A PARTICIPATIVE APPROACH TO SYSTEMS ANALYSIS : AN ACTION RESEARCH
IN THE LOCAL GOVERNMENT

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ABSTRACT

In order to present a participation-oriented systems analysis method, the rationale of users' participation is discussed considering the recent trends in systems analysis techniques from an organizational point of view and putting forward a typology of organization and information systems based on the "integration" criterion.

The local government appears to be an organization which controls a "hypointegrated system" composed of differently goal-directed socio-economic units operating on a portion of land. For such a system the participation issue in systems analysis gains a crucial importance.

The description of an action research in the local government shows a possible approach to the analysis and design of Information Systems and Organizational Systems in a hypointegrated context.

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1. PRELIMINARY REMARKS

An information system (IS) may be defined as the set of methods, procedures, formal and informal techniques and technologies for collection, storage, processing and distribution of information.

The IS is part of the organizational systems. Both entities form the real field on which system analysts act and to which the computer-based IS is applied.

Systems analysis and design are activities directed to analyze/describe the present IS and OS, and build a new IS (and, in a subordinate and often implicit way, a different OS). Both activities may be labeled as "model building" processes: a first model is the outcome of the analysis phase, a means for the diagnosis and evaluation of the real IS; the second model (the newly designed IS) is implemented through hardware and software media, new procedures, new rules etc., and becomes a part of the real organization.

Schematically, the analyst's work, which covers the life cycle of the IS (shown in fig.1), is a dialectical process of abstraction, model building and action.

System analysis techniques are formalized "packages", which support the analyst's job: they usually contain a check-list of the activities to be performed in the different stages of system development, some documentation techniques and, more recently, computer-aided tools.

2. RECENT TRENDS IN SYSTEM ANALYSIS TECHNIQUES: PROBLEMS AND EXIGENCIES FROM AN ORGANIZATIONAL POINT OF VIEW

In what follows only the analysis stage of system development is discussed. The analysis phase may be thought of as a process of perception and selection of the real organizational and "informational" processes, followed by the description in terms of a formal model and, through abstraction and classification activities, by the building of an "infological" model, which will be the input for the design and implementation of the "datalogical" model.

As far as the analysis is concerned, the system analysis techniques suggest, more or less extensively, what is worth to be examined in the OS and IS, how to analyze it, how the relationship between IS and OS should be looked at, what is the interaction between the analyst and the rest of the organization (top management, users, workers, etc.).

Many authors (for example Couger (1973), Golvers (1976)) have pinpointed the crucial role of the analysis stage, both from the functional and economic point of view. The functional importance is due to the following factors:

- mistakes in the requirements definition are often detected only very late in the development of the system: this fact may influence negatively the effectiveness of the system;
- the analysis produces a "reference model" for the evaluation of the efficiency/effectiveness of the new IS;
- during the analysis, forms of interaction are institutionalized between the specialists and the users, which have an influence on the whole design/implementation and usage of the new system.

The economic relevance derives from these facts:

- the time spent in the analysis may reach one third of the total system effort. Couger (1973) writes that, passing from the first to the third computer generation, the analysis phase (study of the existing system and evaluation of requirements) has increased its importance (expressed in percentage of total life-cycle time) from 5% to more than 20%;
- in order to eliminate mistakes (made during the analysis) from the new system, costs may be one hundred times higher than those derived from an effective analysis.

Comparing the increasing importance of the analysis stage on one hand and the evolution of the system analysis techniques (from ADS/3/to BISAD/4/, SOP/5/, BSP and ISDOS/6/) on the other, one may still notice gap between the two and the urgent need for further research in this area.

In fact, while the present trend is characterized by an effort of automatizing the description/documentation and design of formal models (info-and-data-logical; see as an example the ISDOS project), relatively little effort is put on the specification of the crucial areas/problems in the IS and OS, in order to build a model which is not going to be useless although extremely formalized and coherent.

Golvers /2/ describes the present unsatisfying situation in this way:

- there is no effective methodology for the mapping of the real system into a descriptive model, functionally oriented to the implementation of the new IS;
- there is a confusing coexistence of extremely formalized descriptions

Fig. 1 - Work life of the system analyst

of local subproblems and "management oriented" suggestions and recipes, with little methodological content.

Sol summarizes the main recommendations to overcome this cul-de-sac /7/:

- rational and motivated choice of concepts, starting points and theories in the field of organizational studies;
- choice of possible description techniques to specify the present and the target situation, bearing in mind the existence of different users' categories, with their own values, problems, roles;
- effective analysis of the present situation and generation of new organizational alternatives.

In such a perspective, two complementary research areas can be identified at present:

a) the experiences in the user's participation issue.

New small computer-based IS, distributed processing, spreading of on-line terminals, failures with large centralized systems have put in evidence the importance of the users. The correct appraisal of the user's role is partly a consequence (exploited by computer manufactures, too) of organizational processes, which stem out of the change introduced by the computer.

Briefly, it has been understood that Edp system is effective if:

- users give detailed information to the analyst on the activities they perform/control;
- users feed correct data into the system;
- users regulate their activities and decisions using the system outputs, etc.

One cannot design a sophisticated technological system without designing its human interface, both in the development phase and in the utilization.

b) the broader role assigned to organization theory in systems analysis techniques:

- organization theories can show how to design the analysis activity within organization, taking into account the interaction between users' and specialist's roles, patterns of participation, etc;
- students of organization have developed a number of methods for the analysis of organizational systems which may be successfully

included in or adapted to Edp analysis techniques;

- various organizational models have been proposed and implemented, which may be a reference for the introduction of Edp technology. Up to now, i.e. in the current techniques, organizational models are implicitly assumed as constants in the change process.

Works and experiences that are worth to be mentioned as examples of such new trends are those of E. Mumford /8/, who has applied a participative work design to the Edp environment, the suggestion of I. Mitroff /9/ and B. Hedberg /10/ about "dialectic information systems", the new approach of the Swedish School represented by the "user-oriented system design" /11/ and, finally, the workers' participation implemented by the Scandinavian trade Unions (see K.Nygaard) /12/.

In such melting pot of proposals and experiences, a rigorously defined methodology has not yet appeared: just now the participation issue and the ideas derived from organization theories are being explored and tested. In this turbulent search process naive attempts of manipulation, social control, misuses of organizational concepts have not been avoided.

The normative aspects of participation are often emphasized, without providing the means for effective (real) participation, for example in the definition of information requirements bound to real exigencies.

3. ANALYSIS TECHNIQUES FOR HYPOINTEGRATED SYSTEMS

Often, the user-oriented approach is just a means to make the user responsible for the new system which has been designed according to criteria stated by someone else (top management and/or specialists). This formally participative approach may be effective when the users are few, when the system to be automatized is limited and clearly goal-directed.

Our impression is that such approaches, even in their newer look, are condemned to failure, if they are applied to "imperfectly organized systems" (1), systems where various users' categories are present. This seems to be the case of urban, regional socio-economic information systems.

Such an impression stems from the assessment of Edp applications in the public government (local and central): there are plenty of sectorial computer-based IS, with no co-ordination between them and a surprisin-

gly low automation degree.

Most probably, there is a link between the problem of imperfectly organized systems and the participation issue. Such a link may be identified considering the structural motives or factors that support the user's participation in specific organizational structures during the system analysis and design process.

The automation of activities and procedures, or the collection and storage of data for management decisions (data base) require a process of formalization of the laws that govern decision processes and activities within the organization (processes that take place outside the organization are somehow internalized and can be treated as the formers). There are two possibilities: formalization exists already, and the problem is to transfer it into an Edp-oriented form; or, formalization can only be reached through a bargaining process with those who own the process local memory (i.e. the users) (2). In the latter hypothesis, the analysis, design and implementation of an effective IS require that the users agree to placing the memory of the processes they control at the analyst's disposal. When the new system runs, the users must also participate and cooperate in order to fill in those "gaps" or "fissures" between the implemented Edp model and the real OS.

User-oriented systems analysis techniques try to take into account (sometimes uncsciously) the power bargaining game (memory transfer) which takes place during the implementation of a new model within the organization.

A typology of information and decision systems - Having shown the structural bases of participation, it is necessary to turn to the different types of organizational systems, in order to find out in what situation a fully participative approach is absolutely essential to create an effective IS.

J.L. Le Moigne /13/ has suggested the following typology of systems, based on the integration degree of their parts :

- hyperintegrated systems (e.g., the family)
- mesointegrated systems (e.g., the entreprise, the purposive administration)
- hypointegrated systems (e.g., local communities, a region, a country, etc.).

The mesointegrated systems are purposive organizations, such as an

industrial enterprise: each of its departments is a purposive unit, whose objective is to execute a part of the purchase-production-sale cycle; the whole enterprise has, as main goal, profit, (in the short and/or long term) etc. In such systems the organizational structure that controls and regulates the subsystems (departments, functions, individuals) is formally defined, and so is the autonomy of each subsystem. The system and subsystems dynamics is observable, at least to a certain degree; the "memory" of each department is formally located within the organization and it is composed of: procedures, methods, tasks, quantitative and qualitative information (on production or administrative processes) etc. The organizational texture and the set of its objectives and subobjectives (to a certain degree) reflects selectively the socio-economic processes of the environment and internal needs of coordination.

A regional or local community are hypointegrated for the following reasons: each socio-economic unit (agricultural, industrial, service or commercial units) produces goods or services, which may be not integrated with the objectives of the other units operating on the same territory, although adequate to the survival of the specific socio-economic unit. Thus, the texture of the whole region appears to be fragmented from the point of view of the coordination of the goals/objectives of the various socio-economic units.

Furthermore, in such systems there are observability problems: their "memory" is fragmented, departmentalized, "distributed"; there are many decision points, with a high degree of autonomy and a low or non-existent degree of coordination.

The "organizational structure" of hypointegrated systems does exist but is imperfect; for example functional and economic bindings between agriculture, manufacturing industry, local government, services and so on may be identified but such links, which form the "texture" of the systems, are often difficult to observe and control. In such a context an effective IS is difficult to implement using traditional techniques.

One should consider that systems analysis has been developed taking as reference model mesointegrated systems (see for example the Hearle and Mason's approach to the analysis and design of the IS in a local government /14/). Up to now, little effort has been put in the analysis and design of IS in hypointegrated systems, where the "organizational structure" is a problem, i.e. something to be reached and not so-

something to be simply described in terms of functional analysis. The action research reported below does not provide a fully developed systems analysis methodology, but it shows an interesting experiment of participation-oriented analysis of the IS and OS in the Public Administration environment, taking into account some of the concepts discussed above.

4. MOTIVES OF INTEREST OF THE CASE OF LOCAL GOVERNMENT INFORMATION SYSTEMS

The Public Administration and, more specifically, the local Government environment, are very interesting from the point of view of system analysis techniques and Edp, at least in the Italian context. In fact,

- the public administration is in the middle of a deep crisis: it is unable to change its structure, its way of operating and its relationships with the outer society, in a turbulent socio-economic environment. Its "texture" is more and more not coherent with the changing texture of society. Edp technology has been proposed and considered as a means to rationalize the old procedures, to redesign the organizational structure in order to build up regulative capabilities on economic and social processes;
- the diffusion of Edp in the Public Administration has meant the automation of routine procedures (not always in the interests of the citizen-user) and the reinforcement of the pre-existing bureaucratic structure; often it has also meant a considerable economic waste or under-used facilities;
- the philosophy which has guided the introduction/application of the computer in larger and smaller authorities has been that of high centralization with the exclusion of users and citizens;
- a public agency (e.g. a local government) must intervene in processes which are extremely loose, fuzzy, difficult to reach, control and regulate: this fact has not had any consequence on the development of appropriate system analysis and design strategies;
- according to our hypotheses, in such hypointegrated system the users (citizens, economic operators, public managers, etc.) should play an active role as sources/receptors of information and as "organization-builders".

5. SYSTEMS ANALYSIS IN THE LOCAL GOVERNMENT

An IS, dedicated to the regulation of a socio-economic system characterized by its extension on a territory, should be able to identify the interdependences between subsystems, and the relationships between them and the regulating administrative superstructure.

Different plans of analysis may be identified: firstly there is a physical or geographic plan which indicates the location of socio-economic activities on the territory. Secondly, there is a "logical plan" which indicates the aggregations of interrelated activities. This plan may represent the location of the "memory" of socio-economic processes. Then, there is the "bureaucratic plan", which gives the formal scheme of the administrative structure of the local government, subdivided into goal-seeking departments, agencies, etc.

Finally, there is the political system (local parliament or council) which should govern the whole administrative structure and the socio-economic system underneath.

To analyse and design such a multilevel structure, trying to preserve a certain degree of coherence between the "texture" of territory and the regulation superstructure, it is necessary to:

- identify the problems that are tackled or avoided by the present administrative structure (comparing the extant functions of the administration with the socio-economic processes in the environment);
- check the regulation and control variables at disposal, i.e. the means to intervene on the territory (laws, commercial and house-building plans, urban plans, etc.);
- identify the legal constraints to the intervention of the local government, and the economic and human resources at disposal;
- define the means that can be used to study the territory system: surveys, other forms of data-generator units, such as general meetings of users-citizens who operate on the territory; specific departments within the local government, etc.
- institutionalize forms and mechanisms of participation for the users, as feeders and actors of the new system: such mechanisms should aim to collect and unify the "distributed" memory of each operator on the territory. Only the part of memory which may be of collective interest will be shared.

These steps are preliminary conditions to start a process of "building the organization" of the hypointegrated system. The participation issue appears to be not only a democratic ideal but, more rudely, a constraint for the effectiveness of the new IS and OS.

The model-building process (core of the analysis phase) starts from the local perception of socio-economic phenomena carried out by the local user (citizen) and the mutual share of the local knowledge acquired, together with an activity of stimulus carried out by the local government itself.

This down-top approach, in which the definition of users, socio-economic units, operators etc. is a problem not a datum, is radically different from the current approach of the socio-economic data base for the local government.

Implicitly assuming that the territory is a hypointegrated system, the Edp specialists think that a general-purpose data base will be the right solution for the information needs of a local government: all the data at disposal are put in the data base; every user can pick out the relevant information for him, etc.

But data-base approach is an apparent solution. In the data base only general statistics are usually included (of little meaning for the local user), because it is difficult for the user to pre-define what information is relevant to his decisions; the hypointegrated system being loosely connected and/or scarcely purposive, each operator is unable to define its information needs a priori.

The effort, on the contrary, should consist in starting a process of organization and purpose definition in the hypointegrated system; only later it will be useful to think about possible data-base functions and structure.

5.1. The steps of the analysis

The analysis of the hypointegrated systems is an iterative and participative process, that can be split into the following phases:

1. Identification of the users and their main goals
2. Identification of the economically important subsystems (the socio-economic units)
3. Identification of the interdependences between socio-economic units

(drafting of the "logical map" of the territory)

4. Identification of information sources (statistics, opinion leaders, social groups) and design of the procedures to collect missing data and information about the socio-economic units
5. identification of the main mutual influences between units, trying to quantify the interdependences
6. Research on the administrative structure and definition of organizational alternatives coherent with the "texture" of the territory identified by the logical plan.

A detailed description of each step applied in local government of Otranto (South Italy) is contained in /5/. Further remarks are made here to pin-point some aspects in relation to the hypointegrated texture of the system, and to the more general problem of systems analysis:

- i) the definition of the users and their objectives is of major importance as a first step of the analysis. In fact, users have an active information role in structuring the organization of the hypointegrated system. A possible list of users is the following:
 - the elected political men (the city major, the city council, etc.)
 - members, chief Executives, officers belonging to the various public agencies and to the administrative structure
 - the socio-economic operators, some of whom may be opinion leaders
 - the citizenship: users of public services, organized users (trade unions), workers, etc.

The user's participation is, at the same time, an instance of democracy and a choice of method in analysing and designing the new IS. More specifically, the analysis should become a collective learning process, concerning the socio-economic reality of the geographic area in which users live and work.

- ii) The analysis of the territory system takes place by decomposing it into subsystems according to criteria of economic and functional importance. Another criterion is given by the relative responsibility of the social actors who are going to intervene on a specific subsystem.
- iii) The logical plan, that is the output of the preceding phases, is related to a possible logical structure of the database: but this does not mean that its function is Edp oriented! On the contrary,

the logical plan is a proposal in order to start a process of information collection and of socio-economic unit description. Its degree of definition increases as the collective consciousness of the people about socio-economic phenomena increases.

Each socio-economic unit is represented as a "box" in the logic plan. Usually such "boxes" represent important economic activities (agriculture, families, labour force, industry, trade, etc.). Each "box" is connected with the others according to the perceptions and knowledge of the users. Each activity is then composed of "segments": for example, the "box" "Agriculture" can be subdivided into the following segments: hunting and fishing, zoothechny growings, etc.; the "box" "Tourism" into the segments: international holiday resorts, hotels, private rooms, etc.

For each "segment" the following aspects should be identified and quantitatively analyzed:

- economic flows (revenues, turnover, etc.)
- functional relationships (with other segments)
- structures (geographic location, number of employees, type of products, etc.)

The graph of the "logical map" serves as a schema of reference, i.e. as a grid in order to aid the collection of data from different sources. Different methods of collection are employed.

The starting point obviously, should be a consultation of data from ISTAT (National Institute of Statistics).

Information about socio-economic units is more easily found from the principal operators in each sub-system (economic operators, opinion leaders, etc.) who can furnish personal opinions which are, however, based on specific experiences.

Such opinions can be considered hypotheses to be verified by ad hoc inquiry on the field.

When estimates (even qualitative ones) are obtained from various opinion leaders, it is possible to compare them in order to identify both the trend of particular local socio-economic phenomena and the consequent problems involved.

The opinions collected and the results of partial inquiries are then presented for discussion in popular assemblies on specific

themes corresponding to the more important socio-economic units.

The process of information enrichment brought by popular participation makes it possible to transform the logical map into an oriented flow graph (where the arcs which join the various blocks are in some way quantified).

On the graph it is possible to identify privileged itineraries or "circuits" according to their socio-economic importance.

At first the nature of the relationships is of a qualitative kind; in order to organise an intervention it is essential that quantitative structure be found, even, if necessary, by carrying out ad hoc inquiries.

5.2. The control superstructure

The local authority is, as any bureaucracy, a meso-integrated organizational system.

Each office (service) is relatively identifiable on the basis of its objectives, functions, degree of autonomy, "memory". But the loose structure of the phenomena which take place outside the authority is often not coherent with the purposive structure of the local government.

And it may happen that the public bureaucratic structure becomes some sort of "opaque filter" between the socio-economic processes on the land and the elected representatives (i.e., the political decision-makers in the council) (see Fig. 2).

Such structure becomes an opaque filter between territory and the political council (Fig.2). On one hand land use planning requires integrated services, mainly related to the important "chains" identified, on the other the council needs an integrated view of relevant phenomena in order to implement effective decisions. The identification of the chains can be a first means to pin-point the activities which need financial support, further investigation and information, evaluation of consequences etc.

In the local government considered, the first outcome of the action research has been the redesign of the administrative structure according to the oriented network resulted from the analysis, taking into account the juridical constraints.

The redesign is a first step towards the creation of the new IS.

Fig. 2 - Model of land unit.

6. CONCLUSIONS

Systems analysis techniques need to include participation strategies, in order to implement effective computer-based information systems.

Besides ideological or marketing-oriented justifications, there seem to be structural reasons for user's participation: during the analysis and design phases the "memory" of the members of the organization has to be made explicit, formalized and partially transferred into the computer programs; in the usage phase users must co-operate to "feed" the systems and to fill in the gaps which inevitably occur after the introduction of the new system.

Moreover, participation appears to be crucial for the case of imperfectly organized (hypointegrated) social systems. Creating a new information system in a hypointegrated social system is a fairly different task from introducing a computer in a firm, for in the former structural relationships among system parts are poorly defined.

The local government and the socio-economic processes which take place on its land form a hypointegrated system.

Many purposeful subsystems (firms, families, schools, hospitals, transports, etc.) operate on the territory of the local government, the definition of the relationships among the subsystems and between these and the administrative structure is an open problem.

In such a context advanced information systems are usually conceived according to a general purpose data base approach.

For example, a socio-economic information system for the local authority is designed as a data base, which owing to its general purposes, should satisfy the needs of different users. In this way the variety and the fuzzy texture of the hypointegrated system and of its objectives set is taken into account.

A different (down-top) approach is being tested with an action-research experiment carried out in the local authority of Otranto.

In order to define a new IS, at first the imperfect organization of the hypointegrated system is improved through a learning process of knowledge acquisition, memory exchange, and participation among the socio-economic actors who live and work on the land of the local government.

"Organization of a system is an activity that can be carried out only by purposeful entities" (Ackoff /22/), and in this case such entities are officers, associations, employers, trade unions, indivi-

duals, citizens of the local community. The act of organizing is a process of participation. The analysis and design of both the organizational and information system are an outcome of the participation process.

Information system analysis in a hypointegrated context appears to be first of all a social system design activity.

NOTES

- (1) According to R.L.Ackoff, in an imperfectly organized system, "even if every part performs as well as possible relative to its own objectives, the total system will often not perform as well as possible relative to its objectives" /22/.
- (2) The concept of memory has been used by various authors in the context of organizational and IS studies. J.G. March and H.A. Simon /16/ refer the importance of the organizational memory to the innovation process within an organization: each time an innovation is introduced, the most important source of organizational proposals is composed of the solutions and procedures "stored" in the memory of organization members.

According to J.L.Le Moigne /17/ the memory contains models and programs related with the transformation system of the organization. E.S. Dünn /18/ writes that the memory of an IS, applied to whatever social process, is composed of the individual and organizational "history", decision rules, programs and models, the goals and values of individuals and groups. Finally, the notion of "track" by S.Beer /19/ should be recalled and the examples of organizational memory proposed by M. Landry /20/. The concept of memory applied to the analysis of the consequences of Edp technology or decision-making has been presented in /21/; in such a context organizational memory seems to be a component of the "real power" within organization.

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