state. The citizens write letters to their representative in the state legislature in the hope that something can be done about their problem.

The state legislature received these complaints and conducts an investigation of the current level of robberies in the state. They discover that the complaints are well grounded. They also discover that most of the robberies are committed by poor youths in that community. The state legislature is aware of several other problems in the state (e.g., a high unemployment rate, a large number of families living in sub-standard housing, etc.). The members of the legislature decide that the threat to the societal value of law and order is more serious at the current time than the threats to other societal values as posed by the incidence of unemployment or substandard housing (e.g., equalitarianism or the work ethic). This decision is an example of the legislators' prioritization of societal values on the existing level of several societal variables.

*See page 22.

TABLE 2: The Structure of a Process for Establishing an Impact Goal which Contributes to the Achievement of a Value-Related Societal Goal and an Example of this Process.

Type of Value	Priorization of Values	Societal Goal	Existing Level of Value-Related Personal or Societal Variable	Acceptability of Existing Level of Variable	Impact Goal (Desirable Level of Variable in light of a societal goal)	Potential Impacters	Social Service Agency(s)	Actual Impact	Acceptability of New Level (Process Repeated If Unacceptable)
Political									
Economic	Equity of manpower supply and demand in the community.	Increase community work force by 5%	Ten automobile mechanics in community	Not acceptable	Fifteen automobile mechanics	Info on Potential Impacts of Vocational Education on Number of Automobile Mechanics in Community	Vocational Education	13 Automobile Mechanics	Acceptable
Social									
Cultural									

The members of the legislature also decide that the current level of robberies in the state is in disequilibrium with the societal value "law and order" and therefore should be decreased. Currently, the average number of robberies committed per year in the state is 700. (This is the existing level of the societal variable, "number of robberies committed in one year"). The legislature decides that the number of robberies in the state should be reduced to a maximum average of 100 per year; this level is deemed to be more consistent with the societal value "Law and Order". Thus, a maximum average of 100 robberies per year is the legislature's stated societal goal.

There are several social service agencies which indicate that they can produce a product which will have the desired impact upon the robbery rate and thereby contribute to the achievement of that societal goal. Each of these agencies petitions for funds. For example, the police claim that fewer robberies would be committed if they could hire more patrolmen. The prison officials state that they can reduce the number of robberies in the community by rehabilitating those youths who are caught committing the crimes and consequently enter their institutions as criminals. The housing officials claim that fewer robberies will be committed if the youths who are committing these robberies live in a better environment. The welfare officials state that if welfare payments were increased there would be less motivation for committing robberies. The educationalists claim that they can produce an immediate impact on the level of robberies, by removing young persons in that community from the streets while they are being educated. In addition, education provides long range impacts on several personal and societal variables, including the robbery rate, since those youths who are exposed to the educational process will re-enter society with newly acquired skills. They will be more likely to get jobs and become contributing members of society and therefore less likely to commit robberies.

The educationalists present evidence that people who are employed are less likely to commit robberies. They indicate that some likely additional impacts of the educational product on society will be increased money available for other uses as a result of the decrease in money spent to prevent robbery, a decrease in the levels of unemployed persons and persons receiving welfare; spillover benefits to the next generation of children and a long-range impact on the robbery rate as a result of the fact that these more advantaged children will be less likely to commit crimes. The legislature decides that the educationalists are in a very good position to attain both immediate and long range impacts on the societal goal of a reduction in the robbery rate, while the police are in the best position to produce immediate impacts on this goal. They allocate funds to the schools, specifically indicating that their long and short range impact goal is a specified reduction of robberies committed by disadvantaged youths; they allocate funds to the Police Department with the understanding that they are to produce an immediate impact on the robbery rate. Thus the legislature has assigned impact goals to two social service agencies in the hope of achieving their societal goal.

The educationalists, given the inputs "disadvantaged youths" and the societal goal "a maximum average of 100 robberies per year" choose the process which they feel will result in a product that will have the desired impact. For example, they might decide that disadvantaged youths would profit most from a vocational education program consistent with their ability to get jobs upon graduation, rendering them less likely to commit robberies. The Police Department might hire more patrolmen with their additional funds in order to achieve an immediate impact on the number of robberies committed by disadvantaged youths.

After one year the legislature assesses the immediate impact that both the educationalists and the policy have had upon the robbery rate of disadvantaged youths. They decide that these two social service agencies are favorably impacting upon their societal goal. After several years of funding education for disadvantaged youths, as well as providing funds for added policemen the legislature re-examines the average number of robberies committed in the state over a year's time. They find that the average number of robberies per year has dropped from 700 to 200. (Thus, 500 robberies per year represents the actual impact of the agencies' product on the societal variable, "average number of robberies per year"). The legislature decides that although their stated societal goal has not yet been achieved, both the educational product and the additional police protection are having a significant impact on the average number of robberies per year and therefore should continue to be funded in order to bring that societal variable (the robbery rate) into equilibrium with the underlying societal value of safety in the streets. This simple example illustrates the process by which value-related societal and impact goals are established and dealt with.*

IV. Conclusion

The primary purpose of this section of Occasional Paper #5 is to define and discuss the impacts (from the educator's perspective) of the educational product on personal and societal variables and the relationship of these impacts to the achievement of societal goals. A tentative process was established for those persons who are charged with the responsibility of

*This example is expanded upon in Occasional Paper #6.

of managing societal goal identification and achievement. It was suggested that decisions concerning societal goals and the assignment of impact goals in order to achieve societal goals should always be made in the context of underlying societal values. It was also stressed that those persons who assign impact goals to social service agencies, such as education, must make goals explicit if they hope to operate in a rational manner, one which permits accountability between societal goals and service agencies.

Section I, Part 2

EDUCATIONAL INPUT SPACE AND STUDENT SPACE

Educational input space consists of descriptions of those economic and human resources outside of educational space (e.g., in societal resources space) which, through a decision of policy makers at the state level, are placed into educational resources space. (The actual process by which this occurs was described in a preceding section of this paper). In Occasional Paper #2, two major categories of educational inputs were established:

1) human and, 2) economic. Economic inputs, when in educational space, become educational capital; human inputs when in educational space, become students. Educational decision makers make use of information which describes human educational inputs (e.g., human input mixes) in their creations of student mixes. Information describing human educational inputs is stored in student space).

The Purpose of the Delineation of Human Educational Input Space

As previously mentioned, human education input space consists of information (e.g., levels and rates of variables) which describes those persons in societal space who are designated (by societal policy makers in accordance with specified impact goals) to be placed into educational space. Configurations of those persons along societally specified dimensions constitute human input mixes. For example, human educational inputs might be classified within societal space according to range of I.Q. scores as bright, normal or subnormal; according to racial characteristics as Negro or

Caucasian; according to parents' socio-economic status as underprivileged, privileged or highly privileged, etc. An example of a human educational input mix might be all those underprivileged Caucasian individuals with I.Q.'s in the normal range who obtained a high score on the mechanical aptitudes section of the D.A.T.

Once the human educational inputs are actually placed within educational space, they become students. Educators make use of the information provided by societal classifications (e.g., input mixes) in order to regroup the human educational inputs (now students) into student mixes. Student mixes are determined by educators in order to track those students who are similar along certain educator-specified dimensions (e.g., by student mix) into that process mix (e.g., the particular educational process) which will produce at the least-cost (money and time-wise) the optimum educational product (e.g., product mix) most likely to attain specified (by policy makers at the state level) impact goals. Thus, educators would use the information describing human educational inputs by mix to form educationally relevant groupings of those individuals (e.g., student mixes). An example of a student mix based on the input types described above might be all of those students from underprivileged backgrounds with I.Q.'s in the bright range.

Thus, the delineation of human educational input space is of assistance to educators in the formation of student mixes. Under ideal circumstances, in the absence of constraints, the educational decision maker could assign each student individually to the particular form of instruction (e.g., process mix) that would be optimum for that student. In reality, however, limited funds are available to education. For this reason, individualized instruction simply is not economically feasible. The economically feasible alternative to individualized instruction is individually prescribed instruction. Educators, by determining on the basis of individual student characteristics and descriptions the student mix to which a particular student should be assigned and which process mix is best for students of that particular mix, are, in essence, prescribing individualized instruction. Hopefully, a relatively small number of effective ways to group students will be identified. Knowledge of a finite number of effective student mixes will enable educators to increase their ability to accurately predict which process mixes would be optimum for given student mixes in terms of the achievement of a given educational product. Delineation of human educational input space contributes to the educators' ability to define those student mixes.

Suggested Classes of Representative Variables Within Student Space

Student space contains two major categories of descriptive variables: Student characteristic variables - descriptions of those characteristics which the student possesses and student description variables - descriptions of those things in societal space which the student experiences as part of his environment prior to and during his experience in educational space.

I. Suggested Representative Classes Of Student Characteristic Variables Are:

   A. Biographical Descriptive Variables - i.e., the student's sex, birthdate, racial origin, birth order, languages spoken, etc.

   B. Physical Descriptive Variables - i.e., height, weight, physical defects, mental and physical health, etc.

   C. Personality Trait Descriptive Variables - i.e., perceptions of the self, cognitive style, personality traits, social behaviors, aspirations, etc.

D. Interest, Value and Attitude Descriptive Variables - i.e., vocational interests, attitudes towards work, attitudes towards school, values, etc.

E. Achievement Descriptive Variables - i.e., Reading and arithmetic scores, vocational achievement prior to high school, general educational development.

F. Ability Descriptive Variables - i.e., verbal and non-verbal intelligence quotients, differential ability scores, etc.

II. Suggested Classes of student description variables are:

A. Family Characteristic Descriptive Variables:

1. Biographical Variables Describing Each Parent - i.e., educational level, urbanism of background, age, mental and physical health, father's occupation, etc.

2. Family Descriptive Variables - i.e., size of family, sex and ages of children, structural integrity of the family, etc.

3. Home Characteristic Descriptive Variables - i.e., size of home, sleeping accommodations for children, number of different types of items such as televisions, radios, books and magazines in the home, dominant language spoken in the home, student's perception of the home environment, etc.

4. Socio-Economic Descriptive Variables - family income level, parents' occupations and usual employment status, degree of economic independence, adequacy of housing etc.

5. Parental Values, Attitudes and Interest Descriptive Variables - i.e., parental presses such as social press, expectations for themselves and their children, i.e., aspirations; parental

attitudes toward education and the educational progress of their children; cultural pursuits, values, etc.

B. <u>Peer Group Characteristic Descriptive Variables</u>

1. Description of peer groupings and distribution of members.
2. Description of perceived expectations of peer group on members' behavior, including achievement in school, usefulness of school, group loyalty, family loyalty, etc.
3. Description of perceived influence of identified peer groups on self expectations and behavior.

C. <u>Neighborhood Characteristic Descriptive Variables</u>

1. <u>Population Descriptive Variables</u> - i.e., number of people and population density, median income and educational level of residents, type of neighborhood (urban-rural, residential-industrial), crime rate, rate of mental illness, racial, religious and ethnic makeup, predominant language, immigration and emigration rates, etc.
2. <u>Economic Descriptive Variables</u> - i.e., predominant socio-economic status of neighborhood, per capita income, predominantly occupational classes of residents, predominant level of housing, welfare rate, employment and unemployment rate, horizontal and vertical mobility, etc.
3. <u>Socio-Cultural Descriptive Variables</u> - i.e., educational resources available, such as number of libraries and number of volumes per library; cultural resources available such as number of movie houses, theatres, museums; number and type of health facilities available, etc.

4. Attitudinal and Value Descriptive Variables - i.e., community involvement in, support for and attitudes towards education, etc.

B. City or Town Characteristic Descriptive Variables - these would be the same as the neighborhood variables, but on a larger scale.

Measurement of Representative Classes of Variables Within Student Space

Information concerning variables within student space (e.g., student characteristic variables and student description variables) will be acquired in two ways: (1) through analytic data - e.g., measurement instruments and (2) through descriptive data - e.g., questionnaires. All analytic data (with the exception of very gross data required for census information) will be collected on a sample basis only. Descriptive data, depending on its complexity, will be collected on a census and/or sample basis. The actual question of the measurement instruments will be dealt with in a later paper. At the current time, however, some suggestions have been made concerning possible instruments. Table 3 contains some instruments suggested for measuring representative classes of the two major categories of variables within student space (student characteristic variables and student descriptions variables) as well as some of the variables within the representative classes of variables categories.

TABLE 3: Measurement of Representative Class of Noneconomic Input Variables

Suggested Input Variables	Suggested Instruments**	Structural* Description	Approximate*** Reliability	Test-Time in Minutes	Cost Per Test	Cost Per Answer Sheet
STUDENT CHARACTERISTICS	Undetermined Questionnaire: i.e.,					
A. Biographical Descriptions	The Biographical Inventory for Students	Grades 12-13				
B. Physical Descriptions	The 1970 Elementary School Survey-Pupil Questionnaire					
C. Personality Traits	California Personality Inventory	18 scores	r_2 = .65-.80	45-60	.25	.08
1. Self Perceptions						
a) self-concept	Gordon Personal Profile	4 scores	2 "acceptable"	15-20	.09	.09
b) needs, presses, aspirations, etc.						
2. Cognitive Style	Edwards Personal Preference Inventory	15 scores Ipsative data	r_1 = .60-.87 r_2 = .73	40-55	.14	.05
a) abstract-concrete						
b) rigid-flexible	16 P-F (Short Form C)	16-17 scores	r_1 = .71-.93	50-60	.40	.10
c) introverted-extroverted	Occupational Aspirations Scale (?)					
3) Social Behaviors	Project Talent Test Battery: Student Activities Inventory	10 scores		20-25		
a) sociability						
b) leadership	Motivation Analysis Test	45 scores		55-65	.60	.12
c) maturity						
d) co-operativeness	The IPAT Anxiety Scale Questionnaire	6 scores	r_2 = .80-.93	5-10		
e) responsibility						
f) tolerance	California F-Test					
4) Personality Patterns						
a) motivation						
b) anxiety			***			
c) authoritarianism			r_1 = split half			
d) dominance			r_2 = test-retest			
e) independence			r_3 = equivalent			
f) self-control						
g) perseverence						
h) creativity, etc.						

*Normative data unless otherwise indicated.
**Many of the variables listed are not measured by instruments.

TABLE 3: Measurement of Representative Class of Noneconomic Input Variables

Suggested Input Variables	Suggested Instruments	Structural Description	Approximate Reliability	Test-Time in Minutes	Cost Per Test	Cost Per Answer Sheet
D. Interests, Attitudes & Values	Strong Vocational Interest Blank	64 scales	"good"	30-60	.24	.05
	Kuder Preference Record	6 scores	r_1 = .76-.89	40-45	.55	.07
	Vocational Development Inventory		r_1 = .88	40		
	Cotswold Personality Assessment P.A.	6 scores	r_2 = .81-.93	40		.05
	California Study Methods Survey	4 scores	r_2 = .85		.10	
	Super's Work Values Inventory (?)	?	?	?	?	?
	Allport-Vernon Study of Values	6 scores Ipsative data	r_2 = .82	20	.11	?
E. Achievement	California Achievement Tests	11 scores	r_1 = .95	178	.19	?
	Metropolitan Achievement Tests	11 scores	r_2 = .80-.88	316	.30	.16
F. Ability	Otis Quick-Scoring Mental Abilities Test	?	?	35	.08	.04
	School Ability Test (Level 2)	3 scores	r_1 = .95	70-95	.20	.05
	California Short Form Test of Mental Maturity (Level 4)	7 scores	r = .85	45	.12	?
	SRA Tests of Educational Ability	3 scores	r = .90	45	.35	.07
	IPAT Culture Fair I.Q. Test	4 subtests	$r_{1,2}$ = .80	30	.13	.04
	Differential Aptitude Test (Combined Booklet Edition)	9 scores	"excellent"	270	.64	.22

TABLE 3: Measurement of Representative Class of Noneconomic Input Variables

Suggested Input Variables	Suggested Instruments	Structural Description	Approximate Reliability	Test-Time in Minutes	Cost Per Test	Cost Per Answer Sheet
STUDENT DESCRIPTIONS						
A. Family Characteristics						
1. Biographical Descriptions of Each Parent	Undetermined Questionnaire					
	The American Home Scale	?	--			--
2. Family Descriptors	Project TALENT Student Information Blank	?	--			--
	Warner, Meeker and Eells Index of Status Characteristics	?	--			--
3. Home Descriptors	The Home Index	?	--			--
4. Socio-Economic Factors	The Social Status Scale	?	--			--
5. Parental Attitudes Interests and Values	The Family Adjustment Test	11 scores	--	35-45	.16	--
B. Peer Group Characteristics						
1. Biographical Descriptors	Undetermined Questionnaire					
2. Socio-Economic Descriptors	Same Tests Used for Student Characteristics					
3. Values, Attitudes and Interests						

TABLE 3: Measurement of Representative Class of Noneconomic Input Variables

Suggested Input Variables	Suggested Instruments	Structural Description	Approximate Reliability	Test-Time in Minutes	Cost Per Test	Cost Per Answer Sheet
C. <u>Neighborhood Characteristics</u>						
1. <u>Population Variables</u>						
2. <u>Economic Variables</u>	Census Information and					
3. <u>Socio-Cultural Variables</u>	Undetermined Questionnaire					
4. <u>Attitudinal and Value Variables</u>						
D. <u>City or Town Characteristics</u>						
(Same classes of variables as for neighborhoods.)	Same instruments as used in the neighborhood, but on a larger scale.					

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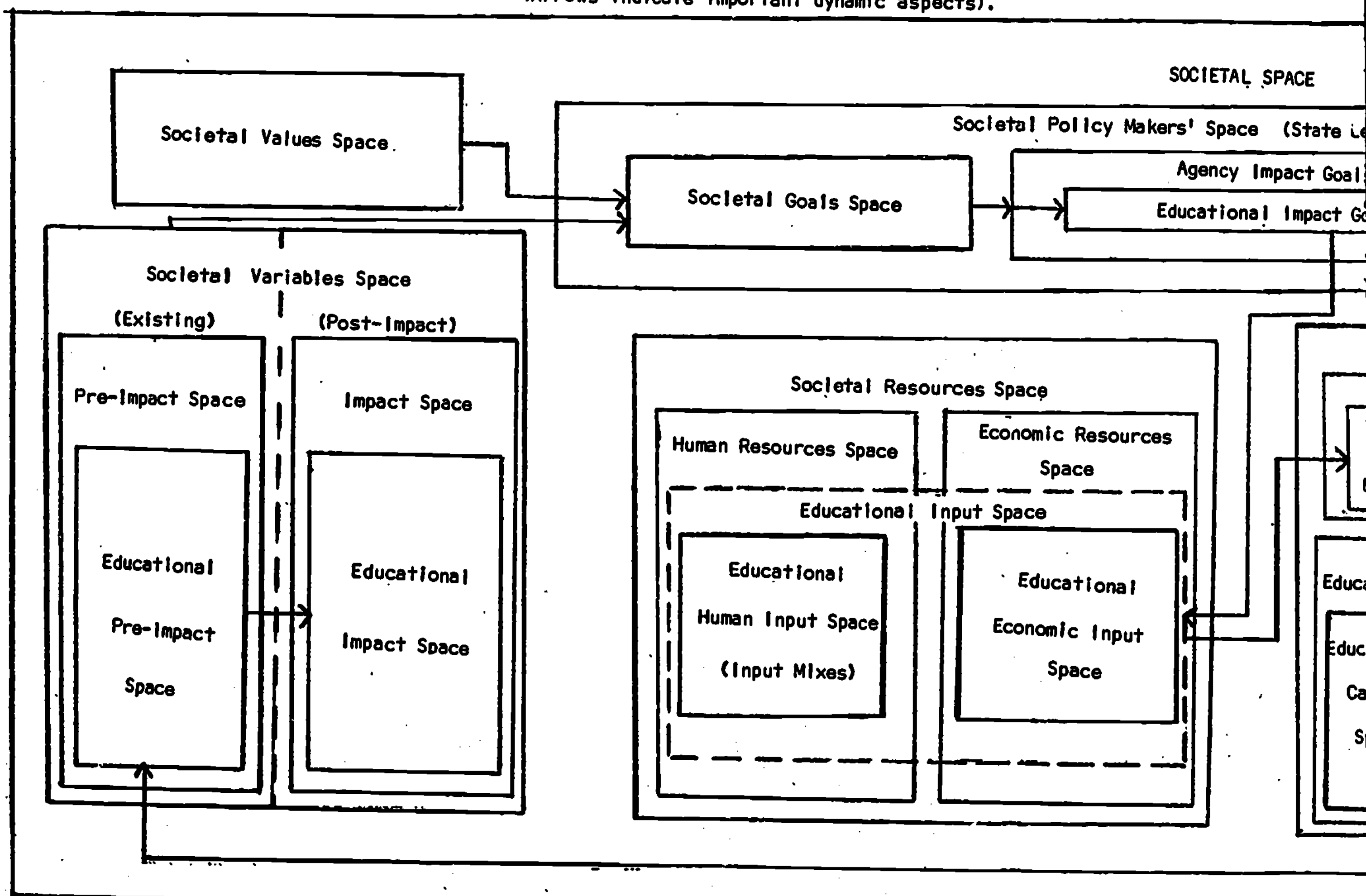
FIGURE I: Depiction of Static Systems Space
(Arrows indicate important dynamic aspects).



In Figure I, societal value and variable space on the left side of the diagram combine and flow into societal policy maker's space, and form the basis for societal goals. Following the arrows of Figure I, societal policy makers determine impact goals for social agencies, including education. This constitutes impact goal space for agencies, including education. Educational inputs, comprised of human economic elements (part of societal resource space) are determined by social policy makers at the time they set educational impact goals. The MISOE decision flow model specified that this is the rational process by which inputs flow into educational space.

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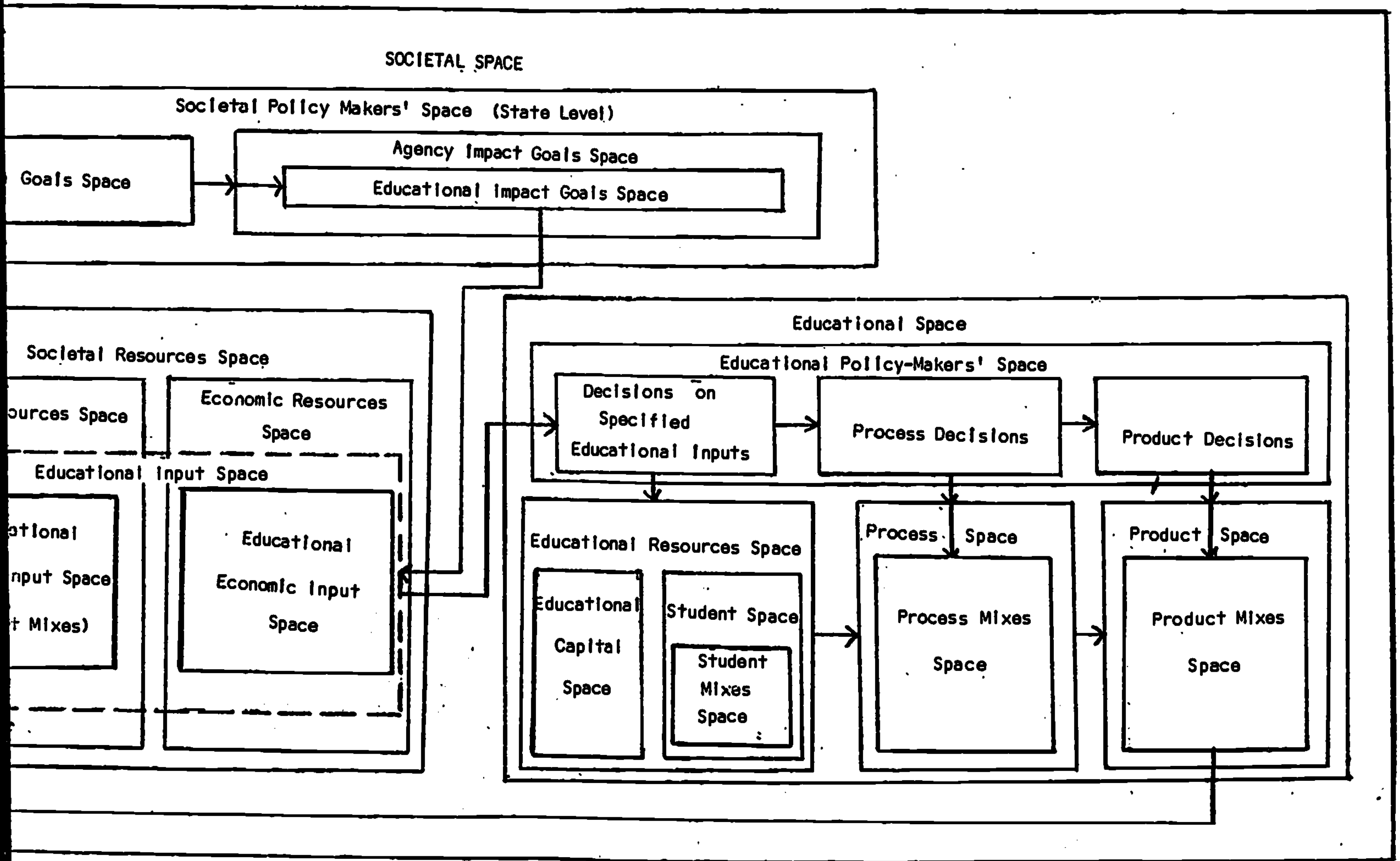

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Once inputs are within educational space, they form educational resources space. Educational managers then determine product and process mixes within educational space and the attained product re-enters societal space and flows into societal variable space. In societal space, educational product impacts upon existing levels of societal variables (educational pre-impact space), resulting in educational impact space. These impacts are evaluated by societal decision makers, in relation to impacts by other agencies and the feedback loop is closed - and the process begins anew.

Section 2, Part I

Process Space

In Occasional Paper #4 it was stated that "the model of process space was set up basically to provide an efficient method for dealing with process information." A simplified example of the storage and retrieval of an isolated variable "two students working on a clutch" was offered. It is necessary, at this time, to emphasize that one of the major purposes of MISOE is to be able to detect, through observation of naturally occurring phenomena, the particular combination of process factor variables which constitute the optimum educational program for specific objectives within occupational education programs, blocks and units, for specific student types; a combination of process factor variables is referred to as a process mix.

In reality, information about the relationship between the singular process variable "number of students working on a clutch" and the product objective "clutch assembly" is meaningful only when viewed in the context of the particular process mix (e.g., combination of human and physical process factor variables in time) of which this variable is a single element. (Some specific examples of process mixes will be given at a later point in this paper). Thus, the relationship between the process variable, "number of students working on a clutch" and the product objective "clutch assembly" must be viewed in the context of the other process variables which are simultaneously related to that product objective. In Occasional Paper #4 process variables were categorized into three process factors. Examples of process variables which might be part of the process mix in which "two students per clutch" occurred are listed below according to the process factor which they would be classified under:

a) physical factor variables - e.g., the physical setting in which learning occurs; the instructional materials employed; etc.

b) human factor variables - e.g., the teacher's operational behaviors; the teaching method or approach; the teacher's personal characteristics; characteristics of the learners; expected learner behaviors; the perceived learning environment; etc.

c) organizational factor variables - the organization of the human and physical factors in time, e.g., the amount of time spent in teaching a particular objective.

Educational researchers have proposed an alternative (albeit related) categorization of process variables into the following categories:

1. The Setting - physical, nonphysical
2. The Teacher
3. The Teaching Method
4. The Instructional Materials
5. The Learner's Behavior

Regardless of how the process variables are categorized, however, (we will stand by the 3 factor categorization in Occasional Paper #4) it is essential to recognize that the learning process (e.g., instructional event) consists of a complex array of interactive process variables; any one variable must be described in the context of the process mix in which it occurs. Therefore, the univariable approach to the storage and retrieval of process information described in Occasional Paper #4 must be expanded in order to handle the complex array of interactive process variables that constitute a process mix.

(The expansion of the storage and retrieval system described in Occasional Paper #4 in order to handle process mixes as well as process variables will be described at a later point in this paper).

In addition to the advantage that the process mix approach to process space offers in terms of MISOE's ability to describe an event as complex as the instructional process, the following advantages are to be gained from increased knowledge concerning the optimal product mix for a given input mix in order to achieve a specified product mix. Knowledge of the optimal process mix:

a) allows prediction of expected output for given levels of expenditures by specific process mixes for determined student types.

b) allows for specification of the economic inputs required to obtain product goals for given student types by prescribed mixes.

c) allows for the prediction of efficient process alternatives by providing knowledge about the relative weights of individual process variables within a process mix in terms of their relative contribution to the achievement of specified objectives by a given student type. Undoubtedly, certain process variables within process mixes will be found to be more intimately connected to achievement of specified objectives than others. Those process variables would then be heavily weighted within that process mix. For example, it might be found that "the number of students working on a clutch" is more strongly related to the achievement of the objective "clutch assembly" than another element of the process mix in which that variable occurred, such as "age of equipment." Thus, "number of students working on a clutch" would be more heavily weighted within that process mix than "age of equipment." Hopefully, some process variables will be determined to be strongly related to achievement over most if not all objectives within and among programs. Those process variables would be heavily weighted within and across appropriate process mixes. For example, it might be found that the process variable "teacher knowledge of subject matter" is very strongly related to achievement of behavioral objectives across all programs, blocks and units. Thus knowledge of the balance of process elements within and between process mixes will enable educators to develop those mixes which are most efficient in attaining a stated object (e.g., product mix) given a certain student type (e.g., input mix).

In summary, the process space model must be able to deal with both the individual process variables which are part of a process mix (this knowledge is necessary in order to describe the process mix in terms of its components), and the complex array of variables which simultaneously constitute a process mix. It is assumed that the process mix will vary by program and by student type. If an educational process can be defined as a mix of human and physical factors in time (e.g., a process mix), then the components of this mix and their balance or weighting are crucial variables in terms of making decisions or predictions which concern the process of education. Given an individual process variable it would be desirable to be able to determine the weighting of this variable (e.g., its mixability within and/or over process mixes in terms of its relationship to achievement of a specified objective or mix of objectives by a particular input mix). Given a particular process mix it would be desirable to know the important process variables of which this mix is composed and the relative weightings of these variables. Hopefully, a good deal of this type of knowledge can be gained through simulations of process mixes (see Occasional Paper #6).

A Detailed Description of a Process Mix

A detailed description of a process mix is offered below in order to demonstrate the complexity of the interactive information that the process space model must be able to accommodate. This example describes a process mix that might contain the variable described in isolation in Occasional Paper #4, "two students working on a clutch".

In Occasional Paper #4, an investigator was sent in to describe the clutch unit in the power train block of the automotive program in Country Vocational High School. He was told which human, physical and organizational variables he should look for. This is the process mix which he described.

A. General Setting - Country Vocational High School serves a lower-middle class, predominantly Irish-Catholic suburban community outside a large city. The community actively supports the school both financially and attitudinally. It is a self-contained secondary school, offering a variety of vocational-technical programs and an academic program. The school is over forty years old and is slightly overcrowded. The square foot value of the building was $25 when constructed. The automobile mechanics program provides for 25 square feet per student. Both students and teachers perceive this as inadequate. The local school board determined that the school must choose its students from junior high school graduates within the suburban area that it serves. No other constraints are placed upon "recruiting" students.

Although all students who apply to the school are required to take the D.A.T., the director personally interviews all applicants and states that his primary criterion for acceptance is his perception of the student's expressed interest and motivation in learning a vocation, regardless of previous grades or test scores. Therefore, the range of abilities of students in the school as a whole is quite wide. All students take the same courses in their first year "Introduction to Vocations", but in the second year they must choose one program. The chairman of the automotive mechanics department has decided that only those students who scored acceptably high on the D.A.T. will be admitted into this program. Therefore, the range of abilities of students within the automotive mechanics program is limited to a select group of students. All students in the automotive mechanics program are male since in the past females have not applied. (This might change in the near future).

The school's principal fosters strict enforcement of the school's rules. The students perceive the general disciplinary atmosphere as being "strict but fair." It is stressed that students must act "professionally", especially when in class. After the first year almost all of the students in all programs throughout the school participate in a "cooperative program".* The state has stipulated that at least

*Cooperative programs allow students to spend part of their school time actually working under cooperative school-industrial supervision in an actual "real world" setting.

equal time must be spent in school as on the job, and that the cooperative program can only occur during a student's senior year. Therefore, throughout all programs in the school, students spend one week in school and one week working in the related, cooperative setting. Half of the eligible students are scheduled to go out of school into cooperative education each week.

All students spend three years in the program into which they are placed (usually this is the program of their choice, if they are qualified according to the department chairman, and if there is enough room). Within a program all students are required to take the same blocks, component units and corresponding objectives in the same order and over the same period of time. The blocks and their component units were sequenced according to the adjudged difficulty of their corresponding objectives. Therefore, all students in the first year of the automotive program are placed into the clutch unit of the power train block of that program at the same time. All are expected to master the three associated objectives (one of which is "clutch assembly" within the same period of time. Within units, however, the order in which the objectives were learned was variable among students. This was primarily because of a shortage of equipment in some units. Thus, students could work on a different part of the same piece of equipment at the same time. Students spend three weeks studying the clutch unit and then move on to another unit within the power train block.

Evaluation of students' progress within the automotive program across all blocks on unit-related objectives is optional; however, students move on to the next unit and related objectives regardless of their previous performance. At the end of the academic year students are evaluated on a series of objectives which span the whole program; if they do not perform satisfactorily they are dropped from the program and are offered the alternative of beginning another program one year behind or going to a regular high school.

B. Specific observations on the instructional events related to the teaching and learning of the three behavioral objectives associated with the clutch unit of the automotive mechanics program in Country Vocational High School follow:

The classroom environment was relaxed and open. There was one teacher in a room of twenty students. It was somewhat crowded. The teacher encouraged students to work independently of him and consult him only if they were unable to work something out for themselves. Consequently, there was a minimum of student-teacher interaction. Students, however, were encouraged to interact with each other in solving problems. The students who caught on faster were reinforced for helping students who had problems. However, the teacher stipulated that students should try to solve their own problems first, and that help from other students was limited to verbal explanation so that each student would do the actual work by himself. Students were supplied with detailed manuals from which they were to work. At no time did the teacher lecture to the class as a whole.

The teacher used a problem-solving approach in dealing with students who sought his help. When students consulted with him he would ask them what they thought they should do rather than telling them what to do. He encouraged them to try out many different solutions, always explaining that they could learn from their errors. After trying several different approaches, if they still could not solve their problem, he would verbally explain, while demonstrating on the equipment, how this problem could be solved.

The teacher was highly experienced and competent. The students indicated that he was always well prepared for class. The students perceived the teacher as being somewhat introverted; the less outgoing students indicated that this discouraged them from attempting to interact with him.

There were three behavioral objectives that students were to learn within this unit. Students were given one week in which to learn each objective and then would proceed to the next. The order in which these objectives were to be learned was varied among the twenty students in order to allow for two students working on one clutch at one time. The two students who shared a clutch would each work on a different behavioral objective involving a different part of the clutch over a one week period. The next week they would switch, etc.

Some Suggestions on the Storage and Retrieval of Process Mix Information

The preceding example illustrates the complexity of information which must be dealt with when storing process mix information. The storage and retrieval system developed in Occasional Paper #4 was directed at the storage and retrieval of a single process variable. As previously mentioned, each process variable is observed (in a systematic and usually quantifiable way) in the naturally occurring environment in the context of a unique process mix (e.g., a unique combination of simultaneously occurring process variables). Although knowledge of the individual variables of which a process mix is composed is important, it is equally, if not more, important to be able to have knowledge of the interactions of individual process variables within a particular process mix and over several different process mixes.

A. <u>Storage and Retrieval of Historical Static Process Mix Information</u>

The first step in the development of a storage and retrieval system for process mix information is the development of a system for the storage of historical process mix data (e.g., the storage of all variables which constitute a particular process mix within a naturally occurring environment). In the detailed example of a process mix it was stated that the investigator was told which human, physical and organizational process factor variables he should describe. The recording and storage of process mix information will be simplified through the use of a standard observation form developed for each variable within programs, which will describe those human, physical and organizational process factor variables which are considered to be of significance. Note then that process mixes would basically be similar in terms of the dimensions that they included. Differences between process mixes would be:

a) in terms of the levels and rates of those dimensions.

b) in terms of the presence or absence of certain relatively unique dimensions.

Thus, rather than writing an essay to describe a process mix, an investigator will rely on pre-tested, standardized instruments. (Each variable will be referenced with the appropriate physical or organizational process factor address, described in Occasional Paper #4, in which it should be stored).

The process variable storage and retrieval system developed in Occasional Paper #4 could be expanded to accommodate the storage of process mix data by the addition of a process mix identification number to the process variable profile code which is stored along with each variable (see Occasional Paper #4, page 15). This number would identify the particular process mix in which a given process variable was observed; all other process variables observed within that mix would contain that same process mix identification number in their profile code. In addition, a cost figure would be attached to each process mix as well as each process variable within a mix. (Economic aspects of process space will be discussed in the following section of this paper). The user of the Process-Space Index described in Occasional Paper #4 (see page 18) could then request two basic types of information about a particular process variable. (Note that some modifications of the Suggested Variable Profile Form described on page 20 of Occasional Paper #4 are required to accommodate requests for the information):

1) What are the other human, physical and organizational process factor variables which constitute the process mix in which this particular variable was observed, and what are the costs associated with each of those variables and that process mix as a whole? (e.g., information concerning a variable within a process mix).
2) In which other process mixes did this variable occur and what are the cost factors associated with each of those mixes? (e.g., information concerning a variable over several process mixes).

B. Storage and Retrieval of Process Mix Data

Once historical process mix information is collected and stored, the analysis procedure can begin. Although we do not know at this point exactly how process data will be analyzed, we do have some definite ideas about the types of information which we would like the analysis to yield. (Note that the dynamic issue of process-product analysis will be dealt with in Occasional Paper #6). As previously mentioned, it would be extremely desirable to be able to determine the mixability of a given process variable within a particular process mix and over many process mixes (e.g., by determining the relative "weighting of that variable" through regression analysis or the amount of variance that it accounts for in terms of product data within and over process mixes). Thus, some additional bit of information which might be stored with each process variable would be a number which identifies the "weight" of that variable within the mix in which it was observed and the average weighting of that variable over all mixes in which it occurred. The Process Index described in Occasional Paper #4 might then include a listing of those process variables, by program, which consistently account for a large percentage of variance in terms of product data.

One of our questions at the current time concerns the generalizability of data which describes the weighting of a variable within one process mix to that variable's weighting within other process mixes. For example, if two process mixes are similar on all dimensions except for the levels and rates of the variables of which they are composed, would knowledge of the relative weight of one given variable within one of those mixes say anything about that variable's weight within the other mix. These questions will be addressed in the Occasional Papers treating analysis.

In addition to information which describes elements within process mixes, we hope to be able to say something about process mixes as a whole on the basis of the analysis of process data. For example, we might want to provide a listing of the most commonly occurring process mixes by program, including their costs and the most effective least-cost process mixes by program (in relationship to product data). These mixes might be listed in the Process Space Index described in Occasional Paper #4. The user could then request an item-by-item analysis (in terms of cost and weighting) of the variables which constitute a particular process mix.

The actual storage and retrieval system for these types of process mix data will be developed at a later time. It is hoped that the process space section of the paper offers an idea of the kind of information in which we are interested, in terms of process data, as well as some of the unresolved questions at this point in developmental time.

Suggested Class of Representative Process Variables and Suggested Measurement Instruments

Table 4 contains a very tentative listing of suggested classes of process variables and related measurement instruments. We have not as yet been able to devote the necessary time to this extremely important area; process variables will be fully dealt with in a later paper. A major instrument for examining process will be the TV camera, used in conjunction with a panel of judges.

TABLE 4

Suggested Classes of Representative Process Variables

and Suggested Measurement Instruments

Classes of Variables	Suggested Measurement Instruments
I. Human Factor Variables	
A. Characteristics and Descriptions (See Human Inputs Table)	Same basic classes of variables and measurement instruments indicated for use in the earlier Table containing classes of human input variables.
	Undetermined questionnaire
1. experience	
2. competence	
3. level of education	
B. Perceptions	
1. School Environment Press	High School Characteristics Index
a) student's perceptions	College and University Environment Scales Holland's Environmental Classification System
b) faculty and administration perceptions	The Principal's Data Sheet The Faculty Morale Scale The School Survey
2. Organizational Climate	Organizational Climate Description Questionnaire
3. Student Body Presses	The Student Rating Scale
4. The Learning Environment (The Classroom)	The Learning Environment Inventory Withall's Climate Index Denny, Rausch and Ives' Classroom Creativity Observation Scale

TABLE 4 (Cont'd)

Classes of Variables	Suggested Measurement Instruments
C. Behaviors	
1. Decisions	Classification of (as described in Occasional Paper #4).
2. Operations	
a) Teaching Method	Classification of - i.e., discussion; lecture, laboratory, recitation --Observational Method such as the OScAR
b) Teacher Effectiveness	Cosgrove's Scale for Diagnostic Rating of Teacher Performance
c) Teaching Style - i.e.,	Observational Methods
1) Authoritarian vs. Democratic	Manning's Rating Scale for Permissiveness Vs. Control
2) Personal vs. Impersonal	Solomon Teacher Behavior Rating Scale Baxter's Rating Scale of Teacher Effectiveness Purdue's Rating Scale for Instruction The Instruction Performance Indicator
3) Teacher vs. pupil oriented	
4) Formal vs. Informal, etc.	
II. <u>Physical Factor Variables</u>	Undetermined Questionnaire (See following section of paper)
A. School Structure-i.e.,	
1. Overall # sq. ft.	
2. Sq. ft. per program	
3. Classroom Dimensions	

TABLE 4 (Cont'd.)

Classes of Variables	Suggested Measurement Instruments
B. Instructional Materials - i.e.,	Undetermined Questionnaire
1. Numbers & types of equipment	
2. Type of school	
3. Numbers and types of textbooks	
4. Types of curriculum offered, etc.	
III. <u>Organizational Factors: Human</u>	Undetermined Questionnaire
A. Organization of Students and Faculty	
1. Numbers of each	
2. How students are grouped	
3. Student/teacher ratio, etc.	
B. Student/Teacher Interactions	
1. Behavioral Interactions	Observational Methods such as: Flander's Interactive Scale OScAR Classroom Observation Record
2. Teacher's Verbal Behavior	Wright & Nuthall's Observational Evaluation of Verbal Behavior Wright & Proctor's Classification of Verbal Behaviors May & DeVault's Analysis of Verbal Behavior
3. Teacher's Non-Verbal Behavior	Morsh's Systematic Observation of Instructor Behavior

TABLE 4 (Cont'd)

Classes of Variables	Suggested Measurement Instruments
IV. Organizational Factors: Physical	Undetermined Questionnaire
1. Spatial arrangement of school	
2. Arrangement of School facilities and equipment, etc.	
V. Organizational Factors: Time	Undetermined Questionnaire
1. No. days in school year	
2. No. hours in school day	
3. Temporal breakdown of school day, etc.	
VI. Organizational Interaction Factors	

Section 2, Part 2

ECONOMIC ASPECTS OF PROCESS SPACE

I. Cost Accounting System - Census

Anticipated information on enrollment, expenditures, and program objectives are necessary prior to the start of the school year so that they can be used as a planning device by vocational administrators at the state and local level. Before going into the cost accounting system, it will be necessary to ask the local cities and towns to estimate the amount of local, state, and federal funds they anticipate spending during the next school year. They must provide the source and amount of their anticipated expenditure for the coming school year - this represents dollar expenditure inputs into the IPPI model. It should be pointed out here that the expenditures at the local level not only include the expenditures made by the School Committee (Table I - State Year End Report), but also expenditures of other departments (i.e., Public Works) provided to the School (Table II - State Year End Report). Since there is no way of knowing what Table II expenditures will be until the end of the school year, it is possible that last year's figure could be used as a reasonable estimate.

The inputs for the cost accounting system-(census) are anticipated expenditures from all levels of government; enrollment information which must be broken down by sex, race, handicapped and disadvantaged students served, programs and program level; total number of teachers and teachers by program; expenditure of PL 90-576 by program, by school and by city or town. Also, anticipated year end performance objectives must be presented by programs, by program level, by school type and by city or town.

TABLE 5

Cost Accounting System - Census

Current Expenditures By Program:

a) Vocational Training Cost

- Salaries of vocational teachers (including those of related teachers' and department heads' salaries.	$ xx
- Supplies and textbooks	xx
- Operation and maintenance of plant expenditures (including related teaching areas)	xx
Total Current Expenditures - Vocational	$xxxxx

b) Academic Training Cost

- Administration expenditures	$ xx
- All instructional expenditures not included in (a) above, such as academic teaching salaries and salaries of substitutes, library, audio-visual, guidance.	xx
- Other school services	xx
- All operation and maintenance of plant expenditures not included in (a) above.	xx
- Fixed Charges	xx
Total Current Expenditures - Academic	$xxxx

Capital Expenditures By Program:

Implicit Rent (estimated by formula)	$xxxx
Total Program Expenditures (Summation of Current and Capital Expenditure)	$xxxxx
Average Cost Per Pupil (Total Program Expenditures Divided by Enrollment)	$xxx

The suggestion has been made in the Occasional Papers that the cost accounting system be kept simple for the census data. However, vocational administrators have stated that the reason why many of their day programs are high cost is that none of the day school expenditures are prorated to adult groups and MDTA groups which use the facilities after day school classes have terminated. A way to solve this problem would be to prorate the 4000 account (Operation and Maintenance of Plant) to the various groups who use the same facilities on the basis of their usage. Also, depreciation of equipment and building should be handled in a similar manner if several groups use the same facilities.

The above suggestion would make the gathering of census data slightly more difficult, but it would indicate to vocational administrators that MISOE recognizes the problem and it would also provide a bridge that vocational administrators could use in relating their individual programs to sample information. For example, to prorate operation and maintenance of plant expenditures to various educational groups, vocational administrators would first have to determine the square footage used by the program in relation to the whole school's square footage. Thus, if the electrical program's operation and maintenance of plant expenditure was $1000 and the day school program used the facilities 900 hours, and the adult program used the facilities 100 hours, the respective charges would be $900 and $100. This approach would also force vocational administrators to obtain floor space information before they had programs selected for use in the sample.

In the census, only current expenditures (1000-5000) should be concentrated upon. Past studies have indicated that teachers' salaries, including department head's salary, supplies, and textbooks account for approximately 70 per cent of total current expenditures with teachers' salaries alone being approximately 60 per cent of the total current expenditures. Thus, the direct allocation of vocational teachers' salaries (including those of related teachers' and department heads' salaries), supplies and textbooks to individual programs along with the allocation of operation and maintenance of plant expenditures to individual programs on the basis of floor space will account for the vast majority of current expenditures. Summation of these expenditures would provide an estimate of the current cost of vocational training provided. The remaining portion of current expenditures (i.e., administration, instruction expenses including academic teaching salaries, library, audio-visual, guidance, psychological services, educational television, other school services, fixed charges, and services of other city departments that can be classified as current expenditures) can be prorated to the individual programs on the basis of enrollment in the program. Thus, prorated current expenditures gives an estimate of the current cost of academic training provided by the school. (See Table I).

Capital expenditures (6000-9000) will be estimated in the census through use of a formula--there is no point in attempting to calculate accurate depreciation measures here. The current insurance value of building and equipment used in the educational process will be used to estimate implicit rent for using public funds for education instead of some other purposes, depreciation of building(s), and depreciation of equipment. T. Schultz, (Economist) estimates that 67 per cent of the total cost of vocational plant and equipment consist of building, 25 per cent for equipment and 8 per cent for land. He assumes buildings depreciate at 2 per cent a year and equipment depreciates at 10 per cent per year. Assuming a $3,000 insurance value on plant and equipment and a 6 per cent implicit rent, total capital expenditures would be calculated as follows:

Interest Charge	$3,000,000 x 6%	=	$180,000
Depreciation:			
Building	$3,000,000 x 67% x 2%	=	40,000
Equipment	$3,000,000 x 25% x 10%	=	75,000
	Total Implicit Rent		$295,000

Total implicit rent divided by total enrollment would give the implicit rent per pupil. The implicit rent per pupil times the enrollment of individual programs would provide the implicit rent per program. It would be the same for all day programs on a per pupil basis unless they shared the facilities with another group. Thus this method of estimating capital expenditures does not distinguish between the different equipment requirements of the individual programs. All it does is provide a rough estimate of capital expenditures. Also, the formula would have to be adjusted for use with regular high schools and comprehensive high schools because of the different mix of building and equipment used in their educational process. Total program expenditures can be determined by summation of current vocational cost, current academic training cost and implicit rent charges. (See Table I).

Obviously, instruments will have to be designed to obtain the necessary census data. Anticipated enrollment data and the number of teachers will be requested in July and corrected with real data in October. Information on program completors will be obtained by June 30 of the following year and information on real expenditures by August 1; they will be used to calculate the real cost of the program and the real cost of a program completor. Thus, the cost per program completor will be higher if dropouts occur in the program. Also, the real expenditure information should be gathered using the same format as that used in the gathering of anticipated expenditure of the previous year in order to avoid confusion on the part of the LEAs. It is also important that the source of funds used to finance each program (federal, state and local) be obtained. The same basic cost accounting format can be used for secondary and post-secondary because they usually meet 180 days in a school year during the day. However, with adult education and MDTA programs, the normal school year is not observed - they usually meet for only a fraction of the school year. This presents a problem in terms of proration of operation and maintenance expenses as well as depreciation expenses to these programs because charging off all of the above-mentioned expenditures to day school programs will tend to over state their total and per pupil cost while understating the total and per pupil cost of the adult and MDTA programs within schools with this mix of programs. Therefore, vocational educators should be warned of this potential problem. The MDTA program should be easy to handle since the Federal Government requires statement of costs and program completor information. Another problem that arises if we do not ask for a breakdown of program expenditures by level (i.e., 9, 10, 11, 12) is the fact that the ninth grade program is substantially cheaper than upper class programs because it is general vocational training and not the specific vocational training of the upper classes. This would tend to reduce the overall per pupil current cost for programs offering general vocational training and place them in a more favorable light than other programs that do not offer this training.

An interesting question that must also be considered is should program cost be adjusted downward for revenues earned by the program in the learning process? Also, if the printing program provided service to the city or town at cost, should we adjust cost downward based on some estimated cost saving to the city? These are interesting questions; however, it may be more realistic to adjust the sample total programs cost downward for revenues earned or cost saved.

Regular high schools should also be picked up on a sample basis so that estimates can be made regarding general academic training costs. General and college programs cost could be determined and compared to the cost of vocational programs. This would provide information on cost differences between educational alternatives. Also, it must be pointed out that business and career homemaking programs are taught in most regular high schools and are vocational programs.

Reports can be spun off the census planning data as the school year starts and from the real data at the close of the school year. Anticipated enrollment and expenditure data will be gathered in the summer and will be used to determine the estimated total program cost and average program cost. Actual enrollment information by program will be obtained in the fall of the year as the school year begins and can be used to calculate total program cost and average program costs on an adjusted basis (i.e., anticipated expenditures would be the same as before). The following summer data on the number of program completors will be obtained as well as actual program expenditure information. This will be used to obtain the actual cost of a program completor. Thus, state administrators will have information on the anticipated and real enrollment and expenditures by program, level, type of school offering the program, geographical area, and student characteristic.

Table VI illustrates a very basic attempt at presentation of Census Data in report form. The assumptions are that we are at the program level in a vocational school and enrollment, expenditure, and performance objective

TABLE 6

Census Report(s)

July 1, 1972

	Total	Per Pupil
I. Anticipated Enrollment - (Program)	20	
II. Anticipated Expenditures - (Program)		
Current:		
Vocational Training	15,000	750
Academic Training	5,000	250
Total Current Expenditures	$20,000	$1,000
Capital:		
Implicit Rent	10,000	500
Total Expenditures - (Program)	$30,000	$1,500
III. Anticipated End Year Performance Objectives-		
List In Total Space For Individual Program	#1,#4,#7,#9	

October 1, 1972

	Total	Per Pupil
I. Real Enrollment - (Program)	22	
II. Adjusted Expenditures - (Program)		
Current:		
Vocational Training	$15,000	$ 700
Academic Training - Based on Real Enrollment of October 1 For Whole School	5,280	240
Total Current Expenditures (Adjusted)	$20,280	$ 940
Capital:		
Implicit Rent - Based on Real Enrollment of October 1 For Whole School	10,780	490
Total Expenditures - Adjusted For Real Enrollment of October 1	$30,060	$1,430

June 30, 1973

I. Program Completors - (Program) 18

August 1, 1973

	Total	Per Pupil
I. Program Completors (From June 30 Data)	18	
II. Real Expenditures - (Program)		
Current:		
Vocational Training	$15,900	$ 883
Academic Training - Based On The Number of Program Completors June 30 For Whole School	5,400	300
Total Current Expenditures	$20,400	$1,183
Capital:		
Implicit Rent - Based On The Number of Program Completors June 30 For Whole School	9,900	550
Total Expenditures	$30,300	$1,733

information has been gathered throughout the year and fed into the computer as it becomes available. Thus, Table VI may be thought of as a computer printout for a vocational program at the various junctions Census Data will be gathered. It illustrates that differences occur in enrollment and program cost information over time. It should not be thought of as all inclusive in terms of variables needed for census information, this must wait for a later Occasional Paper.

Over a period of years time series information would be available such as changes in the type of student served in the state and within specific geographical areas; trends in the cost of providing the various programs of training by school type, especially current cost trends. It would also provide information of the changing performance objectives being used to train students in the various programs. This would give an indication of whether vocational administrators were using information from the management information system to move in the direction of providing educational training in the most efficient manner.

II. Cost Accounting System - Sample

The cost accounting system needed for the sample data will be more specific than that used for census data. It will be necessary to dig deeper into the individual programs selected in the sample. However, the same basic methods of cost allocation that were used in the census (i.e., direct allocation, floor space, enrollment and proration of joint costs)will be used in the sample. This is a necessity in order to maintain bridges between the census and the sample data so that vocational administrators can look at their programs and compare them to the sample programs and vice versa.

Prior Occasional Papers stated that cost data must be developed for expenditure information which costs out data not only by program but by behavioral objective. We must therefore determine how much money was expended on a group of students who set out to learn a particular behavioral objective. Little, if any, program costs are available for vocational education in Massachusetts at the present time. Thus, before we can attempt to determine the total cost or average cost of a behavioral objective in a particular program, we must be able to determine the total cost and average cost of the individual program.

Assume we are now costing out a particular program (i.e., auto mechanics) at a particular level (i.e., 10th grade) in a particular vocational school, comprehensive high school, junior college, etc. Current cost (1000-5000) will be classified as one of three basic types:

1) DIRECT ALLOCATION

These costs represent expenditures that can be directly attributable to a particular program.

TABLE 7

PRORATION TABLE

PROGRAM X		PRORATION METHOD OBJECTIVE	B.O. #1	B.O. #3	B.O. #6
TOTAL COST	$62,000		$35,000	$15,000	$12,000
2300 Teachers' Salaries		Time			
2100 Dept. Heads' Salaries		Time			
2300 Teaching Supplies and Materials		Use			
2400 Texbook Supplies and Materials		Use			
2600 Audio-Visual Supplies and Materials		Use			
4100 Custodial Services		Time			
4120 Heat		Time			
4130 Utility Service		Time			
4220 Maintenance of Building(s)		Time			
4230 Maintenance of Equipment		Time			
Depreciation of Equipment		Use			
Depreciation of Building(s)		Time			
Interest Charge		Time			

2300 - Teachers' salaries of vocational teachers only. Only those teachers directly assigned to instruction in vocational programs. Salary of related teachers would be picked up here.

2100 - Department Heads' Salaries - This must then be prorated to the 10th grade program on the basis of enrollment compared to total students in the 9th, 10th, 11th and 12th grade auto mechanics program.

2300 - Teaching Supplies and Materials - Any miscellaneous supplies not directly associated with a program would not be entered here.

2400 - Textbook Supplies and Materials - Except for any miscellaneous books or materials not directly associated with a particular program.

2600 - Audio-Visual, Supplies and Materials - Only if audio-visual is directly used in the educational process of this program. If not, it is entered elsewhere.

4230 - Maintenance of Equipment - Only if repairs were done on equipment used in this program.

2) FLOOR SPACE

These costs represent expenditures which are related to the space used by the program in performing the educational process. This includes the shop as well as the related instructional areas, if any.

4110 - Custodial Services

4120 - Heat

4130 - Utility Service (excluding telephone service which will be entered elsewhere)

4220 - Maintenance of Building(s)

It is necessary that each school in the sample determine the percentage of floor space used by this program and the breakdown of total floor space into academic and vocational areas.

As mentioned previously, if MDTA or adult education groups use the same facilities as day school students, then a proration of total expenditures must take place between day school and the other program. The adjustment factor would be the percentage of total utilization time the various groups used the facilities.

3) ENROLLMENT

All other current expenditures (1000-5000 accounts) not recorded elsewhere would fall into this area and be prorated to the individual programs on the basis of program enrollment. Examples would be administration expenditures, academic teachers' salaries (excluding the salaries of teachers handling related vocational subjects), substitute teachers' salaries, principal's office expenditures, library, guidance services, other school services, maintenance of grounds and fixed charges.

The enrollment for each program must be determined and divided into the total expenditures to be allocated on this basis in order to provide a per pupil charge. Multiplication of this per pupil charge times the enrollment of the program would provide the expenditures prorated to the program on the basis of enrollment. The represents the cost of academic training incurred by the program. It must be pointed out that the cost of teaching related areas of vocational programs would be picked up under direct allocation and floor space. Related training should be considered a part of vocational training, and not academic training. Normally, students spend alternate weeks in class and in the shop. Thus, if we assume that the related area represents 20 per cent of academic classroom time, (time not spent in the shop) the day vocational programs would absorb 60 per cent of a student's time with the academic area representing about 40 per cent.

In many of the post-secondary programs, as well as the MDTA and adult programs, all of the student's time is spent in learning experiences directly related to vocational education. Therefore, all expenditures associated with these programs would be vocational in nature. Current expenditures (1000-5000) incurred in a particular day school program would be determined by summation of expenditures by (1) Direct Allocation, (2) Floor Space, and (3) Enrollment to the program. Direct allocation and floor space expenditures to a particular day school program would represent the cost of vocational training; enrollment expenditures of the particular program would represent the cost of academic training. For post-secondary programs which provide academic as well as vocational training this same procedure would be used to determine the cost of vocational training and academic training.

Capital expenditure charges for a particular program could be determined by computing an implicit rent by using the same technique as in the census with minor adjustments. For instance, depreciation would be based on the historical cost of physical equipment used to provide training in the individual program. Schools do maintain an inventory of equipment even though most of them do not calculate depreciation. A 10 per cent rate of depreciation is suggested by T. Schultz based on a national sample of vocational schools. Thus, $50,000 of physical equipment less than 10 years old in program X would require a $5,000 depreciation charge--equipment over 10 years old would be considered to be fully depreciated. Depreciation of building would be based on insurance value of building(s) and the assumed depreciation rate would be 2 per cent (i.e., based on a 50 year life); the depreciation charge for the particular program would be determined by a proration based on the floor space contained within the program to total vocational floor space. For example, if program X had 3,000 square feet of floor space out of a total of 30,000 square feet for all vocational programs, they would absorb 10 per cent of the depreciation of the building(s). An interest charge of 6 per cent could then be determined for use of public funds based on the value of equipment and building assignable to this particular vocational program. A problem exists here in that no implicit rent has been calculated for the academic training provided (i.e., 40 per cent of the student's time. This will have to be estimated based on the plant and equipment used for academic training. The summation of current expenditures (1000-5000) accounts), depreciation of equipment and building, as well as an interest charge for the use of public funds, on an individual program basis will provide total program cost and the average total cost of the program on a school year basis. The 1000-5000 accounts can be considered variable costs (i.e., costs which vary with the level of production). This may not be true for all items, and the depreciation and interest charges can be considered fixed costs (i.e., costs which do not vary with the level of production).

It is probably now apparent that the cost accounting system described here for the sample is loaded with definitional and calculation problems. However, movement towards simplification may be at the expense of rigor. Suggestions are welcomed for the improvement of this problem area. The human factors, physical factors and organizational factors at the school and program level in process space should be able to provide much of the necessary information for the cost accounting system for the sample. For instance, the number of teachers and enrollment in a program (i.e., 10th grade-auto repairs) floor space in square feet, supplies used, equipment maintained within the program, pupil-teacher ratio, etc.

Once the total vocational cost of a particular program has been determined (including the breakdown into the various expenditure classifications), it is possible to move down to cost out individual behavioral objectives within the particular program. Process space should be able to provide the following information at the behavioral objective level:

- number of students enrolled in the various objectives.
- number of teachers and the number of hours (time) spent in teaching during school year as well as hours (time) spent in teaching individual objectives.
- floor space of the vocational program used to teach this behavioral objective.
- equipment mix used, if any, to teach the individual objectives (i.e., how many lathes, etc.).
- supplies and textbooks, if any, used in teaching individual objectives.

The assumptions here are that the objectives chosen by vocational administrators to be taught in a particular program represent the work of the school year and that the time spent in teaching a behavioral objective can be determined precisely. Thus, if school is in session 180 days and the vocational program facilities are used 5 hours per day, a total of 900 hours represents the time devoted to vocational training. Therefore, the time devoted to behavioral objectives chosen in a particular program would total 900 hours. Assume Objectives #1, #3 and #5 are selected to be taught in a particular program during a school year. Objective #1 requires 450 hours; #3 requires 300 hours; and #5 requires 150 hours. The simplest solution to the determination of the cost of each objective is to assume a proportional relationship between the time spent on teaching an objective and total program cost. Thus, Objective #1 would pick up 50 per cent of total program costs; #3 - 33 per cent; and #5 - 17 per cent. This approach may be appropriate for teachers' salaries, expenditures prorated on the basis of enrollment, operation and maintenance expenses, depreciation of building and interest charges. However, supplies and textbook expenditures, as well as depreciation expenditures for equipment should vary with the objective being taught. For example, some objectives may require large amounts of supplies compared to other objectives; some objectives may require the use of <u>all</u> the equipment of the program whereas others require little or no equipment.

A decision must be made as to what methods will be used to allocate program costs to the objective levels. The suggestion here is that all program costs other than supplies and textbooks and depreciation of equipment be prorated to the behavioral objectives on the basis of time spent teaching the objectives; supplies and textbooks should be prorated to the behavioral objectives on the basis of use. Depreciation of equipment should be prorated based on the equipment mix used in teaching a particular behavioral objective. For instance, assume total equipment of the program is $50,000 and depreciation is calculated at 10 per cent per year; thus, the annual depreciation charge is $5,000. Assume that behavioral Objective #1 requires $10,000 of equipment and is taught for 20 per cent of total day school time. The depreciation charge to Behavioral Objective #1 would be ($\$5,000 \times \frac{10,000}{50,000} = \$200$). Even this approach presents a problem. For instance, what objective should absorb the cost of the unused equipment (i.e., in #1 above, $40,000 of equipment is unused while the training in Behavioral Objective #1 is going on)? A simpler method would be to determine how much equipment is used in teaching each behavioral objective and prorate the annual depreciation charge to the behavioral objectives on the basis of the value of equipment used. For instance, Objective #1 used $10,000 of equipment; Objective #2 - $20,000 and Objective #3 - $30,000. Thus depreciation charges to Objective #1 would be 1/6 x $5,000 or $833; Objective #2 - 2/6 x $5,000 or $1,667 and Objective #3- 3/6 x $5,000 or $2,500. This same method could be used for operation and maintenance expenditures if less than the total vocational floor space is used to teach behavioral objectives.

Ultimately, total vocational program costs will be broken down into the total cost of teaching the behavioral objectives within the program. Thus, each of the expenditure items making up the cost of a particular behavioral objective (i.e., teachers' salaries, supplies, depreciation, etc.) (See Table I), would be determined on an hourly basis by dividing by the time required to complete the objective. For instance, $5,000 of teachers' salaries is required to complete a behavioral objective which takes 100 hours to teach. Therefore, the cost of teachers' salaries on an hourly basis for this objective is $50, (i.e., $50/hour). The cost per student per hour for a behavioral objective could be determined by dividing total cost of the objective by the number of students enrolled (i.e., average total cost) and dividing this by the numbers required by the objectives.

The cost accounting system previously described has been used to calculate the total cost of an individual program (both vocational and academic) and also the breakdown of total vocational program costs into the total cost of the various behavioral objectives within the programs. Ultimately, it has been shown that a per hour charge can be determined for each expenditure item as well as a per student per hour charge. This cost accounting system requires that each program selected in the sample be investigated in great detail. The MISOE staff and consultants must determine whether this system meets their needs. This system is adaptable to change and suggestions are welcomed.

The sample cost accounting system described here does have bridges with the census cost accounting system described previously in terms of individual items (i.e., teachers' salaries, supplies and textbooks, operation and maintenance of plant, total current costs and average total current cost). However, capital expenditures will not be very comparable between the census and sample information because of the generalization of census information and the specification of sample information.

Section 2, Part 3

PRODUCT SPACE

The purpose of this section is to describe product space such that resident and consultant staff, (and others) can critically examine these specifications and so that analysis stipulations of future Occasional Papers can reference these determinations. Product data is fundamental to the two major analysis types of MISOE, i.e., process-product and product-impact. In addition, product data is a sensitive data element in that it constitutes the behavioral specifications for an educational process. Therefore, product data will be considered in some detail, which at times might burst the boundaries of static space.

A Definition

Product data is information which describes the outcomes of an educational experience or process. Product data can be gross and simply list the numbers of students completing an educational program or product data can be specific, and detail skills, knowledge and attitudes attained by prescribed student types completing particular educational programs. Validity is a concept associated with the positive relationship between the explicit objectives of a program and the product information or data which attempts to describe program outcomes. Validity is a concern with specific product data, although both specific and gross product data are useful and will be employed by MISOE.

Purpose of Product Data

Product data is a crucial management tool to the professional educational manager, who, consistent with the management model fostered by MISOE, is both responsible and accountable for the selection of specific product data and the mix and number of gross product data (see Occasional Paper #6). From an accountability perspective, policy makers (see Occasional Paper #6) would be interested in product data (including both the selection of specific and gross objectives and objective achievement), even though their basic responsibility is impact goal and input standard determinations. Policy makers would also be vitally concerned with the results of product-impact analysis resulting from both gross (between competing programs) and specific (within particular protrams) product data. However, this section deals only with product data; analysis distinctions and relationships are pursued at some length in Occasional Paper #6.

Gross product data is necessary to the educational manager for the range of decisions which assign students to competing programs (or mixes among competing programs) like occupational education, academic education or general education. Such information is also useful for decisions assigning students to alternative occupational education programs. [(It should be pointed out that product-impact analysis is essential to these determinations (see Occasional Paper #6)].

Specific product data is useful to the educational manager for the range of decisions which initiate educational process elements and mixes for particular student types attempting to determine a set of performance objectives.* Specific product data is also of use to the educational manager to estimate the relationships among patterns of achievement and configurations of impact, for specified input or student types.

Since MISOE is focused on occupational education, specific product data will be developed for each occupational education program, while gross

*A performance objective describes a specific skill, knowledge or attitude to be sought by students within an educational program.

product data will be evolved for major educational program types, including general and academic. Further, general educational development product data will be determined for secondary and post-secondary schools (see product data design in Summary of this section of this Occasional Paper). The information will allow an estimation of general educational development between schools offering occupational and academic education mixes and schools offering only academic or general education. Such information should be useful in estimating the academic or general education lost, if any, for occupational-academic education mixes, and the relationships between these mixes and impact goals.

The purpose of product data within MISOE could be summarized as a management tool which:

1) Forms a basis to set standards and allocate resources for process elements and mixes for specific student types seeking prescribed performance objectives within occupational education;
2) Provides an information base to describe the effectiveness of occupational education in terms of specific impacts on local, state and national societal goals such that differences within occupational education programs and among occupational education and competing educational programs can be ascertained.

An Assumption - An assumption underlying the product data of MISOE (particularly specific product data) is that the educational process is basically an experimental process subject to improvement through empiricism. Such a view of the educational process suggests that both process and product should not be conceived as fixed, but that educational managers must continuously probe for more effective ways to attain specified, educational product. Since experimentation requires freedom of choice, constrained only by knowledge, societal values and budget, product objectives must not be over-prescribed (nor must process elements). Rather product objectives (and process elements) should be selected by educational professionals, in light of existing knowledge, and product data must be able to treat the simultaneous existence of multi-product standards across schools. If the price of product data is a single set of standards for educational programs, it is far too high.

Therefore, MISOE will offer an array of product alternatives (performance objectives) for selection and develop information about input, process, product and impact relationships within this constraint. Educational managers will, of course, be accountable for these selection decisions, in view of knowledge, and over time it is expected that considerable evidence for specific process elements and product objectives, by student types, will be developed. Such evidence should influence decision making on the part of the educational professional. Finally, it is acknowledged to be comparatively difficult to construct a flexible specific product data tool, often requiring the development of unique testing and analysis procedures. However, an educational management system capable of being both supportive of growth and responsive to the socio-political variance prevalent in Massachusetts and America cannot afford the deceptive luxury of simple solutions for complex problems.

Specific Product Data

This section will examine specific product data types of MISOE, i.e., information which describes the knowledge, skill and attitude production of occupational education. Specific product data will describe end program capabilities, by occupational education program, i.e., students will be measured only at the completion of a specific program at the secondary, post-secondary or adult level. Further, specific product data will be generated only from a representative sample of occupational programs across schools, types and levels and geo-political divisions, in Massachusetts. (Product data may be obtained on promising programs outside of the sample, and developed for any occupational program in Massachusetts independent of MISOE, see Occasional Paper #1). The fit of specific product data in the total MISOE design is explored in Occasional Paper #6, however, the connectiveness of all MISOE sample data across all IPPI elements discussed in Occasional Papers #1 and #2 should not be forgotten in dealing with specific product data.

Occupational education programs in Massachusetts have been classified into blocks (divisions) and units*. Performance objectives are being evolved for specific occupational education programs, by unit. For example, Electronics has been divided into the following blocks: Passive Circuits; Active Circuits; Electronic Systems and Shop Practices. An example of units within a block would be (Active Circuits); Active Devices; Amplifiers, Oscillators; Detectors; Power Supplies; Pulse Circuits; Integrated Circuits; Transducers and Test Equipment. A broad array of performance objectives within units will be available in a form such that they provide for the easy selection and communication of standards by specific occupational programs. (Performance objectives will be coded across programs and it is anticipated that new occupational programs, many of which will offer less specific alternatives for the achievement of comparable end program competencies within specific programs, will be structured by blocks and units). The following section will treat specific product data which describes non-affective outcomes, i.e., psychomotor or cognitive capabilities. Affective product data will be described below.

Psychomotor or Cognitive Product Data - Each occupational education program treated by MISOE will be described by a series of performance objectives which

*The Evaluation Service Center for Occupational Education is supposed to develop block and unit classifications for 16 occupational education programs (and performance objectives for these programs) by June 30, 1972.

stipulate specific skills and knowledges sought by a program. Specific product data will be criterion-referenced, in that it will describe achievement by discrete performance objectives offered by a school, which is to say that the product data will faithfully (or validly) represent real objectives. Although specific product data only deals with program completors* or with the conglomerate of performances which describe the occupational capability of a program completor, process information records the sequence of performance objective attainment within programs for process-product analysis.

Specific product data for psychomotor and cognitive outcomes will be pass/fail, i.e., either the student can demonstrate competencies by specific performance objective within a unit, block and program, or not. (Obviously, the performance objective stipulates the conditions and extent of the performance such that this go or no go determination is possible).

Since the design for MISOE deals with the natural order of events and attempts to develop information within this constraint, specific product data must treat the simultaneous occurrence of multi-standards across programs, within the sample. As a result of this condition, a substantial proportion of performance objectives will be shared by many programs, while many performance objectives will be common only across a few programs within the sample. The significance of this diversity impacts squarely on process-product analysis, but must be considered in a treatment of specific product data.

The determination of pass/fail by performance objective within occupational education programs is a function of measurement. Students within the sample will be observed by MISOE at program completion (with school

*Gross product data allows for the analysis of the comparative impact of noncompletors among occupational and non-occupational education.

confidentiality maintained). Measurement will take the form of observation of performance by objective (with TV tape to control for interater reliability), work samples, and paper and pencil tests (mostly existing) for cognitive performance objectives. This information will allow for the determination of pass/fail by program completor and objective within the representative sample. The criteria for pass/fail determinations by performance objective within program will be published annually, allowing for the treatment of promising or questionable programs by the state, as well as for replication analysis by local schools.

Specific product data provides a basis for the professional educational management to deal with two important questions:

(1) What is the maximum output from a given level(s) of support;

(2) What is the least cost process most likely to achieve specified output.

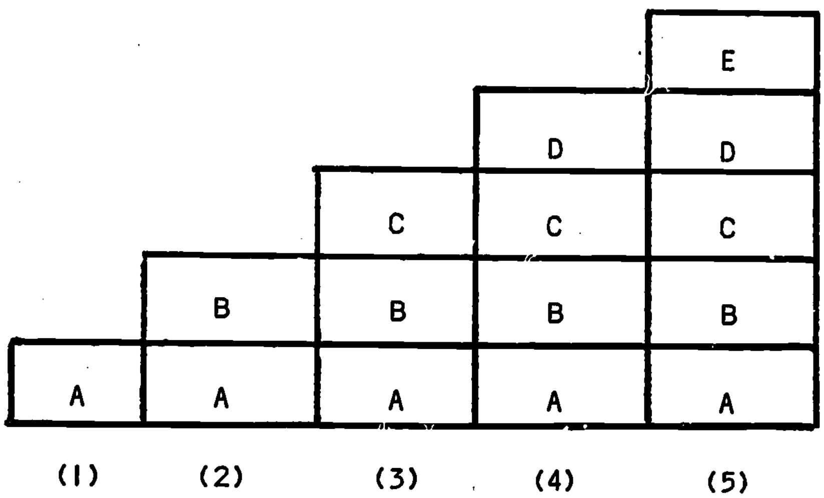
Specific product data will be examined from these two perspectives, in order, beginning with the concept of maximum output for fixed levels of funding. In terms of specific product, levels of output can either be determined by increasing numbers of students with a constant level of attained performance objectives, or by maintaining a constant number of program completors, while increasing the number of attained performance objectives. For example, one could think of increasing educational production by increasing the number of program completors with the same knowledge and skill configuration, or by increasing the skill and knowledge capability of the same number of students, or both, i.e., increasing both the numbers and capabilities of program completors.

A first analysis of pass/fail, criterion referenced, specific product data will be to determine scales through analysis, based on the qualitative scale process of Louis Guttman*. Essentially, a Guttman scale is a process to determine if it is possible to derive from a distribution of a quantitative variable a pattern such that each separate pattern element is a simple function of a unique quantitative variable, or scale variable. The ordering of objects according to the numerical order of the scale variable or score describes the objects scale order. There is an unambiguous meaning to the order of scale scores, and the objects with higher scores are higher than lower scaled objects on each attribute.

Consider the following example in Figure 3.

FIGURE 3

Guttman Scale Example



* Guttman, Louis, "American Sociological Review", 1944, 9, 139-150.

If A, B, C, D and E represent units of common objectives within a block (85% scales can be used as approximations of perfect scales), or blocks within a program or objectives within a unit, then, for example, whatever 2 stands for is associated with whatever I stands for plus B, and so on.

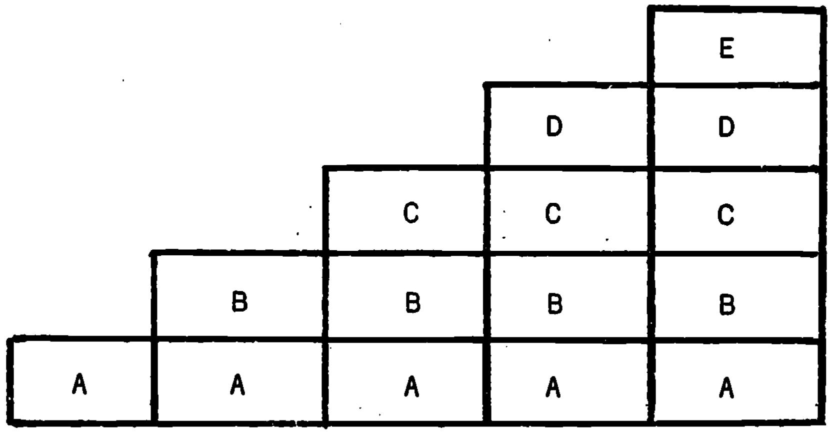
To explore scaling and product data requires dealing with input, process and product relationships, which is creeping out of static space. However, these relationships are only examples, and Occasional Paper #6 treats these relationships in considerably more detail. As previously discussed in this Occasional Paper, a process mix is comprised of a blending of process elements or variables (human and physical factors) for particular students seeking prescribed objectives, while an input mix describes unique configurations of student types.

Therefore, analysis attempts to determine if objectives, units or blocks can be scaled on process mixes or input mixes. The objects scaled (A's, B's, C's, D's or E's) can either be increasing number of students, holding performance objectives constant, or increasing numbers of performance objectives, holding students constant, or both.

Figure 3 provides several examples of scaling criterion referenced, pass/fail, specific product data.

FIGURE 4

Constant Inputs - Variable Process Mixes - Students Constant



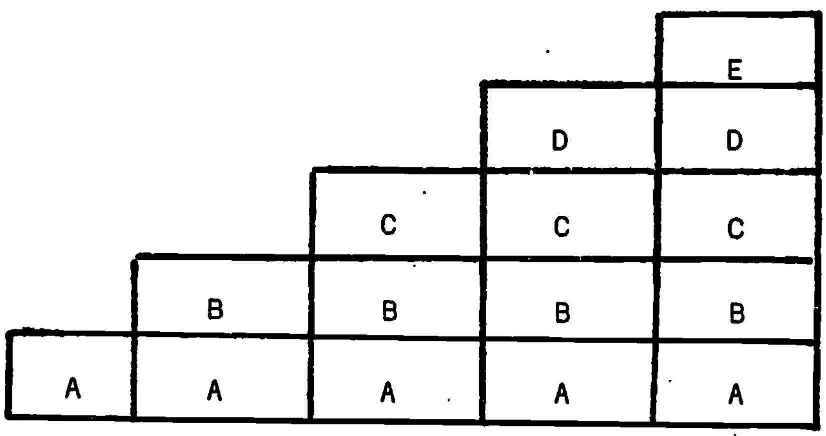
Input Types (1) (1) (1) (1) (1)

Process Mixes (1) (2) (3) (4) (5)

Figure 4 displays a scale which depicts 5 different process mixes (within the same program), treating similar types of students and yielding the same number of completors, with scales or incremental capabilities, by performance objectives, units or blocks. For example, process mix 4 produces everything that process mixes 1, 2 and 3 product, plus D, which could be 2 more units within a block.

FIGURE 5

Constant Process - Variable Inputs - Objective Constant



Process Mixes (1) (1) (1) (1) (1)

Input Types (1) (2) (3) (4) (5)

Figure 5 shows that for input type 4, process I produces A, B, and C number of students, plus D. Figure 6 displays a more complex example in which the scaled units represent both increasing numbers of students and objectives.

FIGURE 6

Scaling By Numbers of Program Completors and Objectives Attained

					E(1)(2)
				D(1)(2)	D(1)(2)
			C(1)(2)	C(1)(2)	C(1)(2)
		B(1)(2)	B(1)(2)	B(1)(2)	B(1)(2)
	A(1)(2)	A(1)(2)	A(1)(2)	A(1)(2)	A(1)(2)
Input Types	(1)	(1)	(1)	(1)	(1)
Process Mixes	(1)	(2)	(3)	(4)	(5)

In this example, process mix 3 produces at least as many program completors as process mixes 1 and 2 for student type 1, (first subscript) and more performance objectives than process mixes 1 and 2 (second subscript).

If process data does not scale, then the following classification system for non-scalable objectives could be used to analyze specific product data.

FIGURE 7

Classification of Non-Scalable Objectives

	Objective 0	Objective 1	Objective 2	Objective 3	Objective 4	
Increasing Powers of 2	2^0	2^1	2^2	2^3	2^4	Unique Pattern Number
Powers of 2	0,1	0,2	0,4	0,8	0,16	
						0
	X					1
		X				2
	X		X			3
			X			4
	X		X			5
		X	X			6
	X	X	X			7
				X		8

This classification system provides a unique number for each separate pattern of objectives attained by students within a unit (X means an attained objective, while the rows represent students). For example, in unique pattern number 5, students achieved objectives 0 and 2. Unique patterns are a function of providing a column for each objective and assigning an increasing power of 2 to each column and summing the evaluation of the power of two for each corresponding objective attained. For example, unique pattern #6 is a function of 2^2 (4) and 2^1 (2). Notice that an X in a column indicates passing a specific objective, i.e., students in row 7 attained objectives 0, 1 and 2. A characteristic of summing increasing powers of two as displayed in Figure 7 is that such a process will always result in a unique number. (This device will only be used at the unit level, however, as OE codes and unit codes developed by ESCOE allow for identification beyond the unit level).

The classification system for non-scalable objectives allows a search, through analysis, for the process and input mixes associated with patterns of objective achievement. Such analysis will specify the combination of process and impact mixes which account for differential or staggered output, and will suggest variable process and input mix alternatives to maximize output.

In general, analysis for least cost process mixes to achieve fixed output for specified inputs requires that common objectives be isolated across programs, and then an analysis search for the least cost process mix be instituted. Figure 7 displays a useful way to conceive of specific, pass/fail, criterion-referenced product data for this purpose.

FIGURE 8

Common Objectives Across All Schools

Program I

Block I	Block 2	Block 3
Unit (I - 3)	Unit (I - 3)	Unit (I - 3)
Objective (I - 2)	Objective (I - 2)	Objective (I - 2)

Common Objectives at Program Level = 18 Across 10 Schools

Figure 8 displays a situation in which a program includes 3 blocks, 3 units per block and 2 objectives per unit (18 common objectives) across 10 schools. (Some objectives will be common across all schools and some will be common only for a few schools). Through analysis, it is possible to determine which process elements are most efficient in terms of numbers of students, number of objectives per students, or both. For this purpose, specific, pass/fail, criterion-referenced product data can be displayed by both number of program completors, and average number of objectives attained by a student or group of students. Such a treatment of the data would allow for an expression of range, i.e., a standard deviation. For example, in the situation presented in Figure 8, the following range exists:

Objective level	0 - 1
Unit level	0 - 2
Block level	0 - 6
Program level	0 - 18

Specific product data for schools 1 - 5 might be displayed as follows (at the block level):

Schools	1	2	3	4	5
$\overline{X}$	5.2	4.2	3.1	2.1	4.8
sd	1.1	2.2	1.1	0.1	2

At the block 1 level, school 1 is producing a comparatively efficient and uniform product, while school 4 is producing, fairly consistently, a product which is meeting less than half of the standards. On the other hand, school 2 is producing a product with wide variation, and probably doing a very good job for about one half of its students. Such product information can be analyzed by specific student types, within programs. This information allows for the estimation of the least cost (in terms of time and money) process mix for a specified input mix for common objectives. For example, assuming a similar input mix and constant time, school 1 has something to say to schools 2 - 5. Such analysis would have to consider number of students or program completors (time is a process element).

<u>Affective Product Data</u> - Up to this point, specific product data has been limited to psychomotor or cognitive capabilities, i.e., behavior which is characterized as mostly intellectual or physical, or both. Frequently, attitudes, i.e., a consistent positive or negative feeling toward an object, person or idea, are important and legitimate product objectives. Examples of so-called affective or attitude objectives within occupational education might be: that students will have a positive attitude toward themselves as a competent worker and work as a socially desirable and necessary activity. Often schools consciously structure the educational process (and the institutional reward system) such that specific attitudes or value systems (sets

of attitudes) are attained by students. It is very likely that these so-called affective product objectives account for some impact goal attainment. For example, it would seem likely that a student with a favorable self-concept would be more likely, on the average, to obtain a job than an equally skilled but insecure counterpart.

Terminal or end program affective objectives will be included as specific product data. The objectives will be determined in the same manner as psychomotor or cognitive objectives for occupational programs and will be available for analysis. The following section is designed to stipulate a structure for affective product data for MISOE. The assumption is, of course, that affective objectives are stipulated by program and can be referenced to specific process elements.

Affective product objectives and data describing affective achievement will be treated separately from psychomotor and cognitive performance objectives within programs. Affective objectives will be determined by program and will reference process elements and, of course, be connectable across all IPPI elements. They will not necessarily reference blocks and units within programs, but will be structured to allow across program comparisons.

In general, within department faculties will stipulate specific objects, ideas and persons toward which the program is designed to encourage the "internalization" of a positive or negative feeling. Descriptive data will allow educational managers to estimate the degree to which these affective goals are achieved, while analysis will suggest which process elements within and across (when appropriate) programs contribute to affective objective attainment. Further, product-impact data will indicate the comparative relationship between affective objective achievement and impact goal accomplishment, both within and accross programs. For example, it might be that a wide range of cognitive and psychomotor variance makes little difference in terms of certain impact goal attainment, given certain levels of affective objective attainment, i.e., there might be no difference in impact goal achievement for students with positive self-concepts but varying levels of psychomotor or cognitive capability achievement. The management model fostered by MISOE stipulates that the affective objective specification is the function of educational management, consistent with impact goals. (Although the question of human values is pertinent at this point, it is beyond the scope of this paper. It is sufficient to say that affective objectives stipulated by professional educators cannot be inconsistent with the societal value system, and these constraints must be made clear by policy makers).

In most instances, affective product data will be obtained by a Likert scale and a semantic differential, or both. These scales permit a statement of an arithmetic mean score which describes a group attitude score toward a person, idea or object. This average score can be classified to represent a positive or negative attitude toward an object, person or idea on the part of a class or within program subclasses of students. Such average scores, along with measures of range, allow for analysis within and across programs, as well as for straightforward comparative descriptions.

Figure 9 displays an example of affective product data for a single objective, for example, the attitude of program completors in two separate schools toward the concept of "following orders at work".

FIGURE 9

Fudge Affective Data For School A & B

Weight	Very Unfavorable 1	Unfavorable 2	Mixed 3	Favorable 4	Very Favorable 5	T
Enrollment						
School A	5	5	10	15	65	100
School B	35	20	10	3	2	70
Scores						
School A	5	10	30	60	325	4.3
School B	35	40	30	12	10	1.8

Enrollment rows describe the number of students who fall in one of five categories determined from a score on either scale, Likert or semantic differential. The scores of the bottom two rows are a result of multiplying the number of students by the weights of row I, ranging from I for very unfavorable to 5 for very favorable. T represents the total number of students, while $\overline{X}$ expresses the average resulting from dividing the number of students by school into the sum of the weighted scores for a school (or any subelement). From inspection, it would appear that School A (in whatever program represented) fosters significantly more favorable attitudes towards the concept of "following orders at work" than School B.

Summary

As a way of summarizing product data, each product data type discussed in this section will be referenced to the two major functions of product data stipulated in the beginning of this presentation.

> "The purpose of product data within MISOE can be summarized as a management tool which:
>
> (1) forms a basis to set standards and allocate resources for process elements and mixes for specific student types seeking prescribed performance objectives within occupational education;
>
> (2) provides an information base to describe the effectiveness of occupational education in terms of impact on specified local, state and national societal goals such that differences within occupational education programs and among occupational education and competing educational programs can be ascertained."

Purpose I - Purpose I decisions are made by professional managers of occupational education and require specific, pass/fail, criterion-referenced product data by program, as well as gross product data describing the number of program completors. (All data in the sample is connectable across all IPPI elements). Examples of these decision types have been presented in this section. Such decisions are a function of process-product analysis, and seek to determine the least cost process mix for a specified input mix or the process mix which maximizes output for fixed levels of input. These decisions describe an important range of responsibility for which the professional educational manager should be held accountable.

Purpose 2 - Purpose 2 decisions are made by legislators, school boards, and educational managers, responsible for occupational education as well as non-occupational education programs (including the determination of occupational-non-occupational education mixes). Such decisions require all types of product data, i.e., specific, pass/fail, criterion-referenced product data and gross product data, including numbers of program completors by occupational and non-occupational programs, and data describing general educational development of occupational and non-occupational program completors*. Also, information is required about the attrition rates of all programs. (This section is focusing on product data and Purpose 2 decisions, but for a full treatment of decision making see Occasional Paper #6). The major analytical data type for Purpose 2 decisions is product-impact data, which will not be expanded upon here (see Occasional Paper #6).

Purpose 2 decisions and product data types will be explored hierarchically, from legislators downward.

(1) Given specific societal goals** legislators have the responsibility to determine which agencies (governmental or propietary) are most likely to favorably impact on these goals at the least cost to society. From a legislative perspective, education is one competing social service. Typically, legislators are concerned with all types of gross product data (as well as results of cost-product-impact analytical data). They might have some interest

*As stated in Occasional Papers #1, MISOE will maintain gross product data and information required for cost-impact analysis on a sample of non-occupational education students at appropriate levels.

**Unless legislators develop explicit, measurable and visible societal goals (1 yr., 2 yrs., 5 yrs., etc.), it is simply not possible to hold service agencies accountable.

in specific product data, but only as an indicator of gross, quality control. For example, legislators would like to know the relative impact of occupational education (by program) and non-occupational education on the productivity of Massachusetts, when measured by such indicators as unemployment, average and aggregate income, balance of payments, etc. This information takes the form of cost impact data and allows for comparison of returns from investments in education (including within educational programs like occupational education) and other services, for example, policies which might attract skilled labor educated out of state. Typically, legislators are concerned with education and non-education alternatives, while educationalists are expected to provide the best mix of educational programs to meet societal goals, at least cost.

(2) Overall educational policy makers are responsible for cost-impact comparisons for competing educational programs in light of societal goals. For example, they would be concerned with the relative effectiveness of occupational and non-occupational education (costs and benefits), i.e., they determine the occupational and non-occupational education mix. Overall educational policy makers would also be interested in comparative measures of general educational development between occupational and non-occupational education and various occupational and non-occupational education mixes, to estimate the opportunity lost, if any, as a result of occupational education, in light of specified societal goals for education.

(3) Occupational education managers would be interested in gross product data among occupational education programs, as well as specific, pass/fail, criterion-referenced product data. In the first instance, it might be found that certain types of occupational programs yield favorable cost-impact ratios, in light of societal long and short range goals, when compared to

other program alternatives. In the second instance, it might turn out that there is considerable cost-impact variation within a specific occupational program, say automotive mechanics at the secondary level, and students who excel on definable units within the electrical block, taking various student characteristics into account, do consistently better in terms of impact criteria than those within auto mechanics who do poorly on this unit.

Finally, MISOE is only concerned with developing product data within the representative sample (see Occasional Paper #1). Such information is of value from a state or regional perspective for product and process determinations, within process allocations, input assignments, or as a basis for describing occupational education effectiveness. In addition to allowing for these comparisons, product data within the sample allows for a description of the aggregate product of occupational education within Massachusetts, by program or within programs, and, in these terms, across programs. Such data could either be by percentage of objectives attained or an average number of students achieving objectives, within units, blocks and programs.

As described in Occasional Paper #1, MISOE will not provide product data to each LEA, although each LEA will be required to submit standards describing product goals by program. It is therefore necessary for the LEA (or the SEA) to measure product in each LEA and make comparisons to the sample. Obviously, such activity should be encouraged. This information at the LEA level allows local management to capitalize on the analytical information of MISOE. Further, LEA findings might be such that MISOE should replicate product measurement for a larger consumption. This topic is treated more generally in Occasional Paper #6; however, it seems appropriate at this time to stipulate the fundamental nature of MISOE analytical data.

For such information to be of maximum usefulness to local management requires sufficient talent on the part of the LEA so that they can replicate measurement. Clearly, it is the function of the SEA to structure a supportive reward system which is likely to facilitate the development of appropriate management attitudes and skills.