

U. S. AIR FORCE
PROJECT RAND
RESEARCH MEMORANDUM

THE CONTEXTUAL MAP

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RM-1575

24 October 1955

Assigned to _____

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SUMMARY

This memorandum describes a tool for assisting decision-makers in dealing with large, complex interacting system problems. The contextual map is a display of information, prepared in such a way that the viewer may comprehend the totality of a complex problem before breaking it up into components. A variety of uses are discussed: 1) as a large, living memory for a decision-making group, 2) as a device for obtaining a tangible, intelligible product from planning activity, and 3) as a superior communication device for coordinating the plans and actions of a number of widely-separated planning groups. It is suggested that the technique may be of immediate value when applied to Air Force research and development planning.

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THE CONTEXTUAL MAP

In the field of human engineering, much attention has been given to the problem of the design of displays of information for optimum human operator use. This memorandum describes a display technique which can be developed and used by decision-makers when faced with the complexities of planning and understanding large interacting systems. In particular, it is proposed that the contextual map will substantially assist decision-making in Air Force research and development, where decisions now have critical consequences for national security.

A USE OF THE MAP IN A LARGE-SCALE PROJECT

During my recent leave of absence at the Center for Advanced Study in the Behavioral Sciences, I worked closely for a year with a political scientist (Prof. Harold D. Lasswell of the Yale Law School), an economist (Prof. C. E. Lindblom, Department of Economics, Yale), and an anthropologist (Prof. Allan Holmberg, Department of Anthropology, Cornell). Our problem--chosen because of its ramifications in anthropology, economics, political science, and psychology--was planning a 10-year program of rapid cultural and technological change in an underdeveloped region.

The region was an inter-Andean valley, the Callejon de Huylas, in north central Peru, where Holmberg, the anthropologist, had been operating the Hacienda Vicos, rented by Cornell University from the Peruvian government, as a laboratory for the study of cultural change.

Hacienda Vicos is on the western slope of the Cordillera Blanca (the "White Andes") at an altitude of about 9,000 feet. Some 22,000 acres in extent, the land ranges from a few acres of rather fertile river bottom through arable uplands to many acres of high mountain land suitable only for grazing. About 2,500 Indians live on the hacienda. They own none of the land, but work it for the hacienda management and their own subsistence. By long-standing custom, Indian families provide the work of one member three days a week to the hacienda management in return for the right to use some of the land. The land is thus parceled out between the hacienda management and the Indians. Because of this way of renting the land, managements come and go, but the Indians remain on the land, living out their life cycle in almost complete isolation from modern coastal Peru and the outside world.

The Indians, the land, and the hacienda management make the region a complex interacting cultural system into which the Peruvian government, Peruvian entrepreneurs, and outside capital are introducing modern technology. For example, a large hydroelectric project being built some 50 miles from the hacienda with French capital is expected to provide electricity for the whole Callejon de Huylas within a few years. Roads are being improved, trucks are coming into the valley, and communications are being established with the coast.

The Peruvian government recognizes that the hacienda, an anachronism in the modern world, must go. But what will replace it?

The Indians (Indians make up about 70 percent of the population of Peru) aren't ready for modern technology--either culturally or politically. To avoid the extremes of revolution on one hand and race extinction on the other, plans were made to carry the Indians of Hacienda Vicos from feudalism to political and cultural participation in modern Peruvian life in the relatively short time

of 10 years. To do this, planned experiences, or "interventions," were started in 1951. These interventions are the independent variables of this experiment in cultural change; the resulting changes in behavior are the dependent variables.

WHAT A CONTEXTUAL MAP IS

As an interdisciplinary team faced with the complexities of a large interacting cultural system and its own problems of internal communication, we needed a method for systematically utilizing the talents of its members despite the frustrations of having to establish a common vocabulary, an agreed-upon ideology, a set of reasonable goals, a common context for symbols, and ways of translating ideas into actions. Our solution was to design and make up a "map room," whose walls contained a large matrix with the time (in years) on the ordinate and the "variables" the group was interested in along the abscissa. This matrix was the "contextual map."

Since we started out with some 250 variables, we ran out of room space. The map we finally used had 130 variables, grouped under "Government," "Economics," "Social Relations," "Education and Mass Media," "Health and Welfare," and "Attitudes." There were spaces for three-by-five cards for each of 10 years under each variable. The entire matrix thus could hold 1,300 cards that summarized the value of the variable in the past or described its desired value for the future. At the top of each column was a description of the value of the variable "in the best of all possible worlds" and a statement of the value anticipated or desired at the end of the 10-year experimental period (1951-61).

Since we were working in 1954-55, and the 10-year map extended back to 1951, we had to work back to the bottom of the map. From a thorough base-line study of the community, we obtained an estimate of the value of each variable in 1951,

and, from a second study, descriptions of past interventions and values of the variables. These were placed in proper time sequence. As an example, the column for the variable "Number of Required School Years" under the group heading "Education and Mass Media" looked like this:

Ideology--Demand for skill in scientific outlook and in the scientific method

1961	Status	Compulsory grammar school education (eight years) for all.
1955	Status	Over 100 students have had more than two continuous years of education. Housing facilities available for seven teachers at hacienda.
1954	Intervention	Second school building finished, including auditorium. Special teacher from U.S. worked with Indian children on arts and crafts for three months.
	Status	Pre-industrial school with seven teachers supplied by ministry of education.
1953	Intervention	First building of new school finished. Primary school inaugurated and turned over to Peruvian government.
	Status	123 of 350 eligible students of both sexes getting some schooling; two teachers.
1952	Intervention	Land prepared for construction of new school. School lunch program initiated, with balanced menus prepared by Home Demonstration Unit, Ministry of Agriculture.
	Status	One teacher, 40 pupils.
1951	Status	Two years of primary school for less than 5 percent of eligible children.

THE MAP AS A GROUP MEMORY

One of the main difficulties in programing and planning is the need to deal with large numbers of interacting variables. Programs of any degree of

complexity strain human memory to the breaking point. The contextual map records past decisions and actions as well as predictions and anticipated reactions for the future. The map is a way of keeping "minutes" in a context of the past so that the relevance of decisions is immediately apparent. Each member of the group can refresh his memory for a meeting by "reading" the minutes in this context.

Our map room contained a conference table and chairs so that decision-making and planning conferences could be held there. Thus the group was continually confronted with the developing map and were constantly aware of gaps in the information and suggested priorities for items to be considered.

The map was a large, living memory for the group. As the decision-making conferences went on, each member of the group began writing up three-by-five cards and coding them for their proper place on the map--a letter and number on the original card told the secretary where to post the duplicate card she typed up. By the next meeting, the cards would be posted and the members of the group could refresh their memories of previous discussions by referring to the map.

REINFORCEMENT

An annoying characteristic of planning and decision-making is the lack of a tangible product. There is little motivation for people to take part in these activities because they get so little reinforcement. Using a contextual map gives two kinds of reinforcement. There is a "product"--the developments on the map--and a prediction reinforcement. The prediction reinforcement takes place over a period of time, since the map continuously compares the predicted status of the variables with their actual status. Systematic comparisons of

predictions with the actual events make it possible to improve the prediction methods used by the group.

COMMUNICATION

One of the best features of this kind of display is the ease of duplicating it. The position coding of the cards makes it possible to put up duplicate maps in many places at once--and this can be done with the whole map or with pertinent sections of it. The cards can easily be carried or mailed in a small card file and set up in a new matrix in a short time. For example, we set up the map we had used at the Center at Hacienda Vicos for the field staff of the project in about half a day.

Because of its portability and ease of duplication, the contextual map is an ideal briefing device. At the Center we were able to get the essential nature of the project across by taking new people into the map room for a briefing and allowing them to wander through the project by reading the cards. The map could even be photographed and made into slides that could be projected on a screen during a briefing.

CONCLUSION

Research and development decisions have critical consequences for national security. Since these decisions involve large commitments of national resources, in both manpower and material, the need for reliable decision-making techniques is urgent.

Development problems can't be solved with single decisions--they require a series of decisions made in proper sequence over relatively long periods of time.

At one point in the sequence basic scientific principles may be in question. At another point the major problem may be the feasibility of putting these principles to good use. Later on, coordinating an intricate program in which many facilities and separate projects have difficulties of their own may require the most effort.

In short, although the fantastic technological advances of the past few years promise achievements heretofore considered impossible, actually achieving what are now possibilities depends on the development of management techniques that can harness these new scientific, engineering, and production skills to get the maximum use of our national resources.

A major contribution of the contextual-map technique will be in complex development projects where it can be used to integrate management decisions that must be made continuously over a period of time. It will do this by bringing the facts the planners need to their attention at all times and by maintaining an up-to-date and comprehensive picture of the relevant conditions and previous commitments that they can refer to at any time. The map will be an enormous group memory that will provide reinforcement and facilitate communication.

The map room is, in one sense, a "learning machine." The parts of the machine that do the thinking and adapting involved in learning are, of course, men--the planners. But they are aided by a display that responds to the issues before it by making the complete context of the decisions readily available and by quickly assimilating current information, decisions, and predictions.

There is nothing magical about this technique. Man, as always, solves the problems. But man's talent for planning can be immeasurably increased if he has better tools to work with--if the men who make the plans are given ways of combining ideas into understandable formulations they can employ systematically.

Having said this, we can point out the unsolved problems in this new method of planning. Since this technique, like any other, is only as good as the ideas that go into it, the best information must be made available and competent talent must be employed. Men with relevant experience and appropriate talent should explore the domain of the project step-by-step and lay out the problem in several dimensions--in the Hacienda Vicos example given above these dimensions were time and cultural conditions. This requires improvement in internal communications--a difficult problem in most planning projects but one that the map technique seems likely to do something about. If the problem is approached in this way, immediate questions and appropriate "interventions" can be identified and acted on, and decisions can be recorded so that their consequences can be checked in the future.

Further technical development of the map is necessary, of course. Most needed is a more effective way of storing, manipulating, and displaying large quantities of information about goals, predictions, and past, present, and future conditions. For this we can look to high-speed, data-handling equipment and the many recent developments in displaying information electronically. An ideal map, for example, would give the decision-making group a listing of all relevant variables, in order of priority, before each decision.

The design of the map room itself is a fascinating problem. Obviously the size of the room shouldn't limit the extent of the map. What seems to be needed is a large room that can be made into different-sized smaller rooms with theater flats and temporary partitions. With the proper use of space many decision-making groups should be able to use a number of maps simultaneously in the same general area.

RM-1575

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The contextual-map method is obviously still in a low state of development. But it promises--because of its facility for display, communication, memory, and reinforcement--distinct and unique advantages in formulating, monitoring, and managing development and research programs.