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A DYNAMIC SOFTWARE SYSTEM FOR THE ARCHITECTURAL BRIEF OF THE POLITICAL SCIENCE FACULTY

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INTRODUCTION

The Political Science Faculty of Ankara University is planning to establish its own independent campus at a site acquired from the Turkish National Treasury near the township of Gölbaşı in Ankara. (Figure 1). The total land available for the campus is about 107 hectars on which 10 000 students will be finally accomodated. The plan for the campus not only include educational and research buildings but all other social, health, residential, etc. provisions as well. Because the campus is to be located at a site rather distant from the city, the residential units need critical attention. There is a lake nearly; thus water sports have been proposed in addition to regular sports activities. The School of Journalism of the faculty is also expected to use various parts of the site for purposes such as film making and for interaction with the local community in the town of Gölbaşı and a congress hall for political sciences is also a part of the plan. Various internal revenue generating organizations are expected to be established within the campus.

The unstable, undefined and undecided nature of the present economic situation in Turkey, as well as the rate of social change force the individuals or institutions involved to make decisions suitable to flexibility in the brief, design and construction phases. The outcome of such an approach is expected to yield results so that the built environment can satisfy various needs arising through the process of social and economic metamorphosis. When we observe the present state of planning activities, we notice the rigidness and the static nature of the decisions made in preparing the brieves of public buildings. This, in itself is in contradiction with the statement made at the beginning of this paragraph. Thus, a dynamic approach for the preparation of brieves is necessary, which will make it possible to satisfy various needs arising in time, whether this be in the planning, programming, design, or construction phases or in the spatial management phase after the buildings have been completed. This whole approach should be aided by a dynamic computer software system which can provide for the modifications necessiated by the inputs that change in time at all phases of the building activity. For the accomodation of various policies need also to be introduced. These have to be extended to the economical and spatial behaviour of the predicted built environment, not excluding the infrastructure and vegetation. A component of social and psychological research should also be conducted externally, affecting various policies, spatial standards, and design principles. The results of these external studies should naturally be included in the evaluation processes and the feedback mechanism of the software system.

Within these guidelines, work has been started for the development of the software system described above for the Political Science Faculty. Two applied research contracts have been signed between Middle East Technical University and Ankara University, to be conducted by a research group under the supervision of the authors.[1]

1. The authors would like to thank to the members of the research group, and the staff of the Political Sciences Faculty for their valuable suggestions and contributions.

This article explains the method, components, and the structure of the software system developed for this purpose. Thus, the discussions will be limited to the description of the software system rather than the specific requirements of the campus to be planned. The discussions will not be on the syntax of the system however; because of the dynamism of the whole approach, the flow of information and its interpretation at various levels seem to be more important. Therefore discussions are provided on the semantics of the whole approach, referring to syntactical issues wherever technical clarifications are of necessity.

ARCHITECTURAL PROGRAMMING

Architectural programming can be thought of as the phase between the planning decision of an establishment and the actual design of the buildings. In other words, programming leads to the actual shaping of the needs described in the planning phase. Thus, programming overlaps with planning on one end while the same is true for design on the other end. This two sided overlap necessitates the provision of a dense feedback mechanism. Through this mechanism, one should be able to test the results of planning decisions as reflected on design as these may lead to various contradictions. Since architectural design is an ill-defined process for most cases,[2] the feedback mechanism seems to be a primary source for resolutions between planning and design. As programming overlaps both with planning and design, it has to be the catalyst for the feedback process.

2. W.J. MITCHELL, *Computer-Aided Architectural Design*, New York: Petrocelli/Charter, 1977, pp. 60-62.

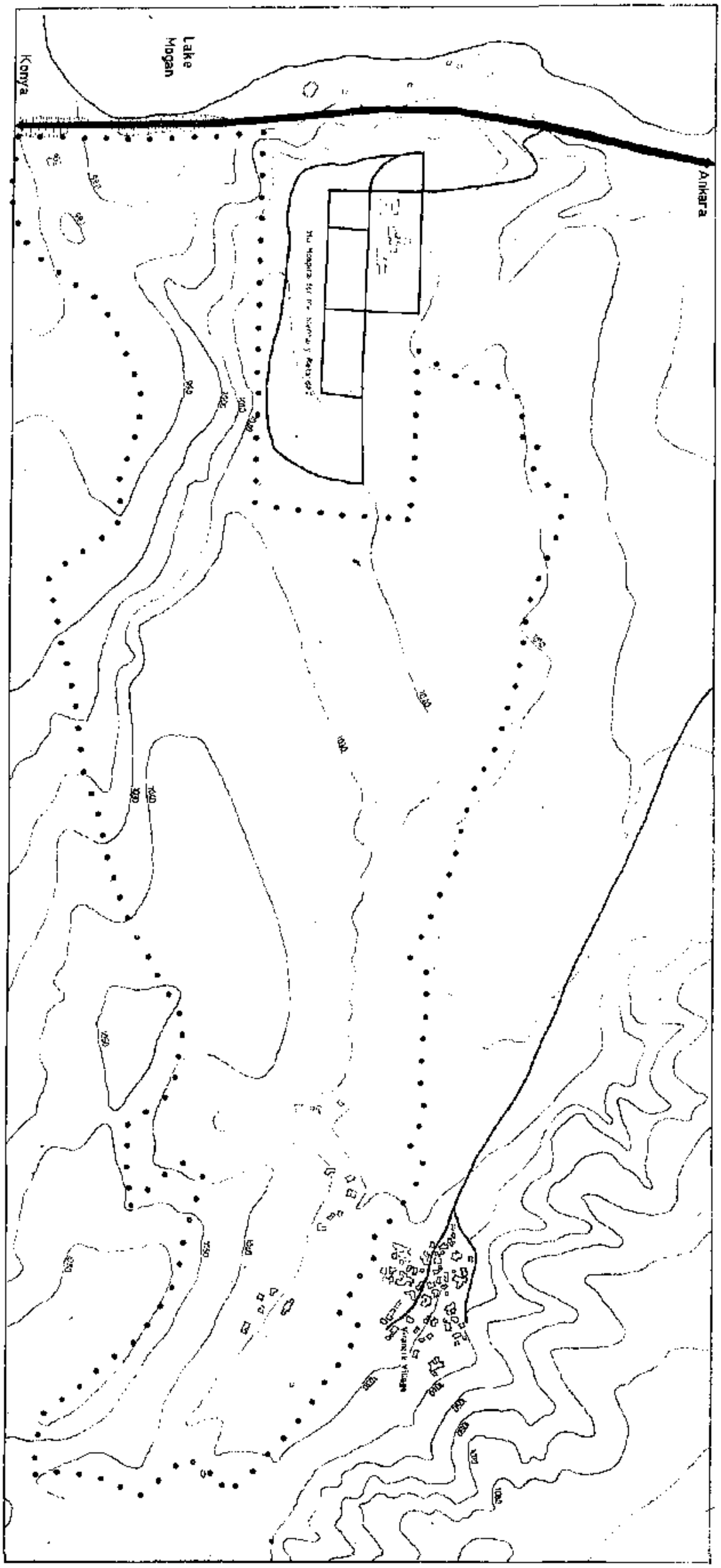

Figure 1. Map of the site for the proposed campus.

There are two important factors that effect architectural programming, originating in the fact that planning and programming as well as programming and design are not seperated from each other by well-defined boundaries. In cases of ill-definedness in the planning phase, the programmers must work with the planners. This requirement leads to a plan oriented brief, introducing some problems to the development of the establishment: the building activities conducted within the framework of the brief that contains decisions on the plan level will unavoidably cause some confusions. These confusions will basically relate to the need for interpretations where information is not available on a satisfactory level. One of the cases for ill-definedness arises when a group of designers has conflicts among its members. Conflicts most likely occur during interpretation of minimally defined issues, let alone program definitons of planning level.

The relations between the brief and the design activities have two problemed issues: what should be the methods and procedures for designing the buildings that are programmed, and what is the level of interaction between the programmers and the designers. If these relations are left undefined, the brief must be prepared almost in the sense of a *user's manual*, with very little chance for future modification. On the other hand, if an interaction between the designer and the planner is favored, programming must act as an evaluation and improvement procedure between the two activities. This forces the programming activity to be open ended and in continuum, requiring the formation of a committee within the establishment itself for controlling its own spatial development.

AN APPROACH FOR THE DEVELOPMENT OF THE SOFTWARE SYSTEM

Since the planning decisions of the Political Sciences Faculty have not been completed in satisfactory detail and since there is a chance of strong collaboration between the programmers and the prospective designers, the following decisions have been made as bases for the approach to be taken during the programming phase:

a. To be involved to a certain extent in the planning phase in order to aid detailed decision making.
b. To be involved in the design phase at such a level of sophistication that planning decisions could be modified through a feedback mechanism.
c. To be able to evaluate the expected results of various alternatives generated in the planning, programming, and design phases.

For this purpose, a software system has been developed for which the input can be grouped under the following headings.[3]

a. The growth of manpower, decisions on the policies of education and research, course schedules, and various other planning decisions,

3. M. PULTAR and B. ÖZGÜÇ, Siyasal Bilgiler Fakültesi Gölbaşı Yerleşkesi Mimari Gereksinme Programı için Devingen Bilgisayar Yazılım dizgesi. Uygulamalı Araştırma Raporu, n. 80.05.05.01, Orta Doğu Teknik Üniversitesi, Ankara, 1980. See also, M.PULTAR and B.ÖZGÜÇ, Siyasal Bilgiler Fakültesi Mimari Gereksinme Programı için Devingen Bir Yazılım Dizgesi, *Bilişim 80 - Bildiriler*, Ankara Türkiye Bilişim Derneği Yayınları, 1980 pp. 132-137.

b. Site criteria and construction restrictions influencing the development of the campus.
c. Dimensional factors influencing the sizing of the spaces.

With respect to the inputs outlined above, the software system will generate the architectural brief for a given time, alternate site allocation schemes with respect to this brief, and construction and operation costs for each alternative. Since the alternative settlement schemes are results of various policies, their evaluation will not only be on construction and operational economies but also on the validity of the policies themselves. The feedback mechanism between planning and design thus should be activated at this stage even if there are no major conflicts. There is always room for an iterative improvement procedure which can take place on a detail level or on a major level such as the comparison of policies with their physical outcomes.

The capabilities of the software system are as follows:

1. The prediction of the manpower (student, academic staff, service personnel) that will use the buildings of the campus during the development plan and the according prediction of the budget and space requirements in terms of global settlement area.
2. The generation of a list of spaces required for a particular section in time together with their standards.
3. The time scheduling of these spaces (especially the lecture rooms).
4. With respect to the relations of the activities to be performed in these spaces, the generation of alternate building blocks.
5. The allocation of these blocks on the site in conformance with the land criteria and construction restrictions.
6. After alternate allocations have been completed, the calculation of the construction and operating costs of the alternatives (In the prediction of the operating costs and in evaluating alternatives, passive solar heating capacities have been a very influential factor).

Even though the present hardware system where the software package in question is run[4] does not allow for real time interaction, the manual intervention of the users is also provided for at various stages. This is basically useful during design decisions of building allocation, infra structure and landscape design. Whatever is manually input to the system, not excluding modifications on system results, are included in the remaining analyses and evaluations.

In the development of the software system, the concept of dynamism has been approached through three main directions:

1. To provide for the first capability of the system, a simulation model has been prepared for the prediction of manpower, budget, and spatial development. With this model, the effects of planning decisions on manpower can be examined.

4. This system is the IBM 370/145 of Middle East Technical University, running on OS/VS1 on a batch mode. This system will be replaced (Summer 1981) by a Burroughs B6930 on which real time interaction will be possible and the capacities of the software system better exploited.

2. All types of spaces that are likely to be used in a campus as such have been listed with their standards. The allocation of some (or all, or none) of these spaces is controlled by factors arising at a certain time within the development plan. Similarly, the sizes and standards of these spaces are also subject to modifications (if necessary) within the same concept of factors arising in time.

3. Upon construction of some of the spaces, the software system will be ready to consider these available areas for re-allocation or re-scheduling. It is natural that additional type of spaces might be required during the development period. One of the capabilities of the system is to check for minimally used spaces and to examine whether this new type can be overlapped with one of them. If not, a new space will be included in the space file. With this organizational capability of the system, functions of spaces might be reallocated, superimposed, or partially overlapped. This capacity will prevent the wasteful usage of spaces in addition to the dynamic management of the building inventory of the campus existent at any time.

The system has been run for the nearest (first 5 years) and the furthest (end of 20 years) time sections of the development plan in order to find logical subdivision in the total development phase.[5] Subdivisions for construction and expansion periods are made with respect to comparisons between the minimal necessities for the campus and the maximum limits to which the campus is expected to grow. The minimum and maximum comparisons are not only handled for the entire development period but for the proposed time subdivisions as well. During the process of construction phase planning various functional reallocation considerations, and various predictions for on site residence (both students and faculty) have been made in order to minimize cost as much as possible without affecting the policies and educational quality. However, these studies have been made with the data presently available, thus manpower predictions were based on the recent past of the Faculty. Furthermore, no economical predictions were made other than an expected inflation rate.

5. M. PULTAR and B. ÖZGÜÇ, Siyasal Bilgiler Fakültesi Gölbaşı Yerleşkesi Mimari Gereksinme Programı ve Açıklamaları, Uygulamalı Araştırma Raporu, n. 80.05.05.02. Orta Doğu Teknik Üniversitesi, Ankara, 1980.

For the future trials of the system, further predictions and probabilistic development patterns of the Faculty that might necessitate policy changes will be studied. Economical development, especially influencing construction and fuel costs (both for heating and transportation) will be examined in more detail, not excluding probabilistic developments and impacts.

DESCRIPTION OF THE SOFTWARE SYSTEM

The flow diagram of the software system is given in Figure 2. The diagram illustrates the operational order of various programs, their relations, input files to individual programs, outputs of various programs in the form of files, and the shared files. The numbers associated with individual programs show the sequence of operation of the programs in a typical run.

The software system consists of three main parts. The first of these deals with the totality of the development plan, mainly predicting values such as manpower, budget, and spatial growth over the total span of the development period. The second part generates brieves and alternate campus schemes for a particular time section within the development period. The third part evaluates alternatives that are either generated by the previous part or have been modified manually. These parts, together with their associated programs and files are illustrated in Figure 2.

The quantitative behavior of the Political Science Faculty within the development period is studied by a program called BENZET[6] written for the DYNAMO problem-oriented language.[7] The predictions for student, academic staff, personnel growth, and their ratios are made with respect to the historical behaviour, budget, and spatial needs of the faculty. The results obtained from BENZET for a particular time section are stored in a file to be used by the second part of the software system. A sample output from this program is given in Figure 3. This graph shows the behaviour of student and faculty growth with their associated spatial needs. Since the graph is taken from a partial study of the growth pattern, it does not necessarily illustrate the actual behaviour.

ZAMAN, the first program of the second part, uses the results of BENZET, as well as the manually prepared course file, and course policies in order to estimate the number and standards of class rooms and lecture halls. Another output from ZAMAN is the weekly course schedule for each term of the time section chosen from the development period. Class rooms found thus are the initial members of the space file that will eventually contain the codes, sizes, and standard references for the rest of the required spaces of the campus. UZAM basically completes the space file, estimating the required spaces and their quantities with respect to BENZET results, previously determined allocation ratios and constants, and the academic organization of the campus at a given time. This particular program also determines whether certain spaces can be common for various uses or departments, which spaces could be in close proximity and which spaces could overlap. The ratios used for determining the spatial needs consist of the minimum manpower for the allocation of a particular space, and area calculation factors with respect to the particular usage of a space.

Certain spaces may be fixed in number and size. Such spaces are input to the system by making use of the ratios coded in such a way that the ratio specification will be interpreted as the actual value.

6. Program names are Turkish acronyms and/or abbreviations as follows:
BENZET - simulation
ZAMAN - time scheduling
UZAM - space allocation
YAPILA - building block composition
DAKIZ - dynamic land use allocation
UZEYI - space optimization
ARADE - land evaluation
ISI - heat budget
DEGER - evaluation

7. A.L.PUGH, *Dynamo II User's Handbook*, Cambridge, Mass.: MIT Press, 1970.

The spaces generated in the space file are organized into building(s) by the fourth program, YAPILA, of the second part. The input to this program is the space file generated both by ZAMAN and UZAM as well as the organizational policy file prepared by external interaction. The output is in the form of a report containing the building blocks consisting of departments, departmental spaces, and the service areas determined using a set of new ratios for each particular type of building. The costs of various components of the buildings are also reported, the detail of which is controlled by option codes. A sample output from YAPILA is given in Figure 4, which is part of a short report, as explained below.

YAPILA is capable of producing four types of report on demand. The shortest building report consists only of building blocks, the departments contained in each block and the general service areas. Costs are given. A longer report will list the rooms of each department with their costs and furnishing codes as well as sizes, lighting, heating and maintenance requirements. The long space report pulls out every minute detail for each space from a standards specification file on disk and prints them out in each department where the room is contained. These details are in the form of physical elements such as surface coverings, ventilating requirements, etc., or in the form of allocation criteria such as orientation or user preferences at social and/or psychological level. The longest report will include such detail on the departmental level as well.

DAKIZ, a land allocation model, uses the outputs of YAPILA, as well as two externally generated files containing land values and allocation criteria for buildings. The site is approximated to an orthogonal grid and each cell (lot) is defined by its values such as building restrictions, soil type, slope, height, lighting, radiation, wind, view, distance from noise-generating sources, etc. These values are stored in the land values file where some values are determined by various interpolations and distributions through another program named ARADE 1. Figure 5 is a sample output of this program, displaying the natural radiation distribution on the site with respect to shopes and orientation. The allocation criteria file contains the relations of particular buildings to land values on a scale of desirability. Since the allocation schemes generated by DAKIZ do not take into consideration various aspects such as dimensional optimization and relation of buildings each other, another program called UZEYI makes modifications and generates improved alternatives on the output of DAKIZ. Because the schemes generated by DAKIZ and UZEYI are only controlled by numerical criteria, they are not acceptable without question. In order to overcome the problems posed by the approach described so far, relation is now set to an extra-systemic component consisting of a group of architects, city planners, landscape architects and urban designers so that acceptable site plans with infrastructure and landscape designs may be generated. It is not unusual that more than one alternative be generated through this process.

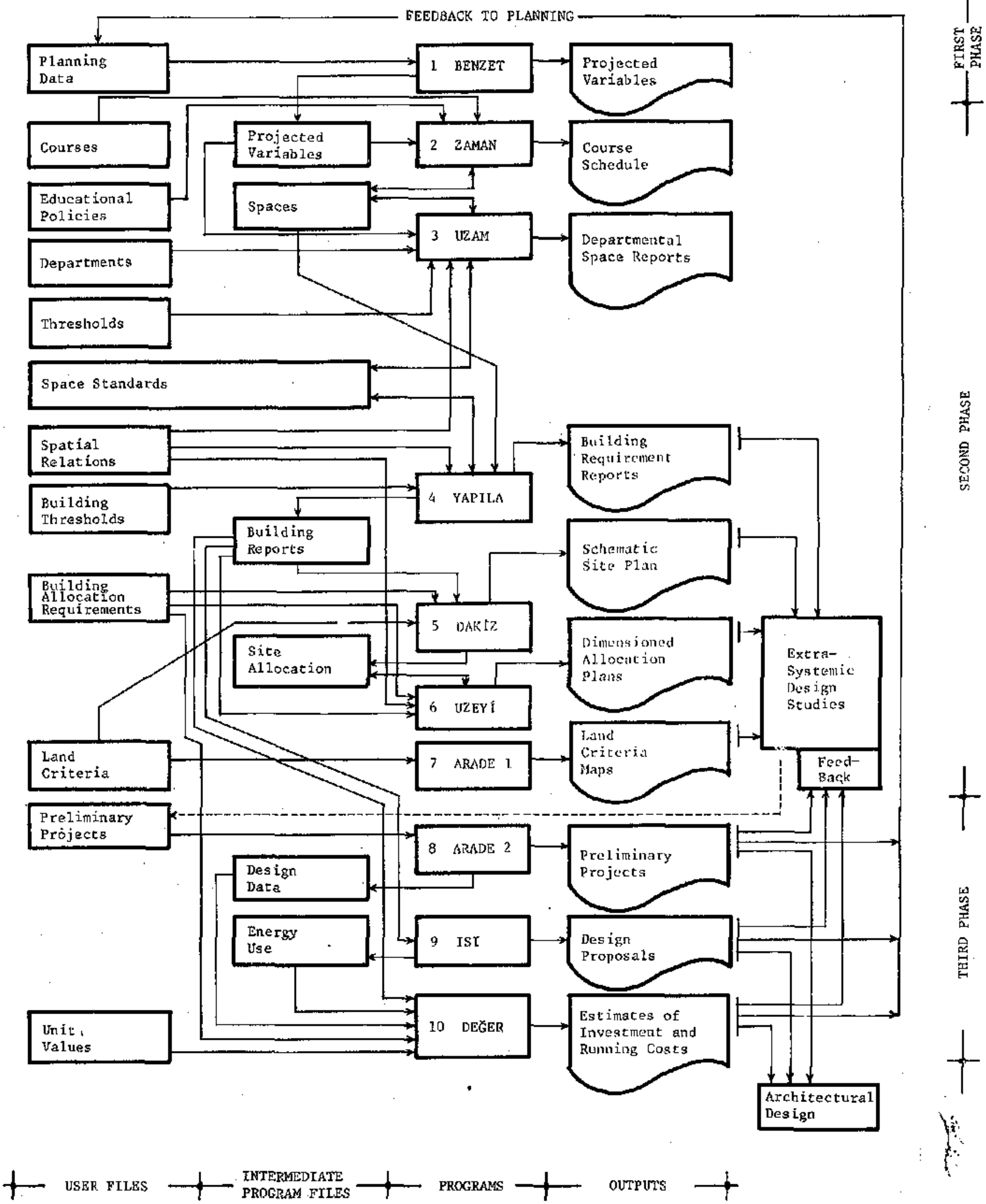

Figure 2. The flow diagram of the software system.

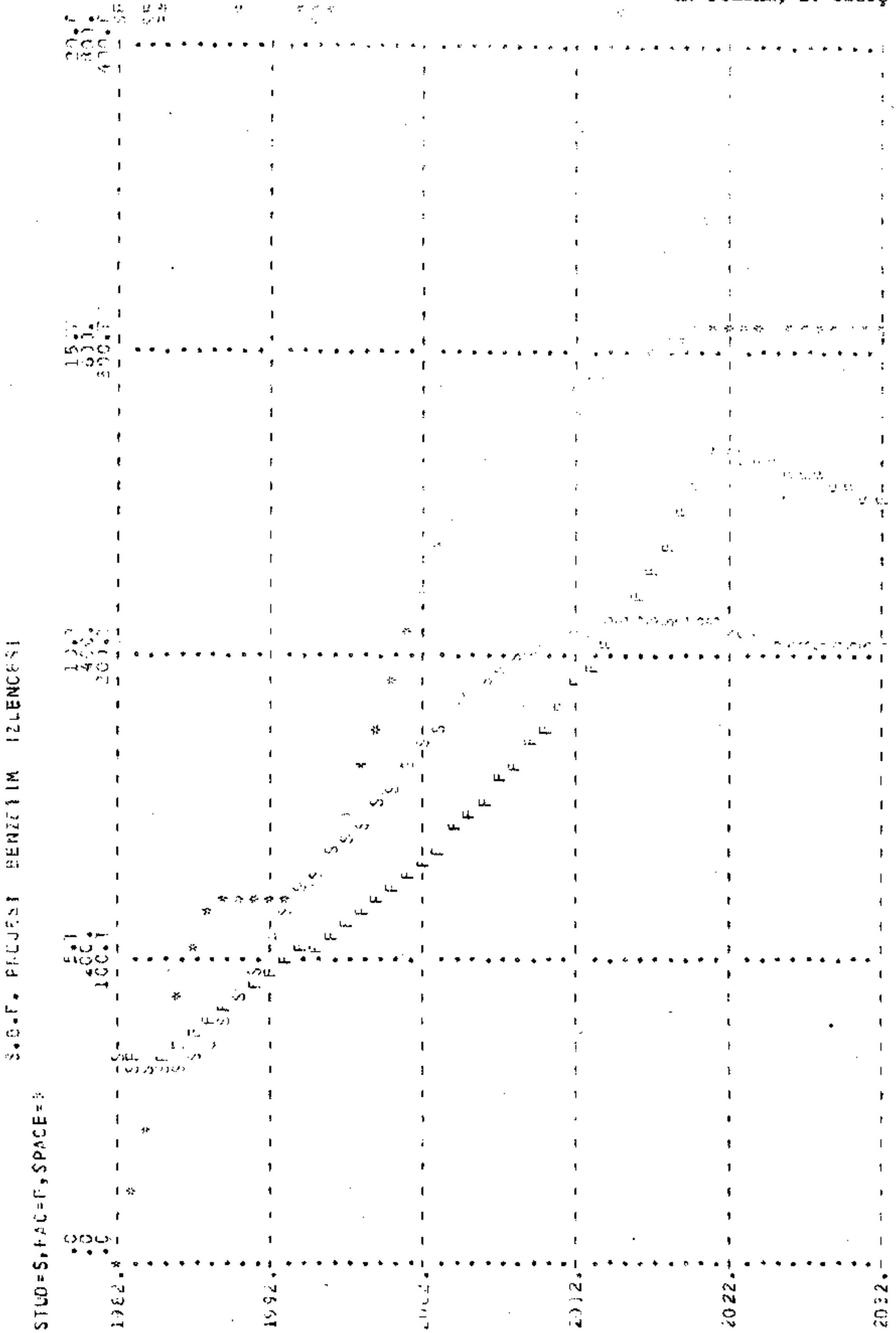

Figure 3. A sample output from BENZET showing the predicted growth in faculty and student body (F and S, respectively), and the associated spatial needs(*).

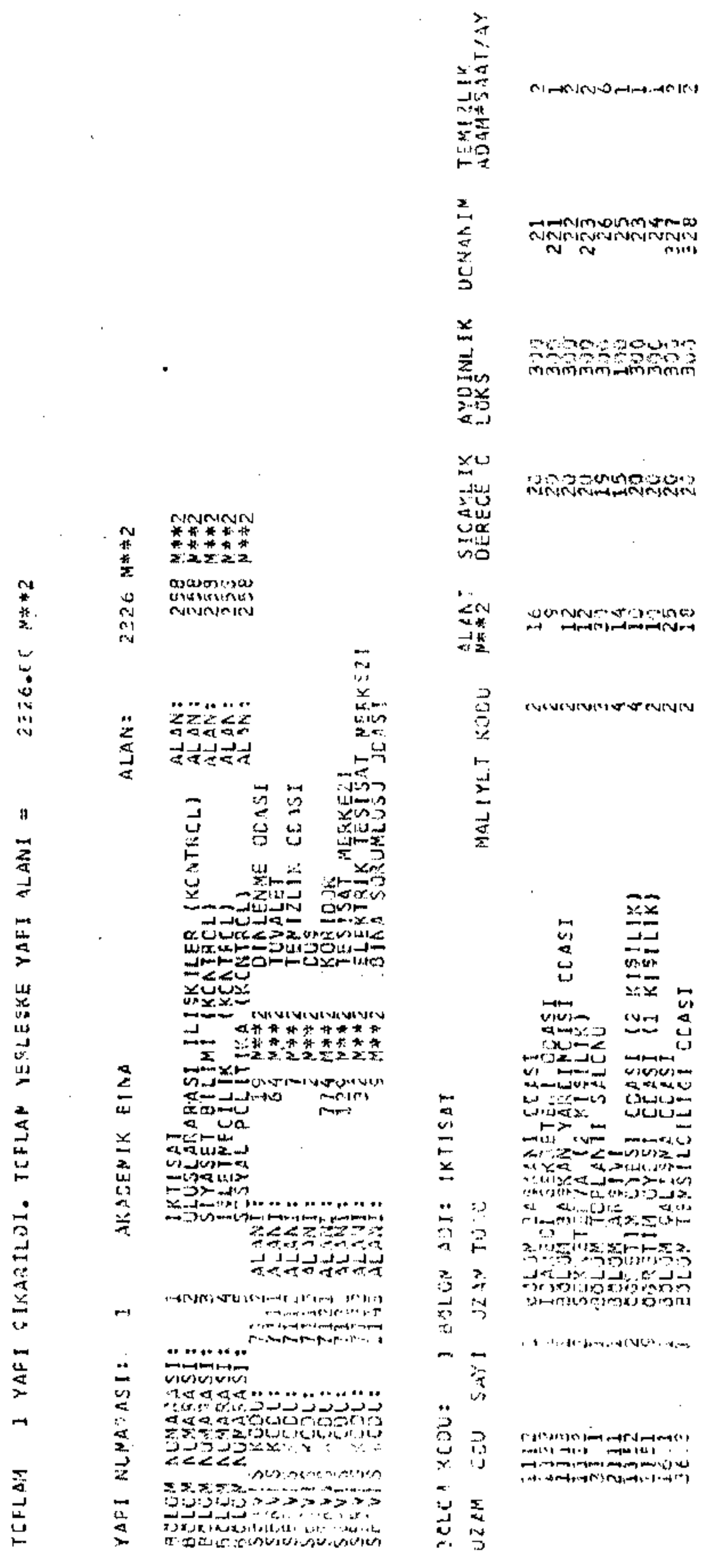

Figure 4. A short-form building report displaying various spaces contained in a particular block with their sizes.

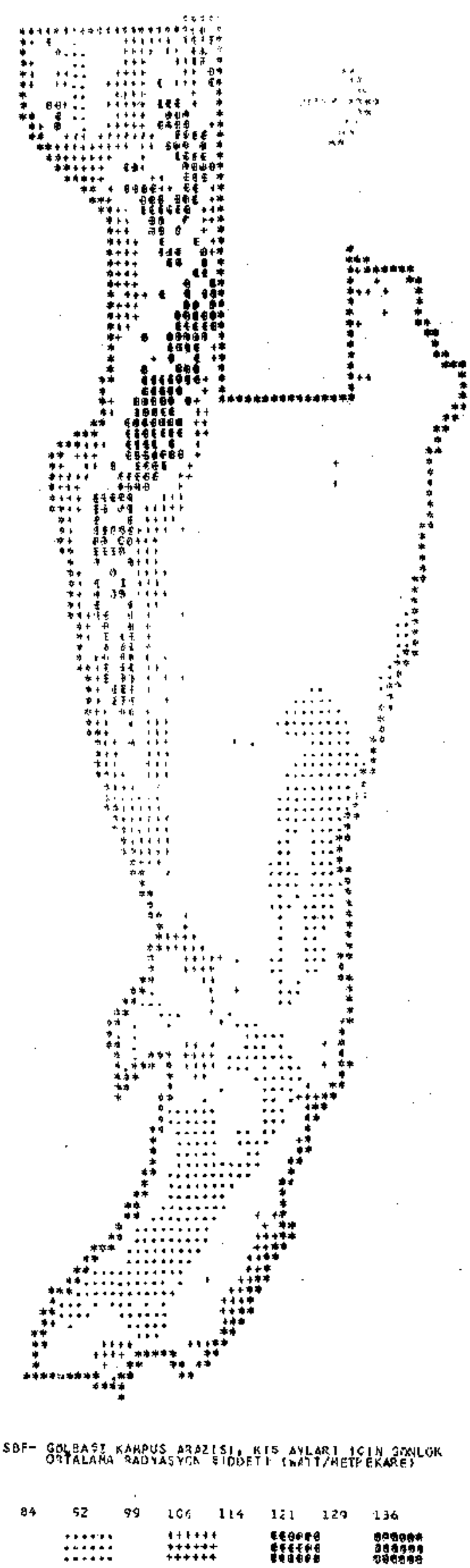

Figure 5. A sample output from ARADE 1. Data values for radiation given on certain points are distributed over the site by interpolation.

The third part of the software system evaluates the alternative(s) generated in the previous parts or by the extra-systemic group. ISI, a heating requirement program, determines suitable orientation, fenestration ratios, and building materials so that maximum solar energy may be utilized. The cost of heating for each building as well as the campus is then calculated with respect to the provisions ISI has provided. ARADE 2, a digitizing program, uses the improved alternatives as input and generates the project file in a digitized form.

The final program of the system, DEGER, uses almost every available file and determines the construction and operation cost of the campus alternatives. It also determines the suitability of the alternatives to the brief and the budget. Any conflicts or discrepancies occuring in the outputs of DEGER provoke the feedback mechanism or else finalize the brief for the particular time section in question.

DATA BASE DESCRIPTION

There are two major types of data that the system uses:

a. Numeric Data - This type of data consist of inputs and constants such as student and academic staff numbers, space standards codes, ratios, etc.
b. Graphical Data - The input and outputs of UZEYI and ARADE are in the form of graphical data. They are either interpreted as various grey-scale grid cells (lots) or actual vector coordinates for line and polygon plotting. Land descriptions, alternative campus allocations and building plots are examples to the graphical files. Since a digital plotter is not presently available at the installation where the software system is run, all hard copies are obtained as grey scale printer outputs.

With respect to the ways the input data is generated, there are three main categories:

a. Data that is externally provided - Most of the numeric data, land description and other data generated through the research of users or specified by the sponsors (such as course files) are directly fed to the system through input utility programs.
b. Intermittent sharable files - The data in this category consists of files that are outputs of some programs and used by others.
c. User - Program Files - These files are partially provided by the user and completed by the results of certain program runs. Space file is an example of this case where areas and certain standards of particular rooms are internally calculated and the data is automatically updated.

Due to the differences in the type of data contained in various files, a Data Base Management System (DBMS) undertakes various internal data management functions. Also containing a dictionary for code interpretation, the DBMS provides for the communication ~~of various~~ internal programs as well as the man - machine interaction. While doing so, warnings, errors and some data optimisation actions are notified to the users in the form of full explanations. The flow diagram of the DBMS is given in Figure 6. The errors and warnings basically relate to system commands that are not known, attempts to use undefined criteria or spaces or missing information that is required at a particular stage. Under certain cases standard actions can be taken, which is notified to the user. Since the majority of the software system is written in FORTRAN IV, much care has been taken in order to avoid the possible execution errors such as division by zero and undefined DO LOOP parameters.

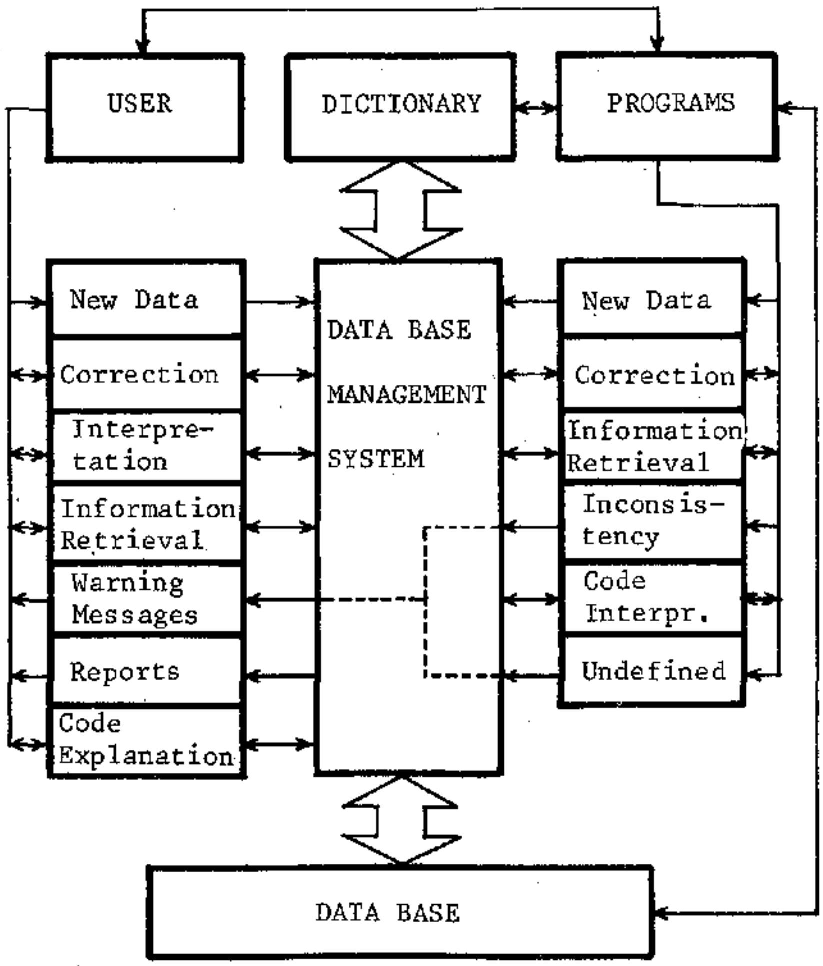

Figure 6. The data management and flow procedures of the software system.

POSSIBILITIES OF OTHER APPLICATIONS

The software system has been explained above with respect to campus development. However, the programs of the system can be used for various other purposes as explained individually below.

1. BENZET may be used to study the influences of different policies as reflected on manpower, budget, and space predictions. Within the framework of such an analysis, critical policies could be determined with respect to the possible future developments.

2. ZAMAN may be used for making course or examination schedules when the available class-rooms are known with their sizes and standards. Furthermore, it could be used in determining the additional space requirements (or wastes) when there are educational policy changes.[8]

3. UZAM may be used to compare the existing spaces with the needs of a predicted period, providing for efficient spatial management by allocating or clustering various functions to less densely used available spaces. This could be done at departmental, building or campus levels or any combination of the three.

4. YAPILA is particularly useful during design stages where the results of different departmental clusters are examined. These clusters can be formulated by either the density of relations between departments or by service and technical requirements. Arbitrary or random choices could also be made for exhaustive generation techniques.

5. DAKIZ may be useful during design by providing alternate choices when the allocation priorities of particular buildings are interchanged. Furthermore, when some parts of the campus are built, certain criteria of the lots surrounding these buildings might change (eg. view). For further developments on the campus, these new criteria will influence the generation of alternatives.

6. UZEYI is another helper of the designer and provides detailed building schematics on the lots allocated by DAKIZ. These "plans" are outputted graphically where sizing is in accordance with the brief. By fixing certain departments (or buildings, or rooms, depending on the scale of the current phase), various alternatives could be generated that grow around the fixed departments, thus satisfying certain priorities.

7. ISI could immediately warn the designers on the heat consumption of the designs they make. This is particularly useful at a stage where fossil fuel is getting more and more difficult to obtain. Furthermore, it could be used in predicting the heating budget of the campus with respect to the changing fuel prices.

8. In fact, this program is being used at present to investigate the spatial consequences of an educational policy change in the Faculty of Political Science on its present premises.

8. The evaluation program DEGER may be used to check the validity of certain planning decisions and policies and can directly provoke actions by the planners. Certain policies might seem to be fairly sound on paper but their reflections on the built environment could be considerably difficult and at high costs. This can be noticed by DEGER and policies might be modified slightly. Even thouh this is a rather expensive procedure computer-wise, it can save enormous amounts of time and cost at the long run.

SİYASAL BİLGİLER FAKÜLTESİ MİMARİ GEREKSİNME PROGRAMI İÇİN DEVİNGEN BİR YAZILIM DİZGESİ

ÖZET

Siyasal Bilgiler Fakültesi, Ankara Gölbaşı'nda yeni bir yerleşke oluşturmayı tasarlamaktadır. Yazıda, bu yerleşkede bulunacak tesislerin mimari izlencesinin yapılabilmesi için geliştirilen devingen bir bilgisayar yazılım dizgesi tanıtılmaktadır.

Mimari izlencenin yeri, planlama ve tasarım ile kesiştiği yerler ve yüklenmesi gerektiği geri besleme görevi etraflıca tartışılarak, dizge bu unsurlar kapsamı içinde ele alınmıştır.

Dizgedeki yordam ve kütüklerin kullanılabileceği diğer uygulama alanları da açıklamalarda içerilmektedir.

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