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THE OPTIONS FIELD METHODOLOGY FOR DESIGN

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Background

The "Options Field" methodology for design was invented by the present author during a project carried out for the Office of Education. In this project it was found that there was a need for a method of design that exhibited a collection of characteristics that no known method of design offered.+ Specifically, it was intended that the method would have all of these characteristics:

- Offer a systematic way to portray a finished design
- Offer a systematic way to develop the background for doing a design
- Be suitable for a group of people to use when working collaboratively, with help from a skilled facilitator and computer programs designed to keep track of the status of the design at all intermediate points in its evolution
- Take into account interdependencies among design dimensions
- Specifically account for the "Law of Requisite Variety" set forth by Ashby as a necessity to be satisfied in design
- Present the design in outline form on one large display, capable of being updated as it is developed
- Provide for iteration as required to arrive at a completed design
- Be applicable to all kinds of systems, including product

+ This method was first discussed in an unpublished memorandum titled "A Methodology for Conceptual Design of Systems and its Application to Environmental Education". Since then the method has been illustrated in several publications. As applied in environmental education, it is discussed in the report DESIGNS FOR THE FUTURE OF ENVIRONMENTAL EDUCATION, U. S. Department of Education Publication No. E-81-39000.

designs, process designs, organizational designs, curriculum designs, and combinations of these

The Options Field method of design was created to take advantage of a method called Interpretive Structural Modeling (ISM), also invented by the present author, since ISM can be used to help a group perform several aspects of a design effort. The ISM process is a computer-assisted group process whereby a group is helped by a skilled facilitator (familiar with the ISM process) to create a structure for a set of elements, based upon a selected relation. The freedom to select a desired relation in each instance of application is what allows the ISM process to be used several times in the Options Field method, each time with a different type of relation. By this means the ISM method allows several of the wanted features of the OF method to be achieved.

Steps in the Options Field Method

The Options Field (OF) Method involves the following steps.

STEP 1. Generate a list of options from which choices will be made during the design process. This list should be as inclusive as possible. Each option should be "simple", i.e., it should not involve two distinct possibilities. For example, options for a roof of a house might include "shingles", "slate", etc., but would not include "slate OR shingles", since this is a composite option rather than a simple option.

STEP 2. Aggregate the options in "dimensions". A dimension is (a) a set of simple options, (b) an area in which there is agreement that a choice must be made in order to give a complete statement of the minimum essentials of the design. A dimension may be numerical (as in the case of the length and width of a rectangular room of a house) or qualitative. Examples will be given later.

STEP 3. Determine which dimensions are dependent upon other dimensions. This is done using the ISM process.

The group compares dimensions by inspecting the options in each, to see if choice of some option in one dimension could restrict the choice of options in another dimension.

STEP 4. Form clusters of dimensions. Two dimensions lie in the same cluster if and only if they are dependent.

STEP 5. Rank order the clusters on the basis of the sequence in which options will be selected. This can be done using the ISM process with the clusters as the elements.

STEP 6. For each cluster, rank order the member dimensions in terms of the sequence with which choices will be made within the cluster. This may be done with ISM if necessary.

STEP 7. Put all the dimensions on the chart called the Options Field (examples will appear later), showing them in the rank order found in Steps 5 and 6, with the options for each dimension listed underneath the dimension, each option preceded by a bullet to facilitate drawing to follow.

STEP 8. Select an option (simple or compound--if the latter it will be a combination of at least two simple options) from the first dimension in the rank ordering found earlier.

STEP 9. Draw a line tying the selected option to the "Tie Line" (examples appear later).

STEP 10. Rule out any options in other dimensions that have been pre-empted by the choice just made.

STEP 11. Repeat Steps 8, 9, and 10, for each successive dimension until (a) the design is complete OR (b) some dimension become inaccessible because prior choices have ruled out all options in that dimension. If the latter occurs, the group must begin again and make choices that are not so restrictive. Otherwise the design is completed by choice of options under all dimensions, iterating if required, to produce an "Options Profile". The latter

portrays all of the dimensions (hence all of the clusters), the order in which choices were made, and all of the choices that were made. Also it shows which choices were considered but not made.

Examples of Past Applications

Now we will present a set of examples of past applications of the OF method of design.

A. Design of a Revised Judicial System, Including a Court Administrator.

Figure 1 shows a completed options profile for a revised judicial system. The system as designed here includes a court administrator to supplement the usual clerk/judge court system which has allowed courts to become overloaded. Note that the design is for civil and "law" cases, and for state or possibly federal district courts.

For more details on this design, consult Reference 1.

B. Design of a Technology Transfer Organization.

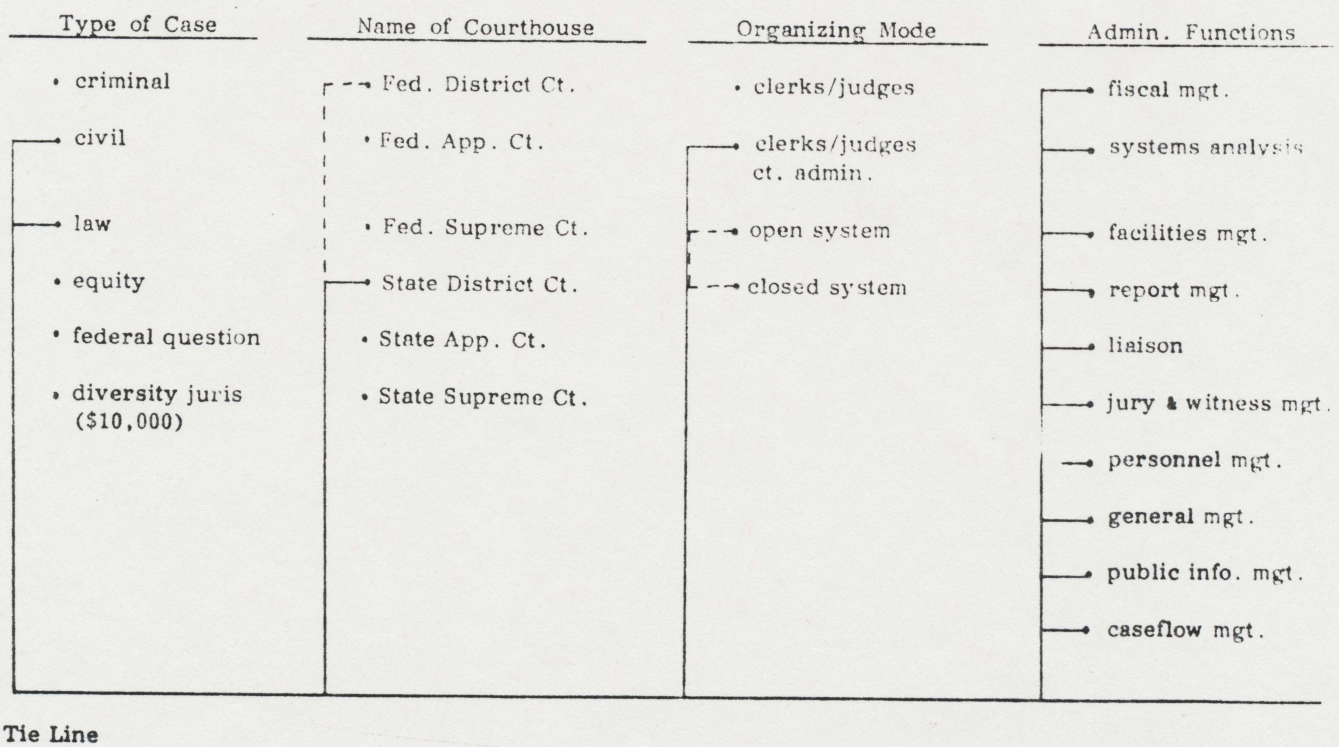
Figure 2 shows a completed options profile for a technology transfer organization. Note that this organization has nine dimensions, and that technological needs are considered first, then presumed innovation style, then presumed innovator skills, etc.

For more details, consult Reference 2.

C. Design of a Peace Research Forum.

Figure 3 shows an options field for a peace research forum. This forum was conceived to have twelve dimensions, with the first choices being made in the dimension: "Basic Outcomes Sought". Note that a composite option consisting of nine objectives was chosen under that dimension. Under the final dimension "Targets" are listed three choices for groups to reach through the forum: governments, industry leaders, and political leaders.

Figure 1. Options Profile for a Revised Judicial System



Tie Line

A Conceptual Design for Technology Transfer Centers Based on Senate Bill S1250

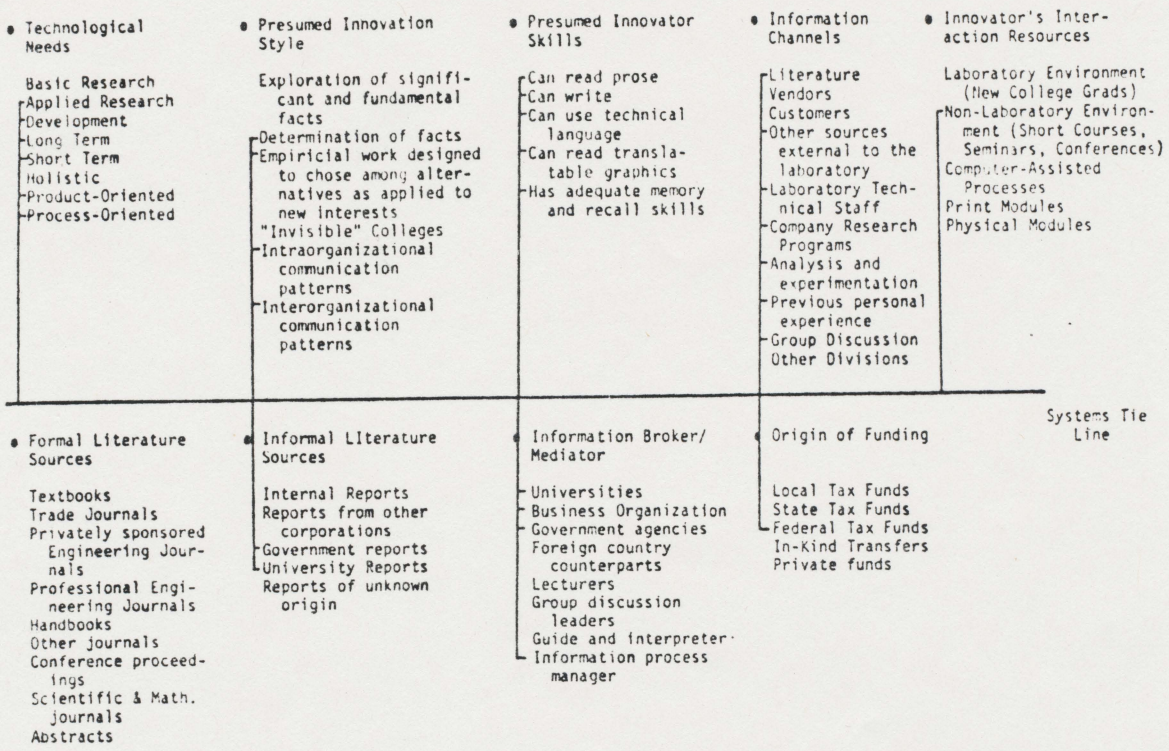


Figure 2 Options Profile for a Technology Transfer Organization

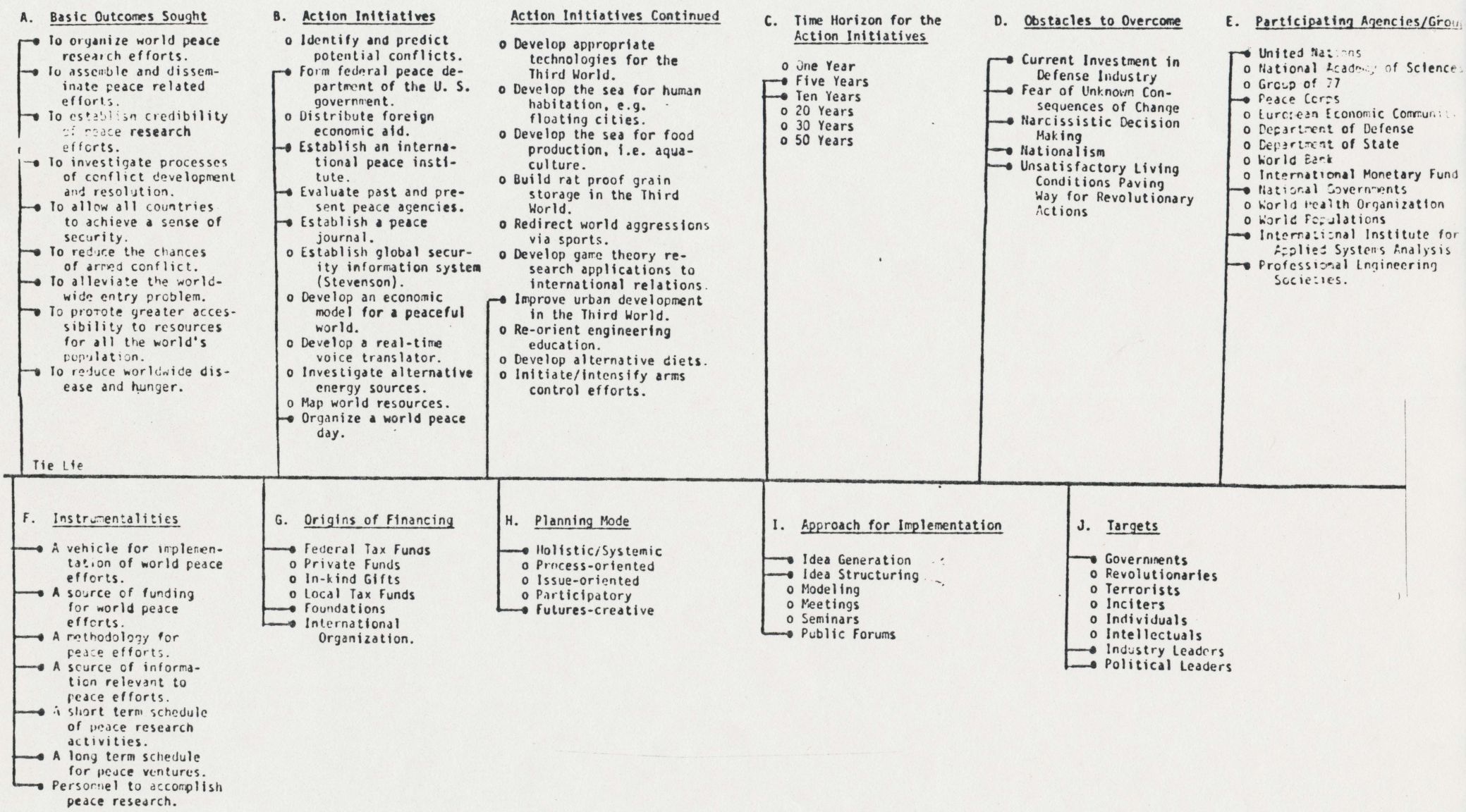


Figure 3. Options Profile for a Peace Research Forum

D. Design of a Product Engineering Center.

Figure 4 shows an options profile for a product engineering center. Note that this design is 10-dimensional. Goals and Objectives were considered to be the highest priority dimension. The terminology used in this design corresponds to that in Reference 3. The design was carried out by an engineering manager in a product engineering center.

E. Design of an Authority Allocation System.

For purposes of managing new product development in a corporation, an options profile was generated for allocating authority for various decisions. The options profile is shown in Figure 5.

F. Options Field for Reducing Municipal Expenditures.

Figure 6 shows an options field that might be applied to setting up a system for reducing municipal expenditures.

G. Design of a Press Safety System.

A press is a mechanically-powered machine that shears, punches, forms, or assembles metal or other material by means of cutting, shaping, or combination dies attached to slides. The press consists of a stationary bed or anvil and a slide or slides having a controlled reciprocating motion toward and away from the bed surface, the slide being guided in a definite path by the frame of the press. Press safety is aimed at preventing operators from being wounded or killed in accidents.

Figure 7 shows an options profile for a press safety system. Note that the system includes eight dimensions, and this particular system is designed for the situation where, in production, the operator loads a part into a die.

H. Design of a Manufacturing Engineering Organization.

Figure 8 shows an options profile for the design of a manufacturing engineering department. Note that this department is presumed by the designers to have seven dimensions. This particular department is partitioned into product groups (see dimension 1) with a compound-option reward system.

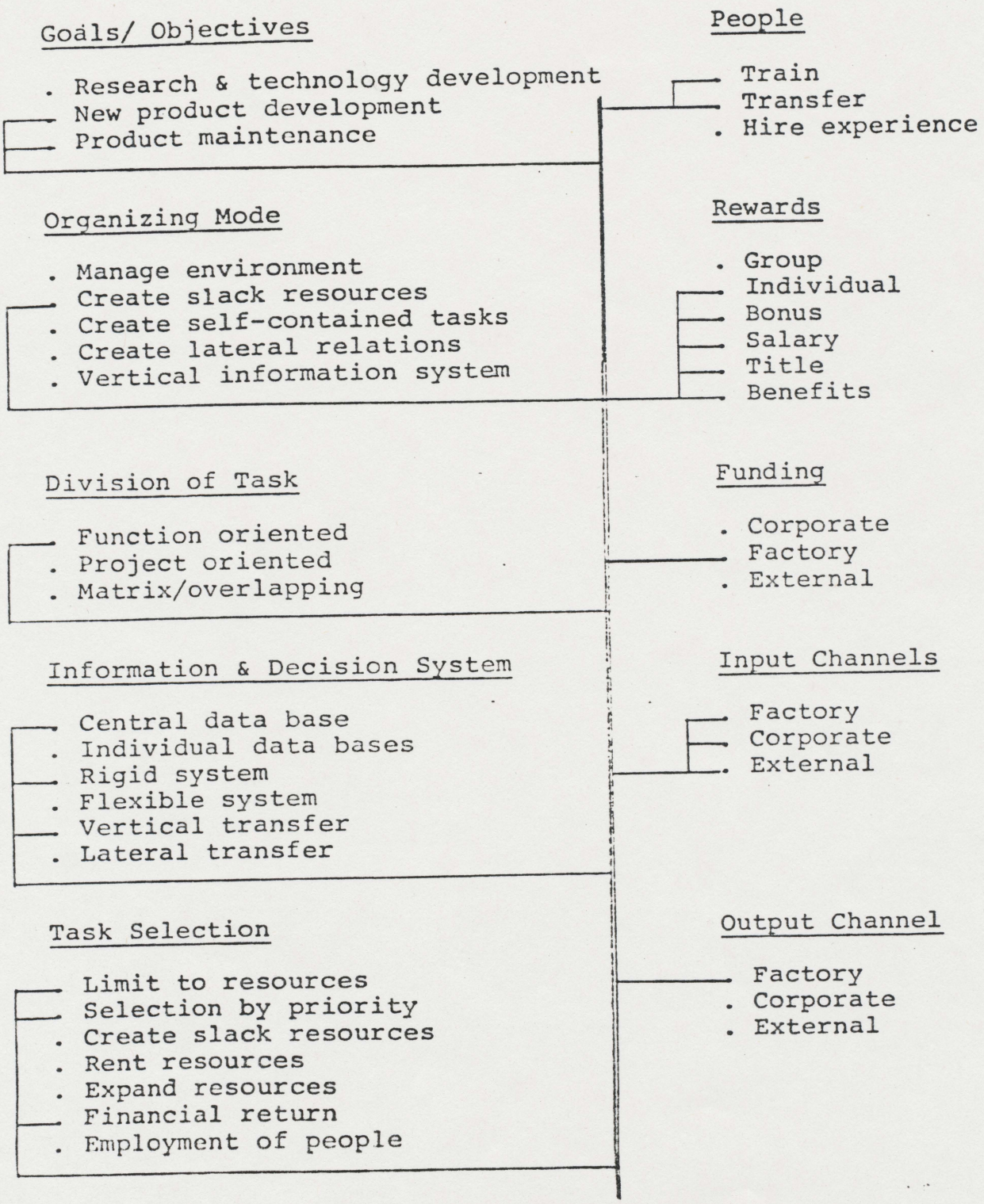
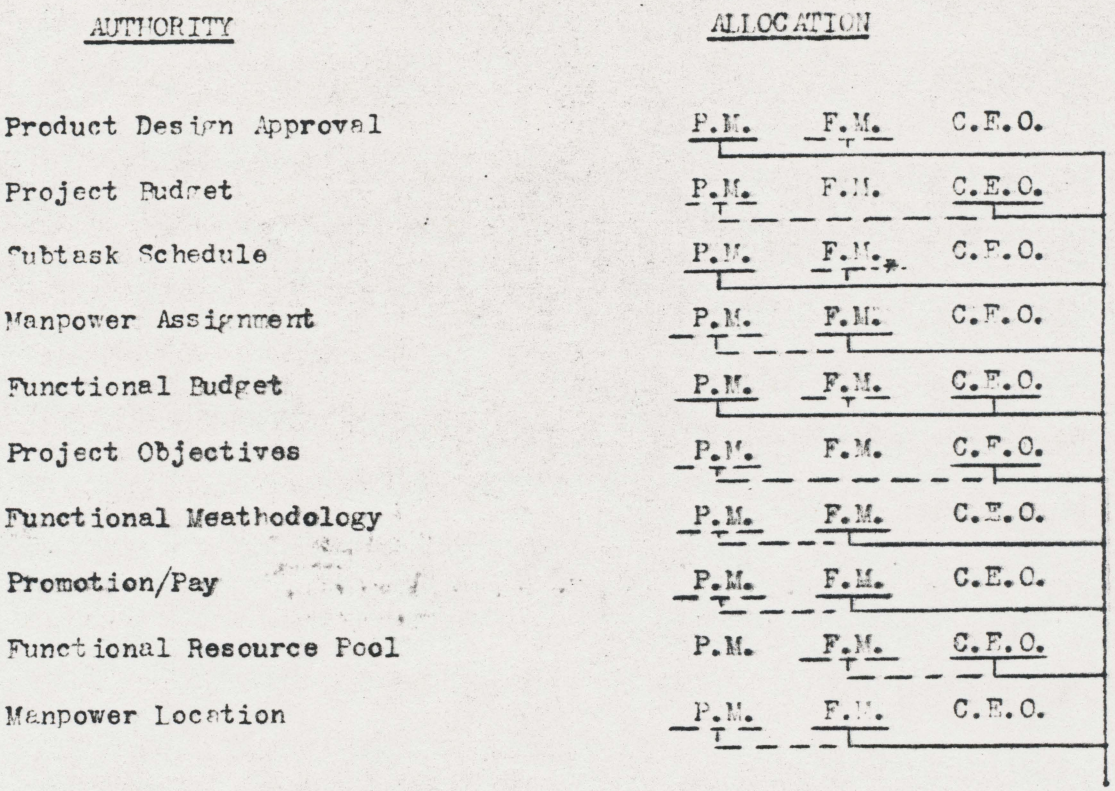


Figure 4 Options Profile for Product Engineering Center



——— Primary Authority Line

- - - - To Be Consulted

* In this case only, dashed line implys limited approving authority, see text.

P. M. refers to the Project Manager

F. M. refers to the Functional Manager

C. E. O. refers to the Chief Executive Officer

Figure 5. Options Profile for Authority Allocation in New Product Development

1. Municipal Team	2. Public Inputs	3. Outside Inputs	4. Outside Pressures	5. Heritage
• Mayor	• Council Meetings	• Consultants	• State Government	• Past
• Mayor & Council	• Budget Hearings	• Vendors	• Federal Government	• Present
• Department Heads	• Neighborhood Meetings		• Regional Government Units	• Future
• Planning Commission	• Availability of Public Officials		• Contracts	
• Planning Committee	• Letters to Government			
• Government Employees	• Letters to the Editor			
	• Public Surveys			
	• Court Suit			

6. Time Frame	7. Integration of Government Units	8. Input Methodologies	9. Labor	10. Data Handling
• Week	• Independent Units	• Lecture	• Skilled Trades	• Handwritten
• Month	• Special Districts	• Random	• Junior College	• Typed
• Year	• County Government	• Public Survey	• Semi-skilled	• Computer Printout
• 5 Years		• Nominal Group Technique	• Volunteers	• Magnetic Tape
• 10 Years		• Interpretive Structural Modeling	• Temporary	• Microfilm
• 25 Years		• Delphi with Government Participants	• Degreed	
• 50 Years		• Delphi with Public Participants	• Unionized	

Figure 6. Options Field for Reducing Municipal Expenditures

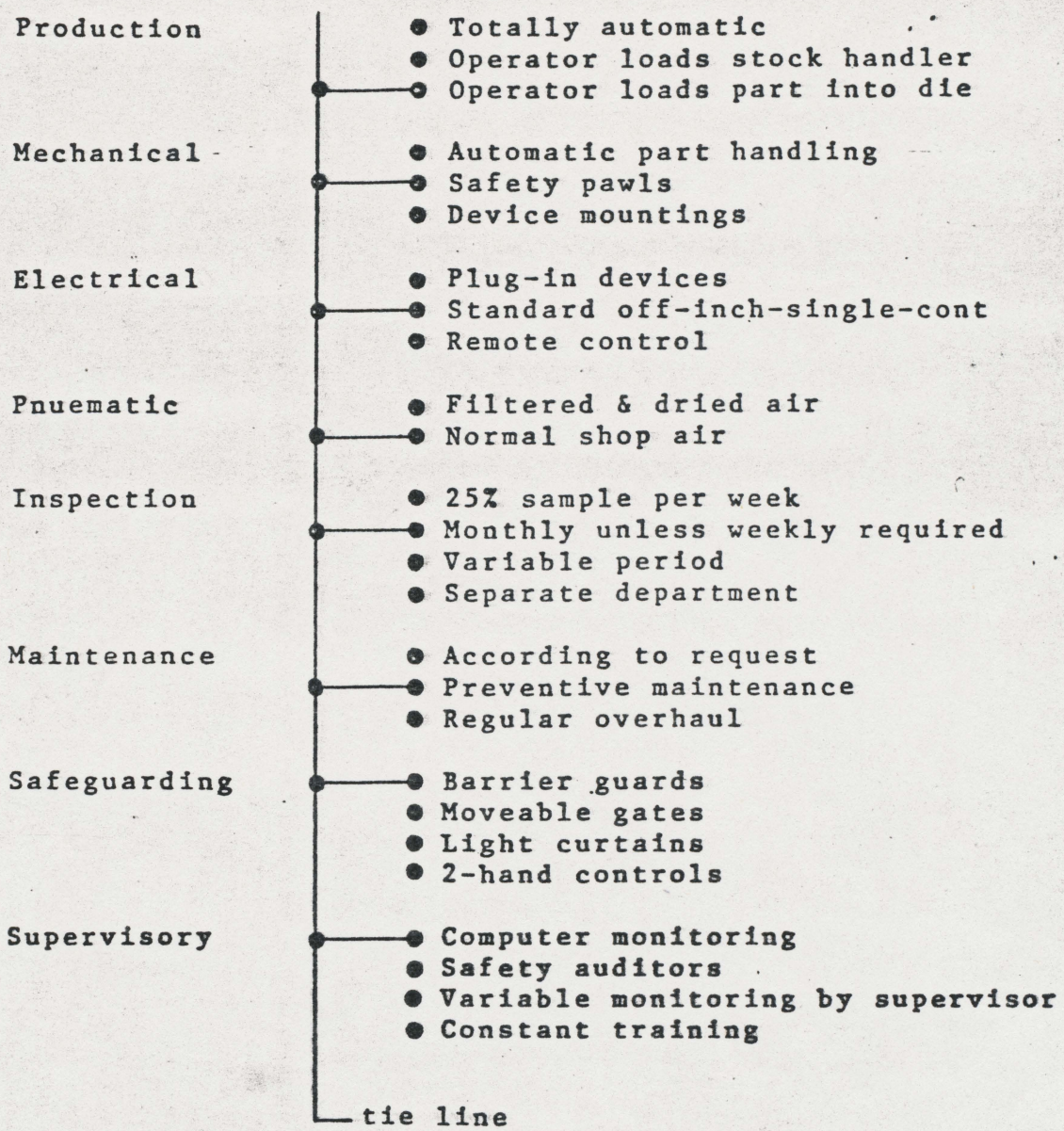


Figure 7. Options Profile for a Press Safety System

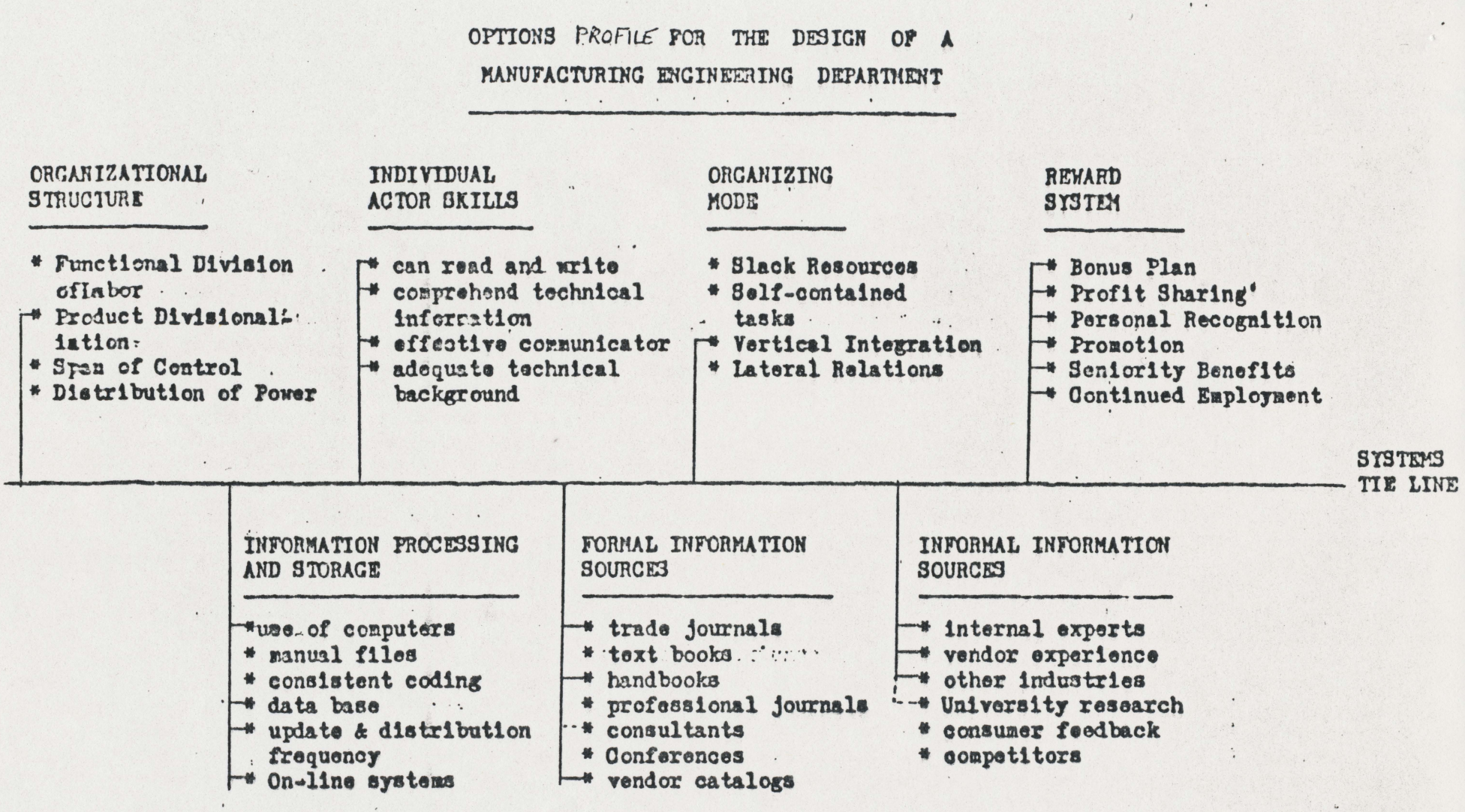


Figure 8. Options Profile for the Design of a Manufacturing Engineering Department

The Design "Quad"

You may notice that the examples did not specifically point out the clusters of dimensions. But basically, we are dealing with a four-level structure which we call the design "quad".

This structure takes the form shown in Figure 9.

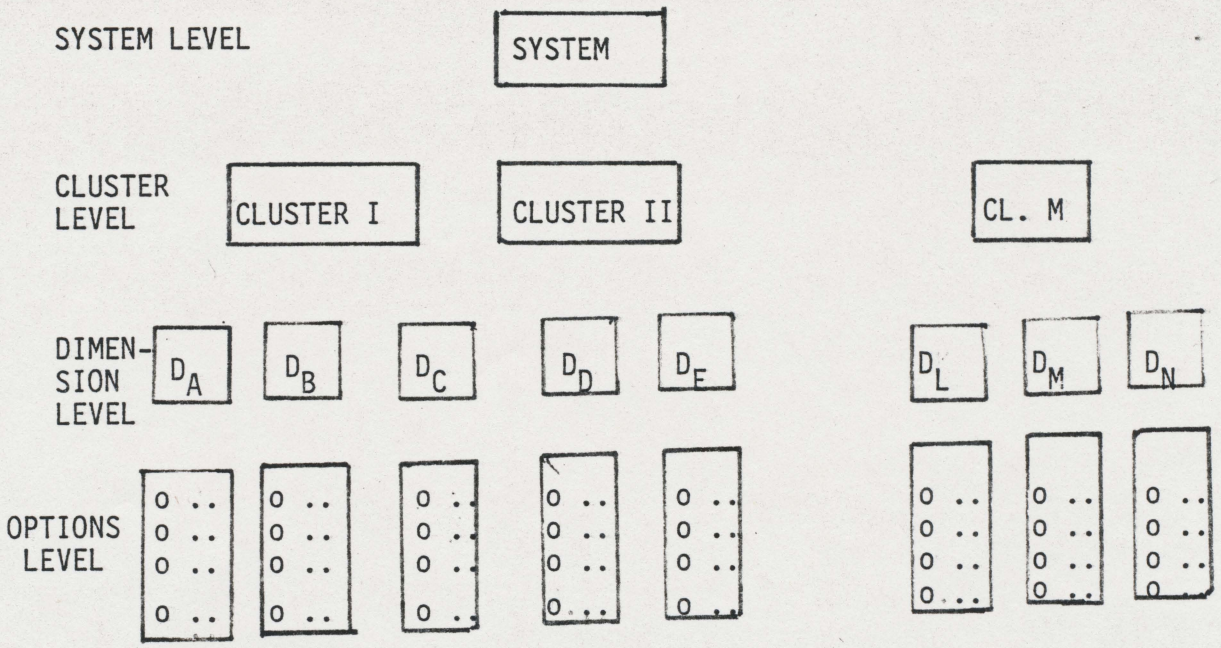


Figure 9. The design "Quad"

Notice that when an options profile is prepared, some of the options may require further elaboration. Any selected option can become a new "system" to be considered, and a new quad can be formed to deal with that option in a more specific way. In this way, a complete design may be formulated as a system of quads, the one we have described being the topmost quad in the system.

The Law of Requisite Variety

As embodied in the OF method of design, the Law of Requisite Variety states that if a system is known to have n dimensions, then the designer must specify the system in n dimensions, and not leave out any dimensions. Otherwise the design will lack the requisite variety and cannot be expected to perform according to the goals set forth for it.

References

1. J. Giampapa, "Design Innovation in the Judicial System: The Role of the Court Administrator", Proceedings of the Southeastern System Symposium, IEEE, New York, 1980, pp. 326-336.

2. D. Keever, "Design of Technology Transfer Organizations for Improving Productivity in the United States", Proceedings of the Southeastern System Symposium, IEEE, New York, 1980, pp. 337-348.

3. Jay Galbraith, Organization Design, Addison-Wesley, Reading, MA, 1977.