DISCUSSION: THE SYSTEMS APPROACH – RESEARCH OR RESEARCH MANAGEMENT*

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Much has been written on using the systems approach as a means of allocating resources in large public agencies.[1] The literature includes discussion of possible applications, potential advantages, procedures, and problems of using such approaches as a means of allocating research funds in agricultural experiment stations. Much of this work has been presented under the heading of planning-programming-budgeting systems (PPB). Essentially, PPB is a systematic approach which attempts to establish station goals, to develop research programs for their accomplishment, to consider the costs and benefits of alternative research projects, and to utilize a budgetary process which reflects program activities over the longer run rather than on a yearly basis.

Professors Parvin and Tyner suggest that a systems approach such as PPB is needed to help experiment station directors determine what questions need to be answered, insure that the priority questions are examined and provide the necessary information. Having raised the issue of using systems analysis to allocate resources in the experiment station, the authors do not elaborate on how these procedures can be applied. Other papers have raised the important conceptual issues [1]. But recent analyses indicate additional work on methods to estimate benefits and costs of alternative research projects is needed to make such approaches operationally acceptable at many stations [3].

As the needed refinement of PPB continues, it is refreshing to find Parvin and Tyner pointing out that the systems approach also can be used to improve research efficiency at another level within the experiment station – as a means of organizing and managing large multidisciplinary projects. The authors state that the systems approach is required to consider the complexities and environmental effects that are important in answering questions today. Many problems require consideration of the interactions of biological, physical, and economic elements within the system to provide useful answers to the questions being asked. In many of these cases, it appears that the systems approach provides a means to organize multidisciplinary research teams and to provide research output more efficiently than with other methods.

Although current research applications involve analysis of more complex systems than has typically been the case in the past, complexity of the systems being analyzed is neither a necessary nor a sufficient condition for use of the systems approach in managing projects. The only justification required is that its use provides a means to complete the research more efficiently than with other methods.

Although I am in general agreement with Parvin and Tyner, I want to comment on the role of the project leader and on three aspects of the projects to which such an approach can be applied: the size, complexity, and applied versus basic research.

PROJECT LEADER(S)

The role of the project leader was stressed, and rightly so. However, it appears that the role of the project leader may vary depending on the number of scientists involved in the total project. Parvin and Tyner state, "Large multidisciplinary research projects require a project manager or small group of

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[1] For a general discussion of this topic see [2, pp. 426-456].

coordinators to function as a linking pin to couple the individual scientists, departments, and, in some cases, universities together." They indicate the project leader must develop a time-dated network analysis over the entire research project covering all experimentation, expected times for completion of the research, and reporting of results.

It is indeed a rare project leader, even if he is an agricultural economist, who can complete this type of planning when it involves biological experiments, development of submodels by each of several disciplines, individual and joint verification of the submodels, and the use of the model to provide answers to the questions being asked. Even if the planning could be completed by a single project leader, it is unlikely other disciplines would feel as obligated to complete their work on schedule as they would if they had helped plan the schedule. While one project leader should be designated for reporting and communication purposes, it appears that a team of scientists representing each of the disciplines required in the project must be involved in designing the network analysis and managing the project.

PROJECTS TO WHICH APPLIED – SIZE

The size of the projects implied by the paper is also an issue. Workers in agricultural experiment stations have not been very successful in bringing large multidisciplinary projects to a productive completion. Admittedly, the organization of systems analysis should improve the probability of success, but the likelihood of key personnel leaving the project, the pursuit of nonproject goals by some scientists and disagreement among personnel appear to increase as the number of individuals on the project increases. There appear to be many questions in the area of production agriculture, particularly in the areas of pesticide use and environmental effects, that can be researched by relatively small (say two to five disciplines) multidisciplinary teams. In such cases one member from each discipline can help coordinate the project.

A multidisciplinary team at the Oklahoma Agricultural Experiment Station is developing a model of the agronomic aspects of cotton production, the related insect dynamics and the appropriate economic elements. The model is to be used to develop economic threshold estimates and to evaluate the effects of alternative pest management strategies. Three disciplines are included – agricultural economics, agronomy, and entomology. A system philosophy has been used throughout the planning and coordination of this work. In this case, using the systems approach has facilitated communication among the disciplines both in planning and conducting the research. Using the systems approach forced team members to agree on the desired output from the project and a specific timetable to conduct the research. Because the group is relatively small, the three faculty members have made the planning and coordination decisions jointly.

PROJECTS TO WHICH APPLIED – COMPLEXITY

The systems approach in organizing multidisciplinary projects appears to be particularly useful in projects requiring the specification of the interaction of biological, physical and/or economic elements in the system. Use of the systems approach allows other disciplines to become directly involved in the modeling of the system, but requires each discipline to be concerned with the interaction of system elements that are normally considered within another discipline's area of expertise. For example, in the cotton study, the agronomists must be concerned with the growth of cotton under less than complete insect pest control. Likewise, the entomologists must consider the effect of agronomic factors on insect populations.

PROJECTS TO WHICH APPLIED – APPLIED VERSUS BASIC RESEARCH

It also appears the approach is more useful when the necessary models can be developed using primarily available research on the elements, relationships, and parameters in the system. Developing models of complex systems inevitably points out the need for more basic research. In some cases, part of this basic research may be accomplished within the time frame of the multidisciplinary project. However, it is difficult to maintain the interest of all disciplines if only a few are involved in actual research on the project over an extended period of years. This suggests that systems analysis must be most useful in managing research on applied problems that can be solved within a relatively short period, say three years or less.

Conceptually, systems analysis could be used to organize all research efforts in the experiment station. However, it is not clear whether these procedures stimulate or impede the intellectual process upon which creative research depends. Thus, it is not clear that all discipline-oriented and graduate student-directed research should be subjected to the type of project management Parvin and Tyner describe. The conclusion stated by Parvin and Tyner that systems analysis will make the researcher more productive is a reasonable, but only a tentative hypothesis at the current time.

CONCLUSIONS

It does seem reasonable to use systems analysis not only as a means of allocating research funds among projects within the experiment station, but also as a means of organizing and managing individual research projects. The use of systems analysis may be particularly beneficial in organizing multidisciplinary teams to provide solutions to applied problems. However, it is not clear that explicit use of the systems approach in organizing and managing all research projects will result in the most useful combination of research output.

Obviously, systems analysis may be used at a third level – as a research tool on individual single disciplinary projection. However, this can be done even if the systems approach is not used at either of the other two levels.

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