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ABSTRACT

In CERI's program on institutional management in higher education, eight universities were brought together to set up teams within their institutions to work on their respective pre-selected problem areas. The planning, programming and budgeting system (PPBS) was developed as a management tool which would improve effectiveness by increasing the requirements of economic thinking and economic responsibility at all levels. The system devised at Chalmers University of Technology has three main objectives: developing an output-oriented finance methodology applicable to the Swedish university system; developing a modern management methodology applicable to a PB university; and obtaining possibilities for changing the decision-making structure outside and inside the universities in a decentralized and democratic direction. The application of program budgeting at Chalmers for higher education and research is devised for undergraduate engineering, undergraduate science and social science, technical research and graduate training courses, and external services such as building maintenance and library services. (LBM)

centre for educational research and innovation

STUDIES IN INSTITUTIONAL MANAGEMENT IN HIGHER EDUCATION
- CHALMERS UNIVERSITY OF TECHNOLOGY -

THE DEVELOPMENT OF A PLANNING, PROGRAMMING AND BUDGETING SYSTEM

technical report

OECD ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

ORGANISATION FOR ECONOMIC
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EVALUATION CONFERENCE ON INSTITUTIONAL MANAGEMENT IN HIGHER EDUCATION

(2nd - 5th November, 1971)

CHALMERS UNIVERSITY OF TECHNOLOGY

THE DEVELOPMENT OF A PLANNING, PROGRAMMING AND BUDGETING SYSTEM

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PREFACE

What role should be assigned to the universities in the design of the future post-secondary education structure? What are the major curricular and pedagogical innovations needed by the universities consistent with the growth of knowledge and the social requirements of specific skills? What techniques and methods of management can be introduced within the university environment which will enable the institution to plan its activities adequately and to use the available resources effectively? These are some of the major issues facing the universities, and the OECD's current programmes in the field of higher education are concerned with all of them. The present series of publications arises from one of CERI's programmes concerned with the problems of university management.

In CERI's programme on institutional management in higher education, eight universities were brought together to set up teams within their institutions to work on their respective pre-selected problem areas.(1) These teams have worked over varying lengths of time, none of which exceeded two years. The results of their work, together with the results of the in-house research of the Secretariat will be presented before a wide audience of university executives and managers and Government representatives from the OECD Member countries at the Evaluation Conference scheduled for November 2nd-5th, 1971.

The programme's work has now produced analyses of the major problem areas of university management and the general directions in which solutions to these problems must be sought. By concentrating the effort in selected university environments the approaches developed may not have the attraction of generality, but this has been more than offset by the demonstration of concrete ways of tackling the specific problems of university management.

In my view, the body of effort represents significant contributions in, at least, four areas:

First, conscious of the fact that universities have become major consumers of financial resources, it has been possible to indicate methods for evaluating the requirements of resources and their costs not only for the university as a whole but especially for its different components. This has involved the use of the budget as a planning tool by linking the expenditures, as far as possible to the objectives of the programmes for which these expenditures have been incurred.

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(1) These universities are The Free University of Berlin, University of Bradford, University of Copenhagen, Technical University of Gothenburg, University of Lancaster, University of Nijmegen, University of Novi Sad, Université de Paris-Ouest Nanterre. The Copenhagen University project was, however, carried out by the team from the Technical University of Denmark.

Second, it has been possible to demonstrate the costs and the consequences of different decisions concerning selected university matters both for current operations and for expansion, in order that policy-makers may choose desired courses of action. Such an approach offers an opportunity for effectively reducing the arbitrariness of decisions concerning the allocation of resources, and thereby improving the general efficiency of operations.

Third, from early in the development of the programme it was found that the basic information requirement for university-wide management was either lacking or was too dispersed among various bodies for its effective utilisation by decision-makers. It was possible, in the programme, to carry out pilot exercises not only to determine information availability and requirements, but also to propose the creation of an information base within the university geared to the needs of the decision-makers.

Fourth, computer-based mathematical techniques and models have been constructed and tested to demonstrate their potential usefulness in providing a range of results quickly and efficiently, not only for the specific problems of the university for which they were constructed, but also for similar problems in a large number of different universities.

The work of the eight universities and the CERI central staff is a basis for a more widespread effort to improve the management of universities. Universities will remain vital institutions of our societies, offering ideas and skills which are necessary prerequisites for healthy social and economic progress. They must nevertheless respond to the need to ensure the effective management of their resources, and it is hoped that the study now completed will contribute to a management movement throughout the university systems of the Member countries.

The PPBS project at Chalmers University of Technology (CTH) was launched in Summer 1969 and was informally associated with the programme on Institutional Management in Higher Education of CERI. Representatives from the Office of Chancellor of Swedish Universities and CTH have participated in the meetings of the project leaders and other centre-based activities arranged by CERI. During this time a valuable exchange of information was carried out between project and the CERI staff.

CERI has recently entered into a formal relationship with CTH to launch the project entitled "Development of a Preliminary Planning, Programming and Budgeting Framework for the Graduate Training and Research Activities at the Chalmers University of Technology, Gothenburg, Sweden". This sub-project has been a pilot study which will result in a system to be tested in a specific area before developing a comprehensive programme budgeting framework for Graduate Training and Research in Sweden as a whole. This pilot study was started in March 1971.

This interim report presents the current status of the total PPBS-project at CTH. The report emphasises the practical aspects of the planning, programming and budgeting system. Since this management tool is novel in its application to the conditions of the university, such as Chalmers, the final results of the project will be eagerly awaited.

We wish to acknowledge the support of Rector N. Gralén of the Chalmers University of Technology, not only for the project in his university, but for the programme through his participation in the Steering Committee of Rectors/Vice-Chancellors which has guided the CERI Secretariat in finalising its programme of work on Institutional Management in Higher Education.

I. BACKGROUND TO THE PROJECT

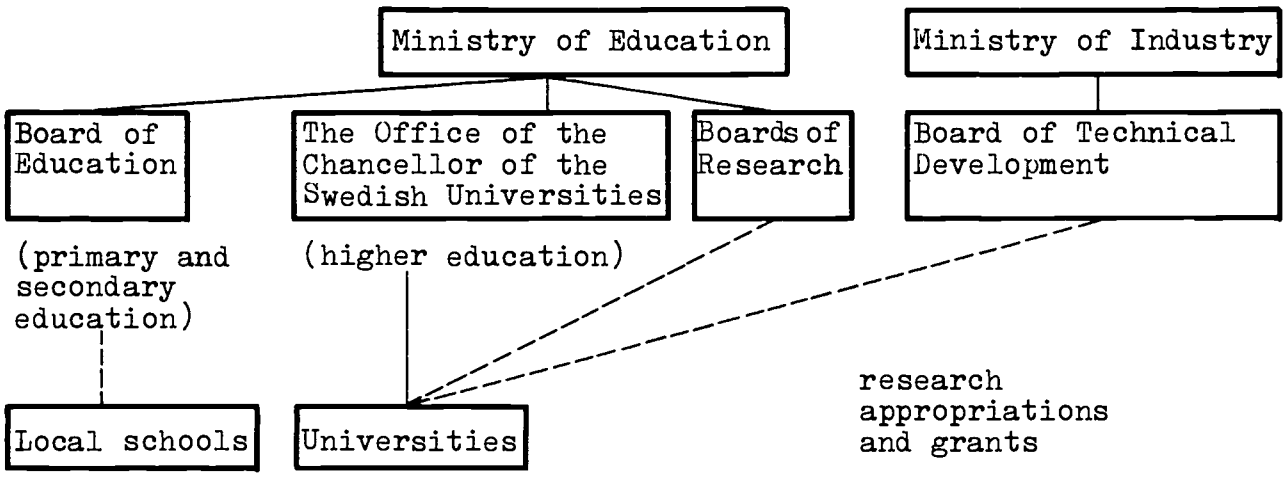
The development of PPBS in Sweden started in 1963 when a committee was established by the Government to investigate the possibilities of using PPBS as modern tools in state administration. The committee was ready in 1967 and presented a report on the principles of programme budgeting and its use in public administration especially for the management at agency level. The committee proposed that a PPBS and cost accounting system should be introduced in state agencies below the government level.

The concept of programme budgeting was defined in the report as follows: "Programme budgeting aims at improving effectiveness by means of creating a system of management which increases the requirements of economic thinking and economic responsibility at all levels". This means primarily that the goals should be specified in programmes for each agency. In order to attain these goals, the Government provides goal-directed appropriations for the different programmes. The basis for the budgeting will consist of quantifications of tasks to be carried out by the agencies and the costs arising thereby. The agencies are to be provided with considerable freedom, within the pre-determined framework, to choose those means, in the form of different factors of production which produce the best results.

The Government decided early in 1968 that pilot studies using programme budgeting would be extended to 23 agencies representing every department in the Government. The Office of Chancellor of the Swedish Universities was among the selected agencies for launching a PB pilot study. In order to build the PB system "from the bottom up", Chalmers University of Technology was chosen as the institution where a field pilot study could be launched.

The development of the PB system in the sector of higher education and research is directed by a "control group" attached to the Ministry of Education. Working groups have also been established at the Office of the Chancellor and at Chalmers University of Technology to lead the PB activities at each level.

Before I describe the activities within the project since 1968 and the present status of the Chalmers University PB pilot study, I should perhaps give a brief summary of the Swedish university system.



The Office of the Chancellor of the Swedish Universities functions as a planning and investigating governmental office. It is organised into five Departments:

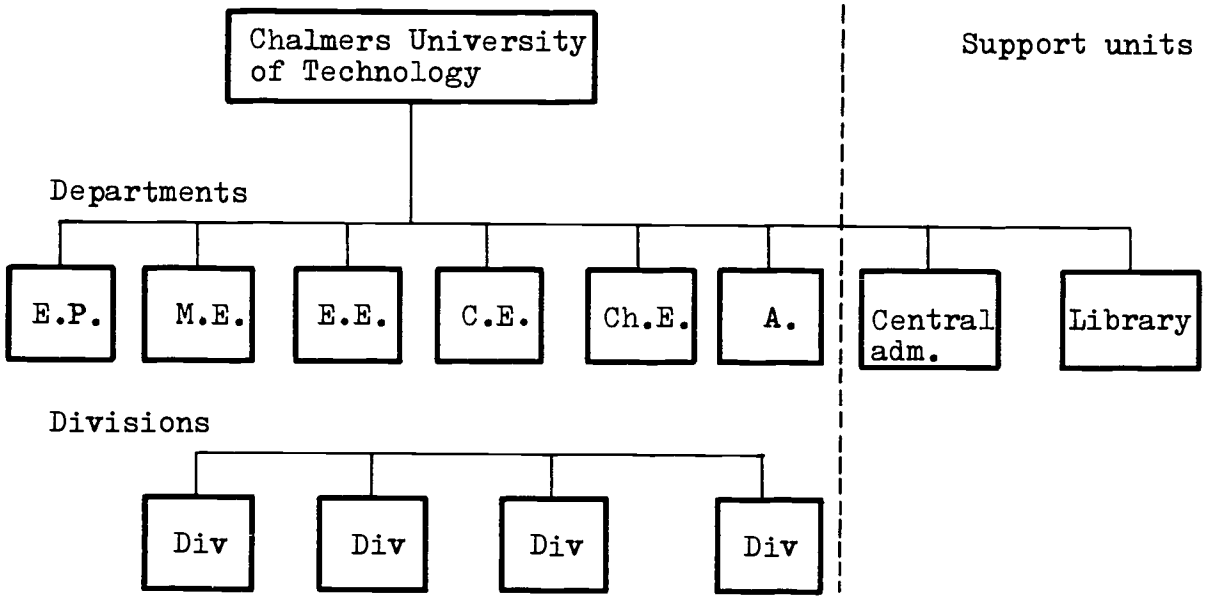
1. Planning
2. Training
3. Educational planning and Research
4. Administration and Organisation
5. Management and Auditing.

Representatives of commercial and industrial life, professional organisations, administration, teachers and students, etc. are associated to the Office through the Faculty Planning Boards which among other things have to give their opinion on the university budget requests. The Office of the Chancellor is also responsible for the various educational plans and for providing a uniform educational system at the different institutions.

One of the universities is Chalmers University of Technology (CTH). The university consists of six departments:

1. Engineering Physics
2. Mechanical and Naval Engineering
3. Electrical Engineering
4. Civil Engineering
5. Chemical Engineering
6. Architecture

The organisation is shown by a diagram on the next page:



II. OBJECTIVES OF THE PB PILOT STUDY AT CHALMERS UNIVERSITY OF TECHNOLOGY

The development of a Programme Budgeting System at Chalmers University of Technology has three main objectives, according to the general philosophy of the Swedish PB system:

- Developing an output-oriented finance methodology applicable to the Swedish university system.
- Developing a modern management methodology applicable to a PB university.
- Obtaining possibilities for changing the decision-making structure outside and inside the universities in a decentralised and "democratic" direction.

The Ministry of Education formulated a more detailed project description in a Memorandum of 27/6/1969, which is shown in Appendix 1. This description was completed after the preliminary investigations and is to be regarded as requirements of the system and its different parts.

III. CHRONOLOGICAL DESCRIPTION OF THE PB PROJECT AT CTH

Setting up a project organisation (Summer 1968)

The project started in the summer of 1968 with setting up a comprehensive project organisation. The project was commissioned by the Ministry of Education and from that level supervised by a "PB Control Group". The Office of the Chancellor, responsible for the project operations, expanded from the beginning the project to CTH. Since the summer of 1968, four persons, on the average, have been working at the project or with questions closely related to it, and half of this staff has been working at CTH. In order to lead the project activities at CTH a "PB working group" was established, consisting of the following members: Rector (chairman), 2 professors, Head of the Central ADM, Heads of the Departments of Educational Planning Administration and Planning plus staff members. The staff of the project is attached to the Department of Planning at the Central ADM.

Two divisions were selected for pilot studies (Autumn 1968)

The economic-administrative structure within the universities was rather unknown when the project started. In order to provide better knowledge of this structure, two divisions, Division of Physics and Division of Control Engineering, were selected. In our first project report in December 1968, a detailed analysis of these two divisions was presented, comprising their organisation, costs and resources, activities and outputs. We tried in this analysis to use the common PB concepts as defined in the general guidelines submitted by the Ministry of Finance.

In this first report more general discussions concerning the objectives and extension of programme budgeting were introduced, especially which costs the PPBS should comprise. At the initial phase it was obvious that only salary costs and current expenditures of the programmes could be calculated in the "output-oriented appropriation system". Other costs, such as that for computer time, investments and capital expenses for equipment and buildings were planned to be covered by the system at a later stage, due to the special conditions and restrictions related to these costs.

Design of university-wide cost-accounting and budgeting systems (Spring 1969)

The analysis of the different activities and objectives made it possible to establish a preliminary programme structure. With this as a basis the budgeting system and the cost-accounting system should be developed. During the spring of 1969, an EDP cost-accounting system was designed and implemented to start on the 1st of July 1969.

Internal budgeting procedure (Autumn 1969)

Related to this cost-accounting system an internal budget procedure was carried on during the summer and autumn of 1969. In this budgeting work the entire division participated with good results, as to the possibility of introducing the new management tools and purposes of PPBS to the professionals within the university. The theory of cost-effectiveness was in general accepted within the university (see Appendix 4).

Construction of a PB proposal model (Spring 1970)

With the budget figures given from the internal budget a Programme Budget Proposal could be submitted to the Office of the Chancellor. The design of the PB proposal followed a Budget Model for the university. This model is shown in Appendix 2. In the PB proposal we made an attempt to show how the outputs of various kinds could be quantified in the undergraduate programme. We soon found that the output-information that the present information systems could provide us with did not satisfy our needs and therefore the development of an ambitious Student Data System, which had already been started, was given top priority.

The presentation of the Graduate Training and Research programme was not especially elaborated in this first PB proposal as regards to the methodical framework of PPBS. Many problems had to be left unsolved and we have only recently been able to examine these questions again in the CERI/OECD sponsored project.

Revision of the cost-accounting EDP system (Spring 1970)

In the spring of 1970, a new cost-accounting data system was implemented, the SEA-system, which is an administrative management data system which most agencies in Sweden will adopt.

Analysis of the internal planning system (Autumn 1970)

The internal planning system was carefully examined in the autumn of 1970, together with a general analysis of the decision structure at various levels of the university. These analyses lead to considerable progress in establishing an outline for an organisational framework that would serve the demands of PPBS. The main purpose related to the organisational design is to establish a management system where the various programmes and sub-programmes at different levels correspond to responsible units within the university - Programme Units. The objectives of the Programme Units are primary to optimise the effectiveness of their programmes, both in the planning phase and in the resource-allocating phase. A Programme Unit has received an output-oriented appropriation to accomplish the objectives of the programme by allocating the resources to a Sub-Programme Unit at a lower level by stating the output requirements and financial frames. The Programme Units should also be responsible for the performance control. In this way, when the responsibility for the output and performance of the programmes is focused on responsible units, it will in our opinion be possible to improve their effectiveness and economic behaviour.

On the basis of the budget figures prepared in our earlier PB proposals, the Government in January 1971 in the Government Bill proposed to the parliament that CTH should obtain programme- or output-

oriented appropriations for the fiscal year 1971/72. This suggestion was followed by a Royal Regulation Letter in programme terms (see Appendix 3). The contents of this transformation are described in section 5 below. The new design of the appropriation system activated the PB development at CTH, and the spring of 1971 was devoted to refining the resource-allocating methods following the principles of PPBS.

Internal resource-allocation (Spring 1971)

This first internal resource allocation of the programme appropriations could not be performed in the extreme output-oriented way desired in our planning. The budget figures and the cost-accounting information were not of high enough quality to apply it as the only base for allocating the resources to programmes, sub-programmes and projects without any relation to the former budgeting system, in which the departments in general, not the programmes, received the appropriations. The reason for the difficulties is that the PPBS at CTH assume a matrix-organisation in which the programmes are acting over departments in a completely free way. One programme could comprise items from several departments, which makes the programme budgets more complicated to establish. It will be some time before the participants at different programmes and department levels have total confidence in the budget figures and the cost-accounting methods. This stability has not yet been achieved and therefore the allocation of resources at this time was a mixture of classical and programme budgeting.

Revision of the cost-accounting and budget principles (Spring and Summer 1971)

The difficulties in the allocation process together with other experiences from the cost-accounting methods called for a revision of the budget procedure and the cost-accounting system. An additional reason for this revision is the preliminary results from the Graduate Training and Research pilot study, which contribute to knowledge on how to handle the Research Programme in the PPBS. The requirements that theoretically must be fulfilled are as follows:

- The definitions of the activities must be unique, that is, one given activity should belong to one programme by definition.
- The cost-accounting system must be designed in such a way that the costs could be readily and pragmatically assigned to an activity. Difficult cost-distribution problems and situations of uncertain budget estimates should be avoided by constructing operational principles and standards.

On the first point above, the problem is put into focus when for example an activity could be connected either to the Research Programme or to the Graduate Training. A clear definition that an activity is connected to a certain programme is better than a more hypothetical but uncertain definition that leaves possibilities to individual judgments.

What is the cost? As far as the second point is concerned, the cost-accounting often could raise problems closely related to economic theory. What is the cost?

Situations with marginal or additional costs for one activity in relation to another are rather common in cost-determinations and the

problem is to decide which activity is to carry the fixed costs. The marginal cost principle and the full-cost principle always compete. To have the situation more operational, our experience is that:

- each type of activity must be defined if the marginal cost method or the full-cost method is to be used when determining costs.
- the marginal cost method is preferable on account of its simplicity both in costing and in management.

In the following sections, the present status of the PPBS parts are described very briefly. Some outlines of further development are also discussed.

IV. PRESENT STATUS OF THE SYSTEM'S

Section 1 - Programme Structure

The application of programme budgeting at Chalmers University of Technology follows the general approach of explicitly and concretely specifying the goals of the agency in programme terms. The goals are broken down into sub-goals, to which sub-programmes can be referred. Each programme and sub-programme should, if possible, be formulated in operational terms. The following programme-structure has been introduced at Chalmers University of Technology.

Head programme	Programme	Sub-programme	Programme element	Programme Structure
1				HIGHER EDUCATION AND RESEARCH AT CTH
	1			UNDERGRADUATE ENGINEERING EDUCATION
		1-6		Schools (e.g. Mechanical Engineering)
			1-	Courses
	2			UNDERGRADUATE EDUCATION FOR THE FACULTIES OF SCIENCE AND SOCIAL SCIENCE
		1-9		Instruction - disciplines (e.g. Mathematics)
			1-	Courses
	3			TECHNICAL RESEARCH AND GRADUATE TRAINING[1]
		1-7		Technical Research and Graduate Training in different research fields
			1-	Research projects
	4			RESEARCH AND GRADUATE TRAINING IN SCIENCE AND SOCIAL SCIENCE 1)
		1-9		Research and Graduate Training in different research fields of Science and Social Science
			1-	Research projects
	5			EXTERNAL SERVICES
		1		Building maintenance service
		2		Library services

1) A proposal to change the classification of these programmes has been made in the pilot study on Graduate Training and Research.

Comments:

Initially the authorities were very eager to split up costs between Research and Graduate Training in order to form a programme for Graduate Training according to the desired goal structure. Because of the high level of integration of activities and costs between graduate training and research, this has not been possible to achieve.

Classification of the research is also a very important matter which must be done in fields of technical research corresponding to the goals of research in the society. This calls, however, for an overall review of the total national research classification which has not been done, mostly due to the fact that Swedish research policy is formed by several departments and agencies.

All the above-mentioned questions are now studied in the CERI/OECD sponsored project:

> "The Development of a Preliminary Planning, Programming and Budgeting Framework for the Graduate Training and Research Activities at the Chalmers University of Technology (CTH)".

We intend to propose in a later report a more elaborate programme structure concerning this area of activities. See the progress report of the project in Appendix 5.

Section 2 - Output measures

We have so far tried to examine the possibilities of measuring the output of the undergraduate education programme. This was however for a long time a problem that confused us because of the output concept: what is output? To go further we had to clarify to what purpose and when the output concept should be used. We also found that the output concept must be related to the responsibility for the performance. In a management system it is of utmost importance to clarify the causalities between different inputs and outputs. To be able to judge the effectiveness of an organisational unit, an output measure should describe the effect caused by this specific unit's own activities. (Bad student performance need not only be caused by low effectiveness of the instructional unit, it could as well be the effect of student inputs).

Some of the output concept used in our pilot study are as follows:

Definitions and purposes of different outputs

	Output concept	Measure	Purpose
National level	Value of higher technical education - quality of the degrees and number of degrees conferred.	(A suitable output measure has not been formulated. Cost-benefit analysis is useful at this level).	Long term planning (Ministry of Education, Office of the Chancellor and Faculties of Technology).
School level	Volume of student enrolment in the school in question. (The quality of education is not considered in this concept).	- Number of students enrolled per school.	Detailed long term planning at all levels. Short term appropriations from Government to Universities.
	Student performance in the school in question.	- Credit production, - F.T.E.-degrees, - Performance ratios per school	Result analysis for external and internal auditing controls. Long term educational planning. Objective in short term management. Useful in the appropriation system.
Course level	Volume of student-participation in courses.	- Number of students per course	Internal university planning. Internal resource allocation.
	Teaching load	Equivalent teaching hours per course	(Cost per student and course must be known)
	Student performance in different courses	- Credit production, - Performance ratio per course	Result analysis for internal audit control. Operational objective in short term management.
Individual level	Individual performance	- Credit production, - Student ratio of performance	Individual guidance to students Student administration

The above-mentioned output concepts could in many ways be used in ratios of all kinds, measuring productivity, effectiveness, intensity of instruction, etc.

To meet the demand of measuring output for PPBS and recording individual students' data for administrative purposes, a special student and instruction information system has been developed. Every performance of the student, such as success or failure on a test, is systematically and currently recorded in a data system. This student and instruction information system provides individualised data and performance data on courses, different schools of education, etc.

The measurement of research output is a well-known and difficult problem. Research activities can perhaps not be measured in quantitative terms as easily as education activities. One reason why we in this pilot study desire to solve the problem of measuring research is that a university has to find out where within its walls top research is being carried out in order to allocate the resources. On this point it should also be mentioned that a large part of the research is financed by National Boards of Research. (See Appendix 5).

Section 3 - Cost accounting

Since the first of July 1969, Chalmers University of Technology has been using an EDP cost-accounting system. The first year we introduced a self-made preliminary EDP system to get used to the methods and to develop routines. At present the whole university is using the general EDP cost accounting system developed by the Swedish National Audit Bureau (NAB) called the S-system. This is a basic accounting system which will be applied by the majority of agencies. The details must, of course, be adapted to suit the specific requirements of each agency.

Briefly, the S-system classifies each expenditure and income in different classes of accounts: type of costs (salaries - material), cost centre (department, section), carriers of costs (products, programmes). During the pilot study period to the end of the present fiscal year (1st of July 1971), it has also been necessary to continue the classification and accounting of expenditures according to the traditional appropriation system. (See section 5 below).

The aim of the cost-accounting system is to measure the cost of each programme, sub-programme and programme element. We therefore have to establish an accounting plan that follows the programme structure (see section 1).

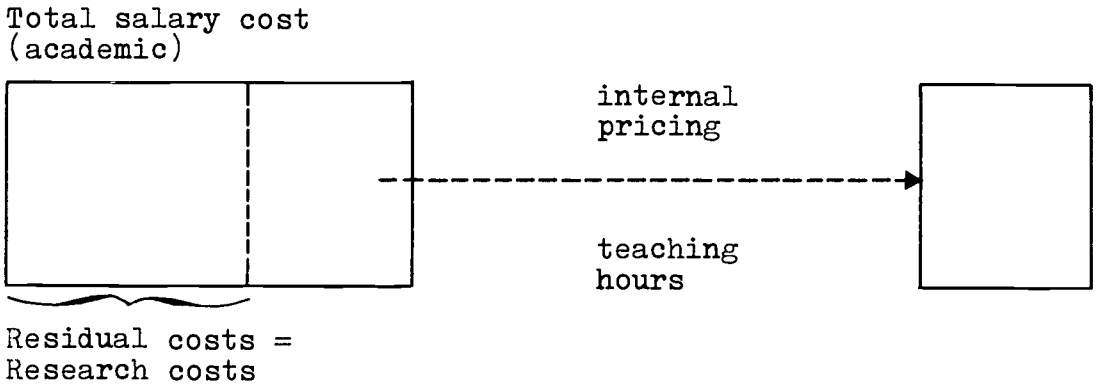
All the transactions of costs and income must thus be specified to courses and research projects. The coding and classification of the costs is done in connection with the payment routine. Considerable problems immediately arise. How shall an expenditure, the purpose of which is unknown at the moment of payment, be classified? To solve this problem such costs are temporarily accounted for as "auxiliary accounts". These accounts are for teacher salaries, administration costs, workshop costs, etc. Costs of these accounts must be carried over to final cost carriers before the end of the accounting period. This can pose some problems, especially when the salary costs have to be distributed to various courses and projects. A time-registration sub-system to system 3 is technically ready but not psychologically opportune for all parts

of the university. To test this routine we have implemented it in one department, including ten divisions. We hope that the development of this system will solve some of the problems dealing with the transformation of working hours into costs of courses and projects.

Our opinion is that it is very doubtful whether time-registration can yield the final solution to this problem, for two main reasons:

- it will require major administrative resources,
- there is no fixed total load for most of the teaching staff; only the amount of teaching duties is fixed and defined in different ways.

Lately, therefore, we tried to find other solutions by internal pricing methods. A central authority within the university will fix "prices" of activities, input resources, working hours, teaching hours (different types and categories). The salary costs of a staff member are initially carried by either the Research Programme or the Undergraduate Programme. Teaching hours or research activities outside the initial programme are recorded and, by a standard price method, the salary costs are distributed. This method only needs information, for example, on the teaching hours done, not all his "real" time devoted to corresponding activities. The costs of his research activities can in this case be the costs that remain on his salary cost account after the "revenues" from the Undergraduate Programme have been incalculated.



Section 4 - Planning system

A good planning system is necessary both for external and internal needs. In the PB pilot study at Chalmers University of Technology we have recently examined the planning system in a more specific way. The different plans and planning efforts have been brought together into a graphically described planning network system. Every different plan and event has been defined according to its internal relationship and placed into its "right" position according to time and organisation level. The aim of examining the planning organisation is to achieve a system where

double work is minimised and the planning efforts are concentrated in the relevant organisation levels and at a suitable time.

The planning system serves both external needs - budget requests and long-range planning at the Office of the Chancellor and Ministry of Education - and internal needs - management questions and resource allocation and executive efforts for a good planning performance within the university.

On the next page such a network plan concerning the internal planning during one fiscal year is given. The plans of Graduate Training and Research are expected to be further developed in our pilot study on these matters.

Section 5 - Budget planning and appropriation system

In the preceding sections I have described the programme structure, the efforts to measure output, the costs of programmes at various levels, and the network planning system. As mentioned above, one of the primary objectives of the Chalmers PB pilot study was to develop an output-oriented university finance appropriation system for the university field. This means that appropriation will be calculated for sets of outputs defined in the programmes. Increased volume or quality of expected outputs will call for higher appropriations and vice versa. I will here present an example of the traditional university appropriation system in order to clarify to what extent this differs from the PB appropriation methodology.

Structure of traditional appropriation system.

1. Faculty of Technology

Teacher salaries	
Professors, lecturers, etc	000 Sw Cr
Assistant teachers	000 Sw Cr
Expenditures etc.	
Salaries to non-academic personnel	000 Sw Cr
Current expenditures	000 Sw Cr

2. Faculty of Science

(see above)

3. Library

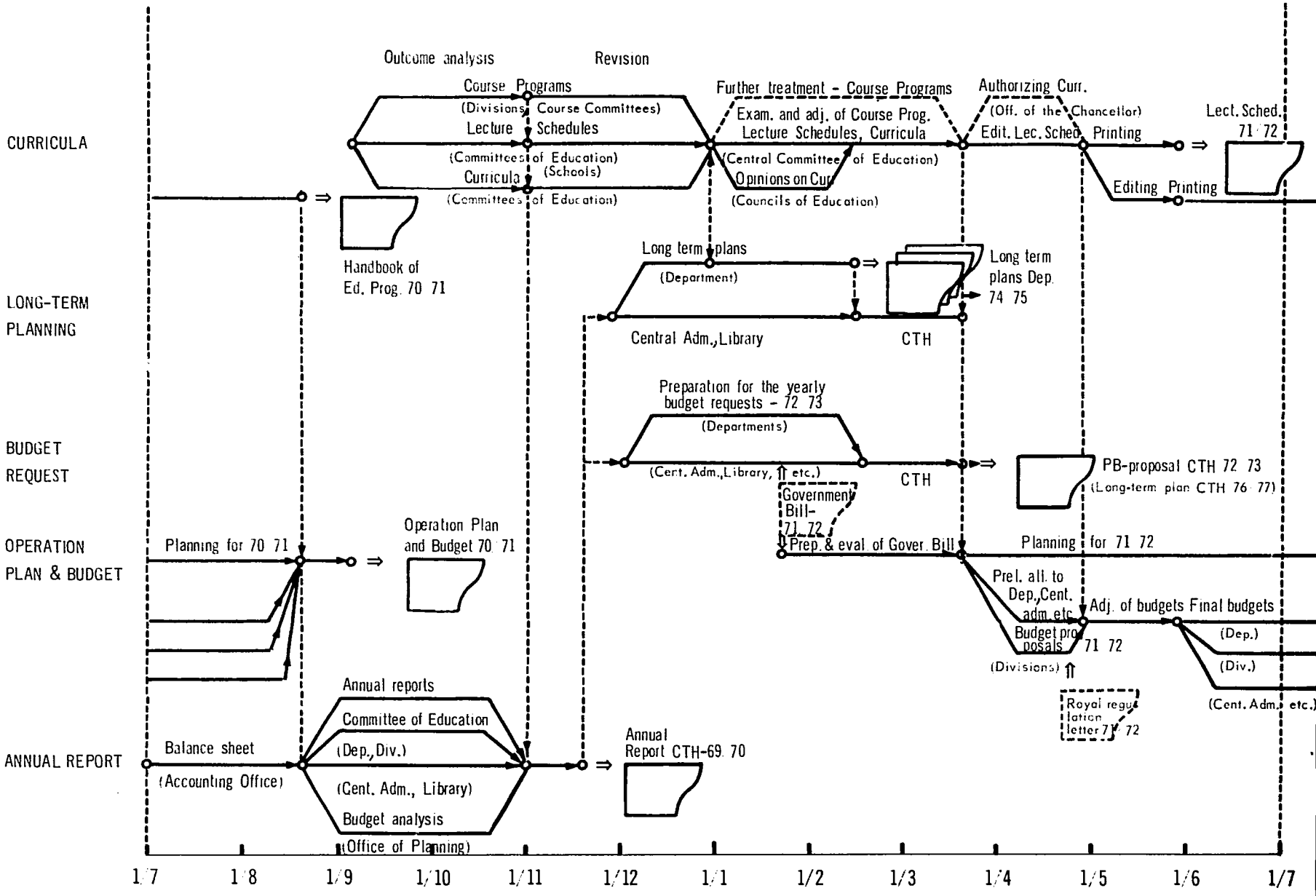
Salaries	000 Sw Cr
Current expenditures	000 Sw Cr

4. Administration

Salaries	000 Sw Cr
Current expenditures	000 Sw Cr
EDP-costs	000 Sw Cr
Telephone	000 Sw Cr
Heat and electricity	000 Sw Cr
Maintenance of physical plant	000 Sw Cr

5. Investment of equipment . . . . . 000 Sw Cr

THE YEARLY CYCLE OF PLANNING AND BUDGETING AT CHALMERS UNIVERSITY OF TECHNOLOGY



This appropriation procedure could in a way be called "input regulated" because there is no freedom for the institutions to choose among different alternatives of factor inputs. According to the PB philosophy the goals should be specified in programmes for each agency. In order to obtain these goals the Government provides goal-directed appropriations for different programmes. The basis for the budgeting will consist of quantifications of the tasks - outputs - to be carried out by the agencies and the costs to perform these programmes. The volume and quality of output should therefore be the strategic variables for determining the programme appropriations.

The budget system and especially the yearly budget proposal from the university must therefore be designed in a way that gives an appropriate description of each programme: the objectives, outputs and costs. A model of such a budget or PB proposal is presented in Appendix 2. This model has been applied twice at CTH when designing the yearly budget request according to the methodology of programme budgeting.

The total CTH budget is built up from the divisions by divisional budgets. Such a divisional budget is shown in Appendix 4. The divisional budget also includes sub-budgets of courses, projects and other cost carriers.

As mentioned above in section 3, the budgeting principles and costing methodology are going to be revised in the direction of more simplicity and clearer definitions of costs and activities.

The Government will at the end of the budget chain judge and present adjusted proposals in the Government bill to Parliament. The final financial frames and administrative restrictions will be stated in a special "Royal Regulation Letter".

Chalmers University of Technology has twice delivered such budget proposals. Until the present fiscal year the Government has given the appropriations in the traditional form, but for the 1971/72 fiscal year the Royal Regulation Letter is designed according to the principles of programme budgeting. The Royal Regulation Letter for the 1971/72 fiscal year is presented in Appendix 3.

Since the 1969/70 fiscal year a special PB pilot study has been launched for some fields of education at the Philosophical Faculties of the Swedish Universities. The enrolments in most of the courses are not restricted in these faculties, which implies great difficulties in forecasting the exact number of student arrivals. Hence the appropriation system must be constructed as a "self-regulating system". The appropriation level is automatically adjusted to changes in enrolments. A special output-oriented appropriation system has been developed to finance the study courses which covers the variable instructional costs of each student arrival. One of our tasks in the pilot study at Chalmers University is to harmonise the local PB system with that finance methodology.

Section 6 - Information systems

To develop a M.I.S. (Management Information System) or PPBS we need as mentioned several times above some basic information systems. These are often computerised. The following list presents the status of the different parts of such a M.I.S.

Implemented systems:

Payroll
Cost accounting
Time registration for staff
Individualised student data and instruction data systems

To be implemented in the near future:

Space, inventory and utilisation system
Equipment data
Staff data

Under development:

General planning and resource allocation information system

Section 7 - Aspects of university organisation and internal decision-making

A very important trend in Swedish university policy is the decentralisation of decision-making. This implies that the responsibility of goal-formulation, planning and execution must be spread down to the lower levels in the sector of higher education and research. General organisational questions of higher education are presently being studied by U-68 (The 1968 Educational Commission, attached to the Ministry of Education). However, since the start of the PB project at CTH, designing university organisation has been of primary interest.

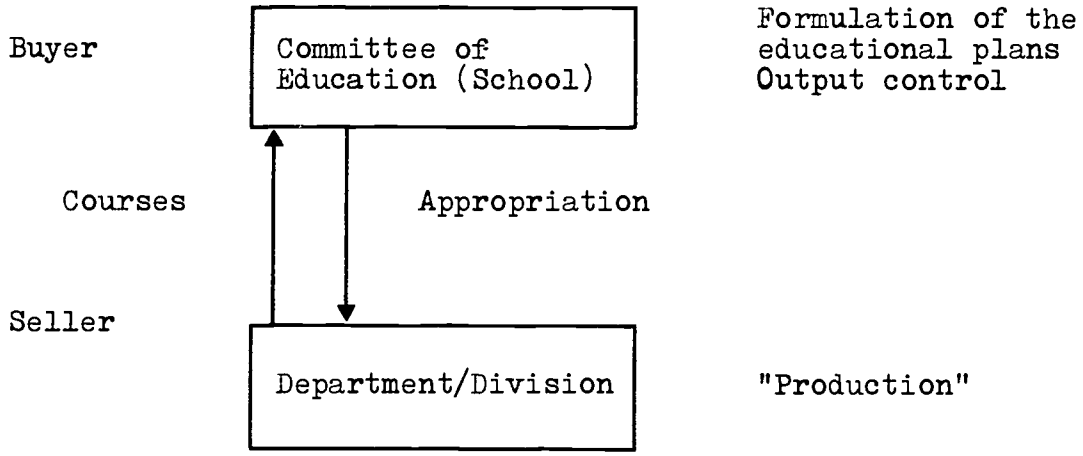
For a couple of years, pilot studies have been launched at some institutions and departments of higher education with the aim of developing decision-making in democratic boards and committees. Such democratic boards and committees consist of members representing teachers, teacher-assistants, students and non-academic personnel. Boards of departments are responsible for all activities within the department and could thus have democratic representation.

As the responsibility of the activities within the university is spread down to several democratic boards and committees the design of the organisational structure and the PB system must be harmonised. In a newly presented internal proposal concerning the design of the organisation at CTH, the decision structure and the fields of responsibility are closely related to the programme structure. The principal points in the proposal are as follows.

Corresponding to each programme there is a hierarchy of decision-making and advising units each of which is responsible for functions such as goal-formulating, planning, resource allocation, output-control etc. of their programme level.

The programmes are carried out by the departments. The department boards have responsibility more related to how production is organised and executed than they have direct responsibility to decide about the qualitative and quantitative contents of the programmes. We have thus in a way established a seller-buyer relation between programme responsible units and executive units which we suppose will lead to better effectiveness and resource utilisation in the university as a whole.

Example of internal seller-buyer relation



According to our discussion of the above democratic units, the proposal also suggests three different types of democratic structure:

- Researcher democracy in the units responsible for the research programme
- Student democracy in the units responsible for the education programme
- Staff democracy in the executive units.

It is obvious that the composition of the democratic units must be done very carefully so that the balance in the system will be maintained.

Another thing suggested in the proposal is bigger administrative units. Developments during recent years have indicated very strongly that this is a necessary condition for adapting a sophisticated management system in the university field. In many departments therefore several administrative routines have already been moved from divisions to the higher department level. This trend is also due to the desire to decrease the administrative load on the faculty.

APPENDIX 1

INSTRUCTION FOR THE PB PILOT STUDY OF THE OFFICE OF THE CHANCELLOR OF THE SWEDISH UNIVERSITIES CONCERNING THE FIELD OF HIGHER EDUCATION AND RESEARCH GIVEN BY THE MINISTRY OF EDUCATION

The extent of the proceeding pilot study

I. General Remarks

The development of general budget-technical tools within the total field of Higher Education and Research should be continued and be given high priority. Suggestions about such new tools should be reported continuously by the Office of the Chancellor to the control group for PB within the field of Higher Education and Research (control group HUFO).

The research and development of PB within the working field of the Ministry of Education is to be concentrated in Chalmers University of Technology (CTH).

II. Chalmers University of Technology

Programme structure

From now on the activities at CTH should be reported under one head programme, named Higher Education and Research at CTH.

Higher Education comprises Undergraduate Education and Graduate Training. Undergraduate Education is sub-divided into schools.

"Research" is sub-divided into Fields of Technology or Science. The classification should be done in co-operation with the Board of Technical Development (STU).

Appropriation system

At present the Office of the Chancellor should presume that the appropriations will be as follows:

1. Higher Education and Research at CTH
2. Investment in equipment.

Appropriation No.1 is an extended grant that can be carried over to the following fiscal year to finance Undergraduate Education and certain parts of the Research.

Under this appropriation receipts and expenditure for parts of the programme not being financed by appropriation No.1 or No.2 are also reported. The appropriation is divided into two sub-items, comprising on one hand Technical Education and Research, and on the other the remaining part of Education and Research at CTH.

Appropriation No.2 is an extended grant for financing CTH's investment in equipment, etc.

The Office of the Chancellor may suggest alternative systems of appropriations.

Budget request for the 1970/71 fiscal year

Beside the budget request, made in accordance with the general instructions for such requests of February 21, 1969, the Office of the Chancellor should, before November 1, 1969, submit to the control group HUFO a budget proposal for the 1970/71 fiscal year based on the given programme structure. This proposal should as far as possible be worked out in accordance with the guidelines issued by the Head of the Ministry of Finance on March 17, 1969.

Furthermore, the Office of the Chancellor should in the form of a "regulation letter" show the principles for level gradings of appropriations and regulations within the whole area of Technical Faculties.

Planning system

The planning of activities is an essential part in the planning and budget system that the PB system comprises. The result of this planning should be an operation plan which will enable the executives and responsible decision-makers of all levels of the university to control the activities during the current period. Furthermore the plan should comprise a budget of the programmes which the agency has to perform. The plan should comprise at least a six-year period starting with the 1969/70 fiscal year. The plan should also serve as a basis for the agency's budget request.

As a first step in establishing a plan of activities, the Office of the Chancellor should make an internal budget of the work at CTH for the 1969/70 fiscal year. When doing this the given programme structure and the grant of resources for the 1969/70 fiscal year should be taken into consideration and as far as possible the total costs at CTH should be included.

The internal budget for the 1969/70 fiscal year mentioned above should be followed up by provisional cost accounting for CTH beside the ordinary accounting activity. In special studies, questions concerning depreciation charges and interest costs for equipment, and so on, should be treated. The task is primarily to start surveying the special set of problems that arise within the university sector in making estimates of this kind.

Cost accounting and output measurement

The purpose of this part of the PPBS is to develop a system of cost accounting and output measurements which allows for the registration of

costs and outputs of different programmes and sub-programmes.

Costs and outputs are to be divided into

a) Undergraduate Education

b) Graduate Training

c) Research

Costs and output accounting regarding the Undergraduate Education shall be sub-divided into Schools and Courses.

For research, besides the classification into Fields of Technology and Science, the cost accounting should be made with regard to projects on one hand and groups of projects on the other. Furthermore, the accounting should show the financing of the projects by resources from

a) the Faculty Appropriations

b) the Boards of Research and other means via the National Budget

c) sources outside the National Budget.

The system should make possible any further classification of costs, outputs, etc., that may prove necessary on a local level.

III. Other activities of investigation

The joint university appropriations should be investigated in order to transfer them as soon as possible to programme-oriented appropriations. The Office of the Chancellor also should survey costs under the 8th Estimate, part Eb, not referred to a programme, and suggest changes in financing or special accounting for activities referable to these costs.

IV. Reporting, etc.

The work of the Office of the Chancellor should be carried out in close co-operation with the control group HUFO.

A sub-report concerning the executed PPBS should be submitted to the Ministry of Education not later than November 1, 1969.

APPENDIX 2

MODEL OF THE YEARLY BUDGET REQUEST

Chalmers University of Technology herewith submits a budget request in programme terms for the 1970/71 fiscal year.

CTH: PROGRAMME AND DRAFT ESTIMATE

	1968/69		1969/70 National budget	1970/71 Proposal
	Appro-priated	Outcome		
1. Undergraduate Education				
2. Research and Graduate Training				
3. External Services[1]				
Total costs				
Complementary costs to be deducted[2]				
Receipts, to be deducted (grants from Boards of Research)				
Total means/ university appropriations				

Comments: 1) This refers partly to costs for maintenance of the physical plant, including fuel, electricity, water, etc., which the central administration of CTH and the maintenance service of physical plants in Gothenburg will have to bear for services rendered to other educational institutions in Gothenburg, and partly to costs for certain sections of the library service that cannot be referred to Training and Research at CTH.

2) At present, depreciation allowances for equipment.

The responsibility extension and duties of CTH

Comments:

A short review of the organisation and duties of the agency: Special attention should be paid to the responsibilities towards other agencies, such as the Planning Committee for Building and Equipment of the Swedish Universities, the Equipment Board for the Swedish Universities, the National Board of Building, and the University of Gothenburg. The extension of certain administrative duties, which lay upon CTH (maintenance of physical plant, etc.), should also be taken into consideration. Finally the research-administrative duties of CTH towards Boards of Research should be generally illustrated.

The aims and programmes of CTH

Comments:

The programmes of CTH are defined under this heading. For each programme and part thereof it should be made clear in what way and to what extent the performance of the programme is influenced by the authorities or by public demand. This should cover both the content and the performance of the activities. Thus it should be quite clear what factors influence the design of the output and the realisation of the programmes; in some cases the Government fixes the output-level, in some cases it is steered by public demand.

The complex programme structure should also be illustrated under this heading with an analysis of programmes and outputs at different levels of the university.

General view of the development within the university

Under this heading a general view of the development within the field of higher education and research should be given, particularly as regards the main field of activity of the university, i.e. higher technical education and research. The development of the activity of the university should be illustrated with adequate output measures.

A more detailed review will be given below for each respective programme.

I. PROGRAMME 1. UNDERGRADUATE EDUCATION

Economic review

Programme	1968/69		1969/70	1970/71	
	Appropriated	Outcome	Appropriated means converted into the price and salary level of 1.7.1969 1)	Basic proposal	Proposal total
Undergraduate training (for a primary degree) etc. Conversion of prices, to be deducted Complementary costs, to be deducted Receipts, to be deducted					
Total means/ university appropriations Difference compared with national budget 1969/70					

1) The bases for price and salary conversion will be given in an appendix.

The costs of the sub-programmes should be presented as shown in the table on the next page.

In this review the following breakdown should be carried through for Programme 1 Undergraduate Education.

Programme 1 - costs and income 1968/69-1970/71

Sub-programme: Schools	1968/69		1969/70		1970/71	
	Appropriated means	Outcome	Appropriated means	Appropriated means converted into price and salary level 1.7.1969 1)	Basic proposal	Total proposals
11. School EPh Costs 12. School ME Costs A.s.o.						
Total costs To be deducted: a) Complementary costs b) Receipts Total means/university appropriations						
Difference compared to national budget sum 1969/70						

1) The bases for the conversion (re-estimation) of prices and salaries are given in appendix.

SUB-PROGRAMMES:

School of Engineering Physics

Costs

Number of study places

Number of degrees

Full-time equivalent degrees 1)

Quota of performance 2)

School of Mechanical and Naval Engineering

A.s.o.

Output of the activity 1968/69

Comments:

An analysis of the 1968/69 results is done separately for each sub-programme.

Planning for 1968/70 - 1974/75

Comments:

A description of the long term planning within the programme should be given here as a background to the budget requests for 1970/71. Changes in the objectives and character of the programme should particularly be pointed out.

Internal budget for 1969/70

Comments:

Under this heading the short term planning of the activity within the programme for the 1969/70 fiscal year should be reported, with resources appropriated in the Royal Regulation Letter of the year used as a basis.

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1) Total number of study points within the School divided by the sum of points a normal examination in that School comprises.

2) Expected total sum of study points within the School according to the defined objective divided by the real total sum of study points within the School.

Budget proposal for 1970/71

In the directions given by the Ministry of Finance, it is stated:

"The assignment of resources within the limits of the basic proposal presupposed by the agency should be described with emphasis on changes of output (quantity vs. quality) and of the methods of production".

In the table on page 34 the concept "basic proposal" for the 1970/71 year is used as the financial framework according to the 1969 financial level after conversion of prices.

Further it is stated in the aforementioned directions:

"Suggestions about alternatives exceeding the financial framework of the basic proposal should be presented in order of priority for each programme. Furthermore the proposals should be characterised in one or more of the following ways:

a) proposal that a certain type of output (sub-programme/project) should be dropped or added,

b) proposal that a certain type of output (sub-programme) should be reduced or increased in volume,

c) proposal that the quality of a certain output (sub-programme/project) should be raised or lowered,

d) proposal that a certain method of production should be changed to bring down the costs.

Proposals reported as alternatives to the basic proposal should be described much more thoroughly than that. The motives of the proposals should be more precisely expressed and the consequences in relation to the development of the demand discussed above should be explained. If the proposals imply changes in the organisational structure of the agency, these should be thoroughly described.

However, if the agency carries its proposals beside the basic proposal, it should be evident which objectives and level of development the agency expects to attain during the year by accomplishing the proposals".

As for the educational capacity of restricted Schools, it should be possible for the university to suggest increased enrolment and to estimate the financial consequences of this. The university can, for example, report the costs for a maximum enrolment at a certain branch of study, where the upper limit is the capacity of fixed resources (space, equipment, etc.).

All proposals presented (basic proposals, alternative proposals) should be put in relation to adequate output concepts, both qualitative and quantitative.

II. PROGRAMME 2. RESEARCH AND GRADUATE TRAINING

Economic review

Programme	1968/69		1969/70	1970/71	
	Appro-pri-ated	Out-come	Appropriated means conver-ted into price and salary level 1.7.1969 1)	Basic pro-posal	Total pro-posals
Research and Graduate Training					
Price conversion to be deducted					
Receipts, to be deducted					
Total means/ university appropriations					
Difference com-pared to national budget sum 1969/70					

1) The bases for the conversion of prices and salaries are given in an appendix.

The costs of the sub-programmes should be presented as shown in the table on page 34 .

SUB-PROGRAMMES:

- Research in the field of Mathematics

  Projects (number and titles)

  Costs

  Revenues from Boards of Research and Industry.

- Research in the field of Engineering Physics

  Projects (number and titles)

  Costs

Revenues from Boards of Research and Industry,

and so forth.

- Research in the field of Mechanical Engineering
- Research in the field of Electrical Engineering
- Research in the field of Civil Engineering
- Research in the field of Chemical Engineering
- Research in the field of Architecture
- Graduate Training (marginal costs).

Programme 2 - costs and income 1968/69-1970/71

Sub-programme: Fields of Research	1968/69		1969/70		1970/71	
	Appropriated means	Outcome	Appropriated means	Appropriated means converted into price and salary level 1.7.1969 (1)	Basic proposal	Total proposals
21. Research - Mathematics Physics Costs 22. Research - Engineering Physics Costs A.s.o.						
Total costs To be deducted: a) Complementary costs b) Receipts to be discounted under the appropriation Total means/university appropriations						
Difference compared to the national budget sum 1969/70						

1) The bases for the conversion of prices and salaries are given in an appendix.

III. PROGRAMME 3. EXTERNAL SERVICES

Economic review

Programme	1969/69		1969/70	1970/71	
	Appropriated means	Outcome	Appropriated means converted into price and salary level 1.7.1969 1)	Basic proposal	Total proposals
External services Price conversion to be deducted Complementary costs, to be deducted Receipts, to be deducted					
Total means/ university appropriations Difference compared to the national budget sum 1969/70					

1) The bases for the conversion of prices are given in an appendix.

The costs of the sub-programme should be presented as shown in the table on page 39 .

SUB-PROGRAMMES:

- Maintenance of physical plant (outside the CTH sector)
  - Costs
  - Output
- External library service
  - Costs
  - Output
- Other external services
  - Costs
  - Output

Programme 3 - costs and income 1968/69-1970/71

Sub-programme	1968/69		1969/70		1970/71	
	Appro-priated means	Out-come	Appro-priated means	Appropri-ated means conver-ted into price and salary level 1) 1.7.1969	Basic pro-posal	Total pro-posals
1. Maintenance of physical plant Costs 2. External library service Costs A.s.o.						
Total costs To be deducted: a) Complementary costs b) Receipts Total means/univer-sity appropriations						
Difference compared to the national budget sum 1969/70						

1) The bases for the conversion of prices and salaries are given in an appendix.

IV. LONG TERM BUDGET 1969/70 - 1974/75 FOR THE PROGRAMME IN HIGHER EDUCATION AND RESEARCH

Comments:

A long term budget should be prepared for each programme and the demand of resources should be calculated for an unchanged level of development for the fiscal period 1971/72 - 1974/75.

Further demands due to planned increases in the level of development, reforms, etc. are to be presented separately for each programme.

V. PROPOSAL OF JOINT RESOURCES FOR SEVERAL PROGRAMMES EQUIPMENT

1968/69	Expenditure	000[1)]	Reservation	000[1)]
1969/70	Appropriation	000[1)]		
	Calculated expenditure	000[1)]	Calculated reservation	000[1)]
1970/71	Proposal	000		

1) In cases when the appropriation for 1970/71 has no equivalent in the preceding fiscal years no statement has to be made.

Comments:

It should be stated what kind of equipment is to be financed by the appropriation and for which programme the equipment is going to be used. Motives for purchases during the 1970/71 fiscal year should normally be reported in connection with the programmes. Under this appropriation should be reported a summary of proposed purchases mainly in accordance with the model below. Proposals of purchases for which no reason has been given in connection with the programmes should be motivated under this appropriation.

The use of the object	Object	Purchase cost
1. Programme a, proposal ... (Appendix) 1)	Z-apparatus	.....SCr
2. Programme a, proposal ... (Appendix) 1)	Y-machine	....."-
3. ..... (Appendix) 1)	.....	.....

1) Reference is made to the appendices where a thorough description is made of proposals submitted under resp. programme and where their economic consequences - including investment calculations - are stated.

Other joint resources

(A summary report of costs for joint service units, etc. is given in an appendix).

Changes in staff and administration

Comments:

Under this heading should be reported proposals for changes in staff and reorganisation of central administrative units or several programmes (e.g. central administrative office and central economic unit). The necessary means for the submitted proposals should be taken into consideration in estimating the means for the programmes. The basis for dividing up costs between the programmes should also be described under this heading.

The implication of the proposal	Motive	Estimated costs		
		total	to be divided	
			programme	share
Augmentation of (1 administrator ..., qualified assistant)	.... (detailed motivation, see App.)	000	a b c	40% 40% 20%

Premises

Comments:

Under this heading the agency should give a summarised judgment of the situation of premises in relation to submitted proposals of activities.

New appointment

Comments:

Under this heading the agency should report a summary of proposed new appointments, which must be decided upon by central authorities. The description of the tasks - used as a base for assigning salary grades - should be made in connection with the detailed motivation for each post. The report can be drawn up as follows:

Post	Motive	Detailed motivation
..... 1 administrator	..... programme a, proposal item 13	
.....	.....	.....

Petition

Comments:

A petition should normally comprise the following items:

a) approval of the proposed activity during the 1970/71 fiscal year.

b) assignment of appropriations.

c) top-level appointments.

APPENDIX 3

ROYAL REGULATION LETTER 1971/72 E.23.

FACULTIES OF TECHNOLOGY ETC.,

CHALMERS UNIVERSITY OF TECHNOLOGY

The means are disposed of by Chalmers University of Technology for intended purposes.

Budget

University Programme	Appropri-ations	Estimated income 1)	Estimated comple-mentary costs 2)	Estimated programme costs
1.Undergraduate Engineering Education	29,923,000	6,957,000	2,466,000	39,346,000
2.Other Undergrad-uate Education	2,151,000	8,450,000	706,000	11,307,000
3.Technical Research and Graduate Training	24,434,000	23,756,000	3,225,000	51,415,000
4.Other Research and Graduate Training	2,114,000	4,188,000	390,000	6,692,000
5.External services	3,291,000	1,634,000	-	4,925,000
Total SwCr	61,913,000	44,985,000	6,787,000	113,685,000

1) Estimated income from Boards of Research.

2) Estimated capital costs for equipment.

Comments:

1. Salary costs for teachers and for technical and administrative staff have been estimated as to 1971 salary level.
2. Under the appropriation is included a representation allowance for the rector of the university, at the very most 3,000 SwCr.

Expenses for activity may be provided from appropriation items 1-5 to the extent stated for each university programme in "Instructions for the activity at Chalmers University of Technology.I. Objective and extent".

The following income should be referred to appropriation items 1-5.

firstly reservation added to the appropriation at the beginning of the fiscal year.

secondly means due to Chalmers University of Technology from Boards of Research, other governmental agencies, municipalities or private business.

INSTRUCTIONS FOR THE ACTIVITY AT CHALMERS UNIVERSITY OF TECHNOLOGY

I. OBJECTIVE AND EXTENT

1. PROGRAMME 1: Undergraduate Engineering Education is carried out in accordance with the proclamation (1969:332) about training at faculties of technology in Schools of Engineering stated in the table below. The table also gives the number of students admitted to each year of study in the 1971/72 fiscal year.

School	Year of Study				Total
	1	2	3	4	
Architecture	60	60	60	60	240
Electrical Engineering	200	200	200	200	800
Chemical Engineering	80	80	80	80	320
Mechanical Engineering	192	192	192	186[1)]	762
Engineering Physics	90	60	60	60	270
Civil Engineering	170	170	170	170	680
Total	792	762	762	756	3072

1) Including 36 places in the former department of Naval Engineering

The training should be carried out with the aim that the students, on the average, per School and year of study, can be expected to accomplish at least 75 per cent of the items included in the curriculum for their respective year of study.

2. PROGRAMME 2: Other Undergraduate Education is carried out according to the proclamation (1969:50) about training at faculties of philosophy, within the fields of astronomy, physics, geo-science, computer science, chemistry, quarternary geology, mathematics, mathematical statistics, mineralogy and petrology.

Training in the above mentioned subjects should be planned so that two-thirds of the full-time students earn 40 points during one academic year, and at least four-fifths of the full-time students earn 40 points during three terms.

3. PROGRAMME 3: Graduate Training should be carried on in accordance with the proclamation (1969:332) about training at faculties of technology in the fields mentioned above under "Particular regulations concerning training at faculties of technology etc."

Should the question arise of limiting admissions to Graduate Training, this should if possible be avoided firstly by redistributing facilities within Programme 3, or secondly by transferring facilities from other appropriation items. A request for such a transfer of the appropriation items should be submitted to the Government by the Office of the Chancellor of the Swedish Universities.

Research is to be carried out within PROGRAMME 3 in accordance with the Operation Plan for the university authorised by the University Council.

4. PROGRAMME 4: PROGRAMME 4 should carry out Graduate Training based on undergraduate education at the faculties of philosophy. This Graduate Training should be carried out in accordance with the proclamation (1969:50) about training at faculties of philosophy in the fields mentioned in "Particulars and regulations concerning training at the faculties of philosophy".

Research is to be carried out within PROGRAMME 4 in accordance with the plan of activity for the university prescribed by the university council.

5. PROGRAMME 5: Within PROGRAMME 5 the external services involving maintenance of physical plants of other agencies in Gothenburg should be performed. PROGRAMME 5 furthermore deals with external library service according to the operation plan for the university authorised by the University Council.

6. Further details on activity within the university programme are authorised by the University Council in the Operation Plan for the university.

II. REPORTING OF ACTIVITIES

Not later than April 15, 1972, the Office of the Chancellor of the Swedish Universities has to report to the Ministry of Education and Cultural Affairs on the Operation Plan that has been authorised by the University Council at Chalmers University of Technology for the 1972/73 fiscal year.

Not later than October 15, 1972, the Office of the Chancellor of the Swedish Universities has to submit to the Ministry of Education an Annual Report of the activities at Chalmers during the 1971/72 fiscal year.

However, the Office of the Chancellor has to submit to the Ministry of Education, not later than September 15, 1972, a report on certain details of the activities at CTH for the 1971/72 fiscal year.

This report should comprise the following:

1. A report of the total balance-sheet for the university programmes.

2. Regarding Programme 1, information about the average cost per student and School and also an analysis of student performance.

3. Regarding Programme 2, information about the average cost per active student and field and about student performance.

4. Regarding Programme 3, separate information for each department about the average marginal cost per active Graduate Student and about the total balance-sheet for research.

5. Regarding Programme 4, information for each field according to item 4.

The annual report and the specific report of certain details are to be drawn up in accordance with general guidelines given by the Control Group for Budget Programmes at the Ministry of Education.

APPENDIX 4

INSTRUCTIONS FOR THE DIVISIONS REGARDING INTERNAL BUDGETING FOR THE 1970/71 FISCAL YEAR

Introduction

Internal budgeting is in itself nothing new to the divisions of the university. Usually everybody within his own sphere of responsibility and within the limits of resources assigned to him draws up a programme of activity of work to be carried out during the next fiscal year. What is new in this connection is that the programme of activity is called an "internal budget" and is drawn up in a systematic way common to the whole university. Systematising will enable us to use the budget estimates for combinations on different levels (department, university).

Example

In this memorandum there is an example showing a budget of a make-believe department at CTH.

The construction of an internal budget

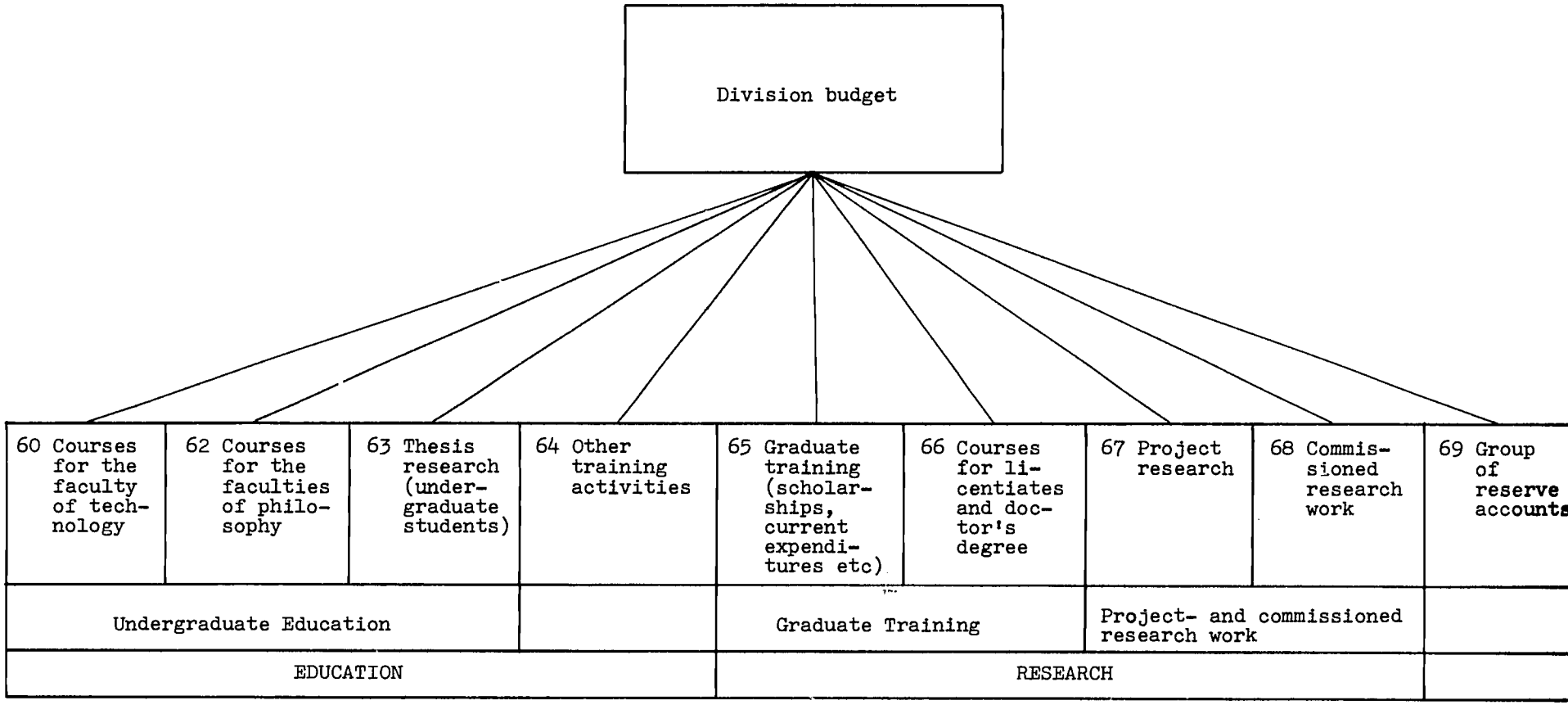
The construction of the divisional budget should be based on the cost carriers in the class 6 account which are given in the plan of accounts of the division for the 1970/71 fiscal year. The construction can be illustrated as follows on the next page. The numbers 60-69 refer to the first two numbers of cost carriers in the class 6 account.

Principles of budgeting

Salary costs

A problem may arise in distributing the salary costs of the permanent teaching staff among courses, projects and other cost carriers, as there is usually no absolute basis for this pattern. Most of the divisions have no exact information based upon a current registration or similar methods. The best method in this case would be to make an estimate of the percentage of working hours distributed to different cost carriers and then to divide up the total salary costs in accordance with this. A direct distribution of salary costs to cost carriers ought to be possible for certain groups of personnel, e.g. assistants and research staff assigned full-time to a project.

When distributing the salary costs, one has to budget 100 per cent of an employee's salary.


Division budget
60 Courses for the faculty of technology
62 Courses for the faculties of philosophy
63 Thesis research (undergraduate students)
64 Other training activities
65 Graduate training (scholarships, current expenditures etc)
66 Courses for licentiates and doctor's degree
67 Project research
68 Commissioned research work
69 Group of reserve accounts
Undergraduate Education
Graduate Training
Project- and commissioned research work
EDUCATION
RESEARCH

For an assistant's salary, the cost of his work at the division should be distributed to cost carriers in education and research. The remaining time, not divisioned duties, should be regarded as time used for the assistant's own studies and thus accounted in cost carrier 653 (account class 65). The conception of "own studies" also includes the cost of time during which the assistant attends graduate courses.

Costs of material

Costs of material, etc. should be distributed to cost carriers as shown in the attached example.

Distribution via auxiliary accounts

Distributing an employee's salary cost directly to cost carriers may in certain cases involve great difficulties. In these cases it is possible to assign the costs of certain groups of office staff,for example, to so-called auxiliary accounts and then distribute the total salary costs to the courses etc. in lump sums.

Other resources

Costs referring to other resources as income from Boards of Research and Industry projects can be reported rather summarily, as shown in the following example.

The university authorities, at this stage of the PB development, are not requiring separate research project budgets. At the divisional level project budgets are generally needed for internal management purposes and for financial applications made to the Boards of Research.

Statistics

Some statistic information should be given by the division in the budget sheets.

DEPARTMENT BUDGET
REVISED 69/70

1969/70 Fiscal year

Cost component	No.	Carriers of costs							Total
		60 Courses at faculty of technology	61 Courses at faculty of Science and social science	63 Thesis works etc.	65 Graduate Training etc.	66 Graduate courses	67 Project research	68 Commissioned research work	(1000 SwCr
I UKA-appropriations (1) Professor Associate professor University lecturer Research fellow Research assistant									
Assistant Training assistant Special instructor Associate instructor Research engineer Research assistant									
1st research engineer 1st working engineer Research engineer Laboratory engineer 1st instrument maker Instrument maker Division technician Office clerk Typist Materials									
Doctoral scholarships									
Computer time									
Total I									
II Other resources Boards of research The Board of technical development Industry resources									
Total II									
Total I + II									

(1) The Office of the Chancellor of the Swedish Universities

COURSE BUDGET
REVISED 69/70
PROPOSAL 70/71

Cost component	Type of Training: Lecture	Lesson	Laboratory work				Practical guidance	Examination	Total (1000 SwCr)
Revised 69/70									
Professor									
Associate professor									
University lecturer									
Assistant									
Training assistant									
Special instructor									
Associate instructor									
Laboratory engineer									
Office clerk									
Materials									
Total									
Proposal 70/71									
Professor									
Associate professor									
University lecturer									
Assistant									
Training assistant									
Special instructor									
Associate instructor									
Laboratory engineer									
Office clerk									
Materials									
Total									
Difference									

Comments on differences in the appendix

Branch of study and year of study	Total no. of students	Lectures: Training capacity(1)	Classroom training: Size of groups	Classroom training: No. of groups	Classroom training: Training capacity(1)	Laboratory training: Size of groups	Laboratory training: No. of groups	Laboratory training: Training capacity(1)	Size of groups	No. of groups	Training capacity(1)
Revised 69/70											
ME 2											
EP 4											
Total											
Prop. 70/71											
ME 2											
EP 4											
Total											
Difference											

Comments on difference, in the appendix
(1) Training volume = number of hours = number of groups x number of teaching hours/groups

APPENDIX 5

PROGRESS REPORT AND PRELIMINARY FINDINGS OF THE CERI/OECD SPONSORED PROJECT ON "THE DEVELOPMENT OF A PRELIMINARY PLANNING, PROGRAMMING AND BUDGETING FRAMEWORK FOR THE GRADUATE TRAINING AND RESEARCH ACTIVITIES AT THE CHALMERS UNIVERSITY OF TECHNOLOGY (CTH), GOTHENBURG, SWEDEN

INTRODUCTION

This progress report aims to submit the preliminary findings of the project. The project started on the 1st of March 1971 and was finished by the 1st of September. A great lot of written material has yet to be translated, typed and edited before the total report is published.

The project has been carried out at Chalmers University of Technology (CTH) and the project group has been attached to the Department of Planning within the Central Administration. Throughout the project Mr. Stig Zandrén has worked as permanent research-assistant, and Mrs. Anne Dahl has helped us in part with the survey of the divisions and the economic review of Chalmers University of Technology. Miss Annika Hansson, has been Secretary of the project group. Consultants have been connected to the project for special issues. During the project work, members of the project group have visited national agencies involved, and participated in seminars and conferences on research administration. Interviews with several professionals within the university and at national levels are not documented explicitly in the project report but have influenced us in our work.

The project description divides the study into three phases, and this progress report as well as the presentation of preliminary findings are organised in the same way.

PHASE I - THE CONCEPT OF PPBS

The concept of PPBS is in general rather broad, and we had the feeling it could serve many different and perhaps conflicting purposes. We therefore had to define what we meant by PPBS. After analysis the following main principles should be considered in PPBS in this study.

1. The aim of PPBS is to improve the effectiveness of public administration.

2. Demands from the private sector of the economy formulate goals for public administration.

3. The goals or the objectives form the programmes of an area of action or of an organisational unit.

4. Financing by government appropriations should follow the programmes, that is, each programme should correspond to an appropriation.

5. Output measures or more generally output information should be used when judging the effectiveness and productivity of the programmes in connection with the process of allocating resources.

6. A planning system should be performed so that the principal streams of information are focused on different plans regarding the programmes. Various information systems are needed.

7. The organisational framework should be designed so that programme responsible units are established at all programme levels.

As a consequence of programme budgeting, certain requirements for the organisational units must be satisfied. Five criteria for a good PB organisation were set up for further analysis.

(1) The programme unit should be responsible for the performance of one or several programmes. The goals or the objectives of a programme, furthermore, should be well formulated for the programme unit.

(2) The programme unit should have all the facilities relevant to its objectives to manage the total programme area. Such means could be resource allocation, output formulation, etc.

(3) Relevant programme information is needed for programme decisions within the programme unit.

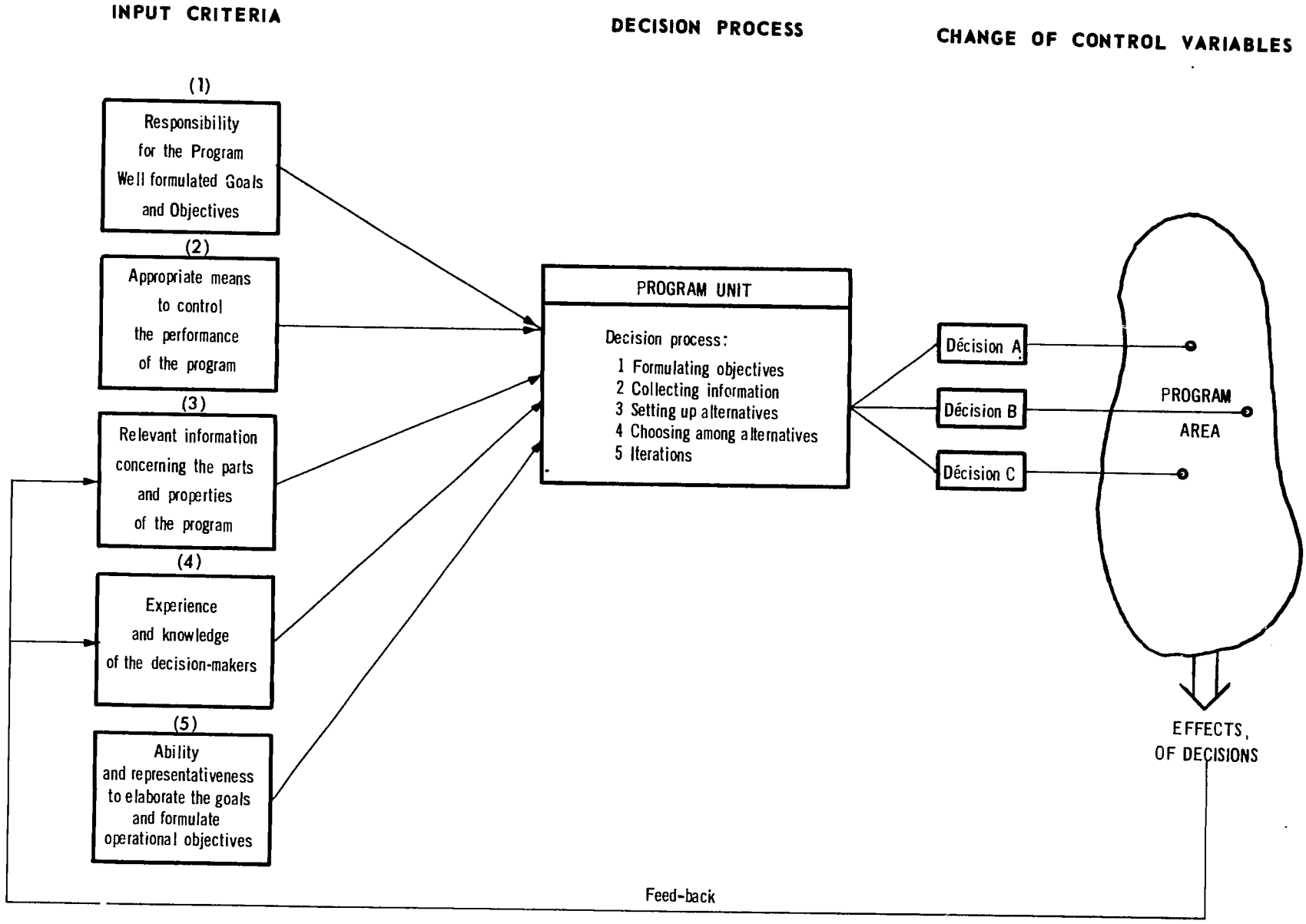
(4) The decision-makers in the programme units must have good knowledge of the questions in the programme area - the expert decision-makers.

(5) The decision-makers in the programme units should in many cases be able to serve as representatives of the goals of the programmes - the representative decision-makers.

The decision process of a programme unit may be illustrated as follows:

Figure 1

THE DECISION PROCESS OF A PROGRAM UNIT



National research policy

First of all, the national research policy is involved when the role of the Parliament and the Government are discussed. In this section we note that

(1) No special department deals exclusively with research and development (R & D), and each ministry is responsible for the R & D of its own sector.

(2) Co-ordination is done by government or in joint committees - some with advisory functions.

(3) There is a general discussion in Sweden and other countries about co-ordinating national R & D.

(4) Below the governmental level, the state agencies are responsible for the performance of various public activities. These agencies are formed by a long tradition of Swedish public administration and one of their main tasks is to present and prepare the yearly budget request to the Government.

(5) Hence, for the area of universities, the Office of the Chancellor of the Swedish Universities (OCU) is responsible for resources to higher education and for some of the resources needed for research within universities - the base organisation.

(6) Building space and equipment are supplied by two special state agencies

- The National Board of Building.

- The Equipment Board for the Swedish Universities.

(7) In several areas special Research Councils have been established. They provide the project groups within the universities with resources for scientists and current expenditures. Overhead costs are generally not funded by these institutions. The Research Councils allocate the resources both to universities and private, semi-private institutions, or state laboratories, mostly on a project basis, and they have in general established a well-functioning decision-making body in their various fields of research. Applications for project resources are handled in a relatively ambitious way.

(8) Goals or objectives for the undergraduate and graduate training are to a certain extent formulated by the Government. The Office of the Chancellor is given the responsibility for management and control of these programmes.

(9) The general goals of the research performed within the universities are described in the instructions to the university. No special mechanism is established to control research within a university division. The researcher himself is responsible for the choice of research activities within the research programme of the division. Only when resources from Research Councils are applied for is an evaluation of the effectiveness

of the research projects carried out. No conscious judgment of the research activities is in general made within the university when allocating resources to the divisions.

At the Office of the Chancellor, the Faculty Planning Boards deal with research questions only when suggesting new professorships and proposing programmes for these chairs to the Government. No directions are given from the Government in this planning to the Faculty Planning Boards and generally the proposals will not immediately lead to any measures. The Office of the Chancellor has the function of co-ordinating the proposals for new chairs. A real research policy and formulation of research objectives could not be carried out.

The Government defines fields of research for the Research Councils. Through Government proposals more specific goals are given to the councils when the priorities for research fields are presented.

The agencies at the national level were tested on how they fit the organisational requirements for the organisation of a Programme unit in PPBS. Then the five criteria mentioned above were used to come to the following conclusions, briefly presented.

(1) The Office of the Chancellor is primarily responsible for undergraduate education. The objective can be formulated satisfactorily, and the main means of controlling the programme - output formulation, resource allocation are available. Information on the performances of the field is received to such an extent that the control function for the undergraduate programme could be fulfilled by the Office of the Chancellor.

(2) For Research and Graduate Training, one can say that although the Office of the Chancellor (OCU) is formally responsible for these programmes, no objectives or consistent policy is formulated, except for Graduate Training, where OCU is responsible for providing the universities with the resources for training and supervision.

(3) However, around 60 per cent of the resources for the project research are alloted via OCU, and consequently one can say that OCU has many ways to control the financial side of research. Output requirements are however not formulated by OCU in the research field and information on research performances is not sent back to OCU. OCU is furthermore not prepared to handle pure research questions.

(4) The Research Councils have a responsibility related to the various fields of research, and goals and policies are formulated for each one. The Research Councils have a decision-making body which is well designed to handle these questions, but our general view is that they lack the appropriate means or control-variables to fulfil their intentions.

The main parameter is short-term allocation of resources to project, and these resources are mostly additional costs to the resources provided by OCU, the National Board of Building

and the Equipment Board for the Swedish Universities, etc. The possibilities to act in long range terms, for example, by setting up the basic organisation, proposing and deciding about new divisions and professors, new buildings and equipment for research, are rather limited.

(5) The Research Councils have an indirect influence on Graduate Training by creating assistant appointments, connected to the research projects, but much demanded by the graduate students. This impact upon Graduate Training is generally considered by the councils.

(6) The National Board of Building and the Equipment Board for the Swedish Universities are "auxiliary" agencies whose objectives are to provide universities with the necessary space and research equipment. Being the responsible agencies for the investments they control the amount of space and equipment in the universities, and therefore these agencies have a great deal of influence on the performance and realisation of various research programmes.

Description of the Research and the Graduate Training at CTH

Phase I is terminated by a quantitative description of the present state of Research and Graduate Training at CTH.

It can be said of the relationship between Undergraduate Education and Research and Graduate Training that a little bit more than half of the costs (53 per cent) are borne by the latter programmes. This figure varies, from one department to another, but on the whole there is a fifty-fifty balance between education and research at CTH. Some interesting facts about the costs of research and graduate training have emerged, such as the following:

(1) Around 40 per cent of the research costs are financed by the Research Councils or commissioned by the industry.

(2) The financing from the Research Councils follows a certain pattern. In most cases one Research Council is responsible for financing the main part of the project costs in one department. In these cases one can say that the department or the field of research has its own sponsoring Research Council. Grants from industry and commissioned revenues are not as important as expected.

(3) The cost of Research and Graduate Training per top scientist is on the average 390,000 SwCr per fiscal year and the same cost per top scientist man-day is an average of 2,800 SwCr.

(4) The number of graduate students is increasing rapidly. The classical sciences (maths, physics and chemistry) are still predominant in Graduate Training, due to many factors. One is that the large volume of courses in the Undergraduate programme in "the basic divisions" leads to "over-financing" of "these divisions", which makes it possible to offer many staff

CHALMERS UNIVERSITY OF TECHNOLOGY

Figure 2

THE FIVE CRITERIA OF PPBS APPLIED TO THE PRESENT ORGANIZATIONAL UNIT AT THE NATIONAL LEVEL

Code:

OCU Office of the Chancellor of the Swedish Universities
RC Research Councils
KBS/UUH National Board of Building, Board of Equipment
UTE Undergraduate Technical Education
GT Graduate Training
TR Technical Research

\+ The criterion is satisfied
(+) Part of the criterion is satisfied
\- The criterion is not satisfied

Criteria \ Subsystem		OCU/UTE		OCU/GT		CCU/TR		RC/GT		RC/TR		KBS,UUH/UTE,GT,TR	
1. Responsibility and Goals for the program		The University Law	+	The University Law The Graduate Training Prop (1969)	+	The University Law (No specific goals)	(+)			Government Propositions and instructions	+	Government Propositions and instructions	+
2. Means of Control	2.1 Output	Curricula Enrolment	+	Curricula	(+)	Professor's program	(+)			Project plans Long-term plans for special areas	+	Volume of buildings and equipment	+
	2.2 Resources	Salaries Current expenses (not investments)	(+)	Special grants to GT (teaching) Scholarships	(+)	Offices Appointments Some current expenses	+	Appointments Scholarships Project grants	+	Project grants (short term)	(+)	Building and equipment grants	+
3. Information from the program part	3.1 Planning	Budget requests	+	Budget requests	(+)	Budget requests (no information about output)	(+)			Project applications	(+)	Programs for building	(+)
	3.2 Feed-back	Examination results Labor-market reports	(+)		-		-			Project reports Research catalogues	(+)		-
4. Expert decision-makers within the program		Committees of Education, Secretariat Section for Higher Education	+	Special OCU-committee for GT	+	Faculty Planning Board (General knowledge of research problems)	-			Board of the Council	+	Expert only on building and equipment technology	-
5. Representative decision-makers		Faculty Planning Board	+	Faculty Planning Board	+	Faculty Planning Board (Broad representation)	-			Delegations Committees	+		-

positions to graduate students and a large graduate course programme. Another reason is that the large number of undergraduate students in pure sciences increases the demand for Graduate Training.

(5) The ratio between graduate students and supervisors is 5.8 on the average. The costs per graduate student are an average of 27,000 SwCr per fiscal year (3 times the cost of an undergraduate student).

(6) The Research Councils admit that in many cases they fall "wide of the mark" in principal decisions concerning the establishment, organisation and volume of research activities at the universities. In the short-term allocation of project expenditures to the scientists at the universities, they also admit that the information on the real capacity of personnel, equipment, space, etc. at the university division is not available in an amount appropriate to the detailed granting of resources. This is mostly due to the fact that the researcher sends the application directly to the Research Council and no further information is required from the university authorities. The demand for special equipment could, for instance, lead to the following questions:

- Is there any similar equipment at the university or in its neighbourhood which could be used instead?
- Could the university take responsibility for the maintenance and other costs involved in using the equipment?
- Is there enough space for the installation? Does it require any reconstruction of the building?

These and many other questions of responsibility and information between Research Councils, University, the Office of the Chancellor, and Space and Equipment authorities are at present unsolved, or only partly examined.

PHASE II - THE DIVISIONAL ANALYSIS

For the general purpose of getting a more detailed picture of the costs, activities and achievements of GT & R, a pilot study was undertaken at three divisions in phase II. The objective of this pilot study is defined in the project description. The whole pilot study is divided into the following sections:

A. Selection of divisions.
B. Survey of time utilisation.
C. Cost accounting.
D. Survey of rooms and equipment.
E. Description of performance.
F. Development of output measurements.

The divisions selected were:

- Division of Applied Electronics.
- Division of Soil Mechanics and Foundation Engineering.
- Division of Theoretical Physics and Mechanics.

The aim of selecting these divisions was to compare divisions of different character with respect to the:

- size of the division,
- nature of research,
- degree of external support,
- number of graduate students,
- etc.

The survey of time utilisation gave us quite a lot of experience. Firstly we had to make a relevant list of activities that the personnel would be able to use in recording the time spent. The items on this list had to be related to both the programmes and the types of activities.

Two types of investigations for the time recordings were used:

I. A detailed work report covering one week.
II. An estimation of time utilisation during the past year by the personnel.

All personnel at the divisions participated in the survey, and so did the graduate students.

A cost study was performed connected to the time survey. Sources of income and the expenditures on different types of costs were classified on activities and programmes.

The figures of the sample of these three divisions are of course too limited to use for wider conclusions. Therefore we present below some rough "indications" of the performance of GT & R at the divisional level at CTH.

Graduate Training

(1) The number of graduate students is greater in the theoretical and basic research divisions than in the others, but this division also has proportionally more supervisors (professor, etc.). The graduate students are mostly employed by the division as assistant lecturers or research assistants (externally funded). A limited number have special scholarships. In divisions where the undergraduate programme is big, most of the graduate students are assistant lecturers. In divisions where the undergraduate programme is smaller and with external fundings from Research Councils, it is more common that almost half of the students are research assistants. Thus, these research assistants, employed by means of resources for projects from the Research Councils, in general participate in Graduate Training to the same extent as other graduate students do.

(2) Both supervisors and graduate students had difficulty in specifying how much time was spent on graduate training outside the graduate courses. This was obvious from the list of activities, and was also confirmed in the interviews with supervisors and graduate students.

(3) The participation in graduate courses was proportionally higher in the division representing basic sciences due to the fact that this division offered more courses at the graduate level. The reasons why graduate courses are not offered to such an extent at the divisions representing applied research seem to be:

(i) the limited number of graduate students in small sectors of applied research,

(ii) the limited number of supervisors in relation to the number of graduate students,

(iii) the more experimental methodology of research.

In addition, the time spent by graduate students on studying literature is greater at the theoretical and basic research division. As a conclusion one may say that the activities of graduate students in applied research divisions are more connected to project work.

Research

(4) There is a trend towards project administration of the research at the universities but the project concept is more accepted in applied divisions and in divisions with external fundings. The projects in general also overlap each other and most scientists in the divisions are active in several projects. In divisions with basic research the most accepted classification is fields of research, rather than projects.

(5) The applied research is proportionally funded more by external sources than basic research. This is of course due to the fact that the applied research in this case is experimental while the basic research in the division we studied is theoretical. Another reason is that the divisions of basic sciences are already well established for basic research organisation within the universities, and therefore do not require so much external resources to carry out the desired research activities.

(6) Generally speaking, it is obvious that most of the internal resources for research are used as basic resources of the projects, supported by the external resources. It is in many cases possible to estimate that the external fundings of a project constitute 30 per cent (expenditures and direct costs), and the remaining 70 per cent costs of the project are directly or indirectly financed by university resources. The university resources will be used for salary cost for professors, technicians, administrative personnel, and for equipment, space, etc. Projects without any external fundings are rare in applied research divisions, but less rare in basic research divisions.

Organisation

(7) The divisions are generally not divided in separate responsible units for Undergraduate Education, Graduate Training and Research, etc. In the Research programme, however, project groups or sections are informally established. Only in big divisions with heavy teaching loads a separate undergraduate section may exist.

(8) There is a trend not to fix certain appointments for certain duties. In our study we found that research assistants financed by the Research Councils often participate in the Undergraduate programme. A lecturer in general also participates in research projects, etc. although this is not included in his formal duties. We also found opinion firmly against overly fixed duties for the academic staff.

Output measures

In the pilot study of the divisions we also tried to find appropriate output measures for GT & R. At this level the available output measures could be called measures of performance, rather than measures of effectiveness. Some of the possible measures of performance are shown below.

Graduate Training

- Number of Graduate courses.
- Size of graduate courses teaching load.
- Number of FTE Graduate students.
- Number of degrees awarded.
- Performance ratio for graduate students (points per year)

Research

- Number of projects.
- Size of the projects.
- Man-days offered by scientists on the projects.
- Volume of external fundings of the projects.
- Number and quality of reports.
- Performance ratio regarding the time-schedule of the project (network planning).

The possibilities of using the output concepts are of course related to how the model of decision-making is designed and therefore the value of these concepts will be considered in the model of PPBS.

PHASE III - THE PPBS MODEL FOR GRADUATE TRAINING AND RESEARCH AT CTH

In this phase of the study we are building a model for PPBS applicable at CTH. To do so we have to consider the present organisation of research in Sweden, and must ask ourselves whether a PPBS methodology can be introduced in the present organisation. Is it possible to act in programme terms at the university level in the present organisation? Our answer to these questions is that our present organisation is not completely prepared for PPBS in research, but on the other hand, the present organisation would benefit if some of the techniques of PPBS were applied.

It should be quite clear that the present pattern of national and state agencies involved is the biggest obstacle to introducing PPBS in the area of graduate training and research. The universities, in our opinion, could be well adapted to a general PPBS methodology but this would also require "PPBS behaviour" on the part of the national authorities. If we in this study are suggesting a PPBS model for the university, we must thus make the same assumptions and proposals for the national level, because the present behaviour in most areas is dependent upon restrictions and actions at the national level.

Hence, to a greater extent than expected, we had to devote ourselves to a discussion of the national level before the university model could be presented. It should however be mentioned that the principal questions are identical at all levels.

1. GOALS AND PROGRAMME

Recommendations:

The proposed programmes of the university area are the following:

1. Undergraduate Education.
2. Graduate Training.
3. Research.

Programme 1 covers the total costs of undergraduate education in the universities.

Programme 2 covers the additional or marginal costs for graduate courses, thesis works and special scholarships. Costs for supervision and project work are not included.

Programme 3 covers the total research activities at the university, including research projects supported by the Research Councils, internal research activities, research information activities, library functions, etc. Research activities by graduate students and most of the supervision of graduate students is also referred to this programme.

Considerations:

Programme 2 - Graduate Training is thus proposed to be a separate programme. The reason behind this step is that the responsibility for the performance of Graduate Training rests with programme units other than those of the Research programme both within the university and at the national level. Furthermore we are only considering additional costs for Graduate Training in the programme, mainly the costs for graduate courses and thesis works. Costs for supervisors, and time graduate students spend on their own studies as assistant lecturers, should be provided by the research programme. The purpose of this arrangement is that the Research programme and the Undergraduate programme should be the two basic programmes which determine the size of the organisations for research and education. The Graduate programme will supply divisions with resources according to demand for carrying out Graduate Training.

Hence, the number of assistants employed in the research organisation should be regulated by the research organisation, not by the demand for Graduate Training. Special scholarships are available for meeting the demand for study places that cannot be provided by the research organisation. If the Graduate programme includes costs for part of the assistants (time available for their own studies), there is a great risk that the size of the research organisation may be too strongly controlled by the demand for Graduate Training due, for example, to a great number of undergraduate students in the subject. If the Researcher programme is well performed it will be able to offer a normal number of assistant appointments to graduate students, and only when for some reason the demand exceeds the normal number of staff positions for the graduate students at the divisions should scholarships be used.

Programme 3 - Research is proposed so as to include the research activities which at present are financed by the Office of the Chancellor (OCU), Research Councils, and the National Board of Building and Equipment Board of Swedish Universities (see p. above). The reason why all these activities are continued into one programme is that, according to the description of goals, objectives and other instructions, no separate research goals are to be found related to each of these different sources. From our pilot study we know that the resources from the different agencies get together in the research projects. As a project is referred to one unique research goal, all public sources participating must consequently be related to that goal.

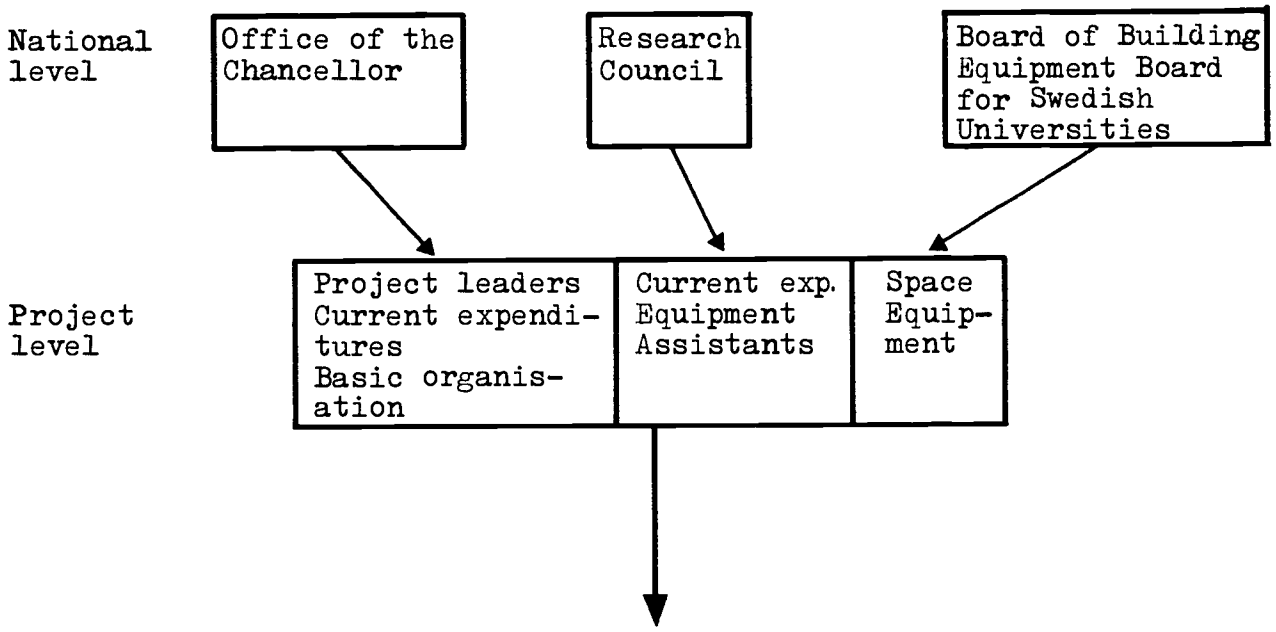


Figure 3. Financial sources of a research project

2. PROGRAMME ORGANISATION AT THE NATIONAL LEVEL

Recommendation:

Each programme at each level should correspond to a programme responsible unit (criterion 1 of the basic concept of PPBS).

- The Office of the Chancellor is proposed as the programme agency for the Undergraduate Education programme.
- The Office of the Chancellor is proposed as the programme agency for the Graduate Training programme.
- The Research Councils are proposed as the programme agencies for the Research programmes.

Considerations:

The Office of the Chancellor (OCU) is an agency well prepared for controlling the Undergraduate programme at the national level. Its present organisation is mainly designed for Undergraduate Education and could offer considerable knowledge on these matters.

For Graduate Training, the Office of the Chancellor serves as a co-ordinator of various Graduate programmes, e.g. by formulating the general requirements for the doctor's degree. Some of the techniques used in training could also be considered by the OCU, but it should not handle the scientific content of Graduate Training. Questions involving

financing Graduate Training and controlling the total number of graduate students in each Faculty will be handled by the OCU since it is responsible for the programme. It should be emphasised that the Graduate Training programme is mostly a programme regulated by the local authorities who will be responsible for the distribution of graduate courses, the distribution of graduate students, the scientific content in the training, etc.

The Research Councils are agencies well prepared for research questions. They are experienced in dealing with goal-directed research policy in terms similar to PPBS. They generally have solid knowledge of research on account of the participation of scientists on the numerous committees in various subjects and fields of research. We also have considered that this knowledge could not be transformed into effective measures for the realisation of the programmes in the present organisation. We propose that the Research Councils be responsible for the basic research organisation of the universities at the national level. This responsibility would give the Research Councils possibilities for long-term planning of the total area of public research in their respective fields of research, including professorships, equipment programmes, space and physical plant, organisation, etc.

The present research activities at the university could easily be referred to different Research Councils. In most cases each department has "its own" Research Council. Hence, there will be several research programmes at the university.

3. PROGRAMME ORGANISATION WITHIN THE UNIVERSITY

Recommendation:

Each programme should at each level within the university correspond to a programme responsible unit.

- In the Undergraduate programme the present programme units are:

  Central Committee on Education (responsible for the total programme),

  Committees on Education (responsible for the sub-programme - schools),

  Course committees (responsible for the programme elements - courses).

- In the Graduate Training programme the programme responsible units proposed are:

  Central Committee on Graduate Training (responsible for the total programme),

  Graduate Committees (responsible for the graduate activities at the divisional level).

- In the Research programme the programme responsible units proposed are:

  Committee on Research (responsible for the research field at the departmental level),

  Project groups (responsible for the research projects at the divisional level).

Considerations:

In the Undergraduate programme at present we have an established programme organisation at all three levels. In the Graduate Training programme there is a Central Committee on Graduate Training. No corresponding programme units at the school or departmental level are realistic at present due to the fact that the Graduate programmes are run entirely at the divisional level. The Central Committee on Graduate Training will serve as a Co-ordinator connected directly with the divisions.

In the Research programme we find that the most appropriate programme units for research decisions are the departments. The departments are established mainly as units in which research disciplines and research methodology are similar. However, we also consider that a distinction between the department and a separate Committee on Research could be useful in many respects. For example, a Committee on Research could play a more independent role in policy questions, resource allocations, etc., without having too many departmental influences on "non-research questions". The Committees of Research will deal directly with different project groups.

The executive and productive units are still the divisions and the departments. They have the objective at each level of co-ordinating Education, Graduate Training, and Research activities with staff structure, financial questions, space and equipment requirements, etc., and they could therefore be regarded as general administrative units.

The overall responsible unit for the production as well as for some policy questions within the university is the Board of the University.

The Programme Organisation is presented on the next page.

4. THE PROGRAMME APPROPRIATION SYSTEM

Recommendation:

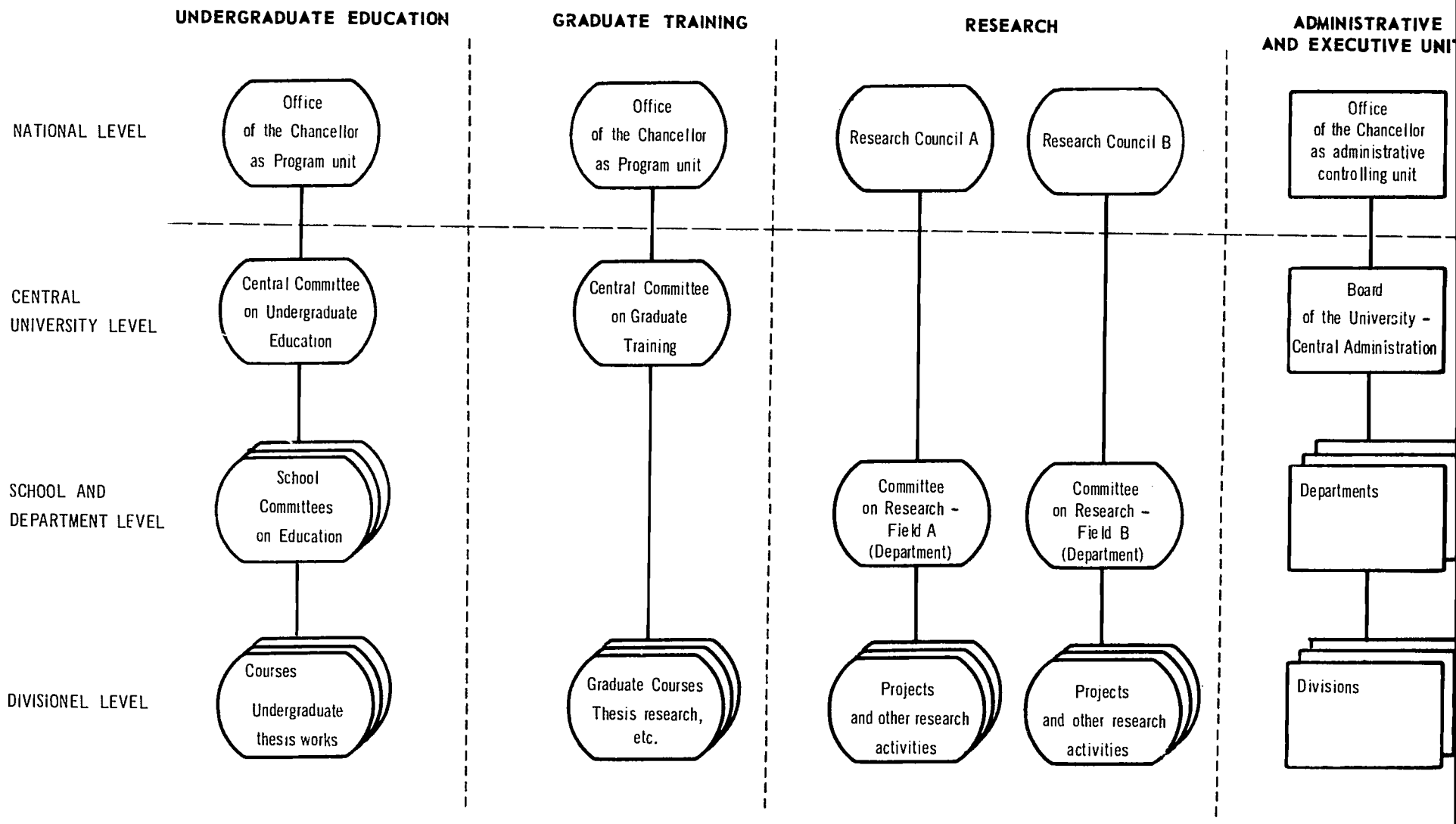
A state appropriation for the Graduate Training programme is granted to the university by the Office of the Chancellor.

A state appropriation for each Research Field is granted by the responsible Research Council in question.

The programme appropriations as mentioned above include all costs for the programmes during the fiscal year, even capital costs for building space. (Investments in buildings are granted by special investment appropriations).

Figure 4

PROGRAM ORGANIZATION AT CTH



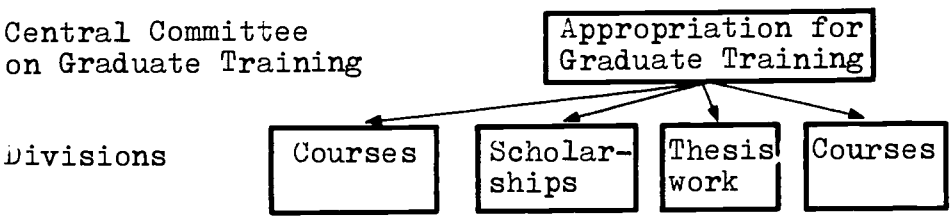
Considerations:

The appropriation should follow the programmes and be treated by programme units at each level. The actual appropriations will then be:

	Programme/Appropriation	Granted by	Programme unit within the University
1	Undergraduate Engineering Education	Office of the Chancellor	Central Committee on Engineering Education
2	Undergraduate Education (other)	"	Central Committee on Education (other)
3	Graduate Training	"	Central Committee on Graduate Training
4	Research Field A	Research Council A	Committee on Research (Department)
5	Research Field B	Research Council B	"
	etc.	etc.	etc.

(at least six fields of research)

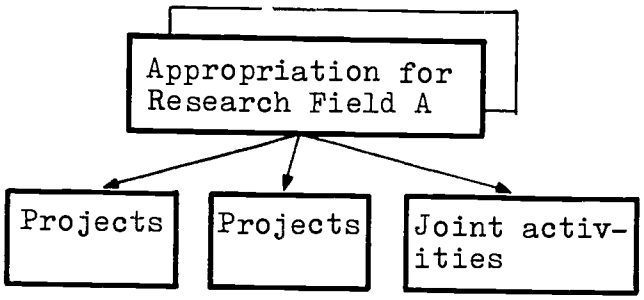
The appropriation for Graduate Training within the university is allocated directly to the divisions for various activities within the Graduate Training programme.



The appropriations for Research Fields within the university are allocated to the divisions to carry out the research projects and other research activities.

Committees of Research (Departments)

Divisions



5. THE PLANNING SYSTEM

Recommendations:

In order to estimate the future outputs and inputs requirements of the programmes, a Planning System is needed for Graduate Training and Research. In the PPBS the Programme Plans are the fundamental items in the Planning System. The Programme Plans will first of all show the following variables:

- The output or the performance within the programme (the qualitative and quantitative figures of the programme),
- Total costs of the programme,
- Different output/costs alternatives.

Secondly the programme plans show:

- Financial calculations of the kinds of resources needed in the programme alternatives,
- Physical calculations of the kinds of resources needed in the programme alternatives.

Each programme will have plans which will consider different time-periods as:

- Long-term plans (3-5 years),
- Annual plans,
- Short-term plans (less than one year),
- Operational plans.

The Programme Plans will interact at all stages and levels with Secondary Plans as:

- Staff plans,
- Equipment plans,
- Space and Building plans,
- Organisational plans.

The Secondary Plans are mostly related to the administrative or productive units as the divisions, departments, university, etc. The aim of Secondary Plans is to estimate and gather together the requirements of certain kinds of resources that are limited or of considerable importance, such as investments, new chairs, etc.

In general one may say that the plans of all kinds are more detailed in short-term planning at lower decision level than in long-term planning at higher levels.

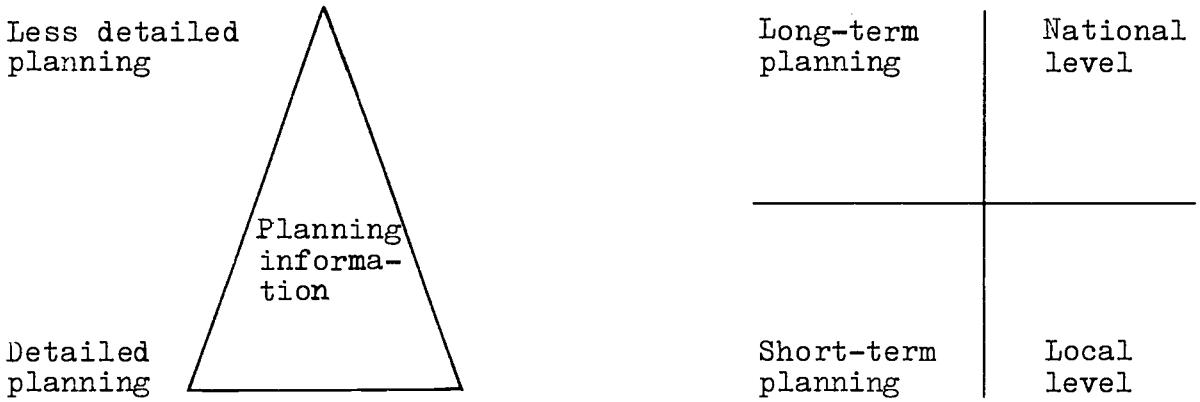


Figure 5. Planning information versus planning levels.

Comments:

The planning starts from the project-level and is built up to Field programmes. It should be noted that the project plans are presented up to the level of Research Councils, where the final decision on whether the project should be sponsored or not is made. At the departmental level (Committees on Research) and at the university level (Board of University) only the implications on Secondary Plans as building, equipment, technical assistance, etc. and the connections to other programmes such as Undergraduate Education and Graduate Training, are considered.

It should furthermore be emphasised that Research Councils, when granting resources, need not specify in detail the various project costs. It seems to be sufficient for the Research Councils to present:

(1) A statement of which projects they are sponsoring (authorised).

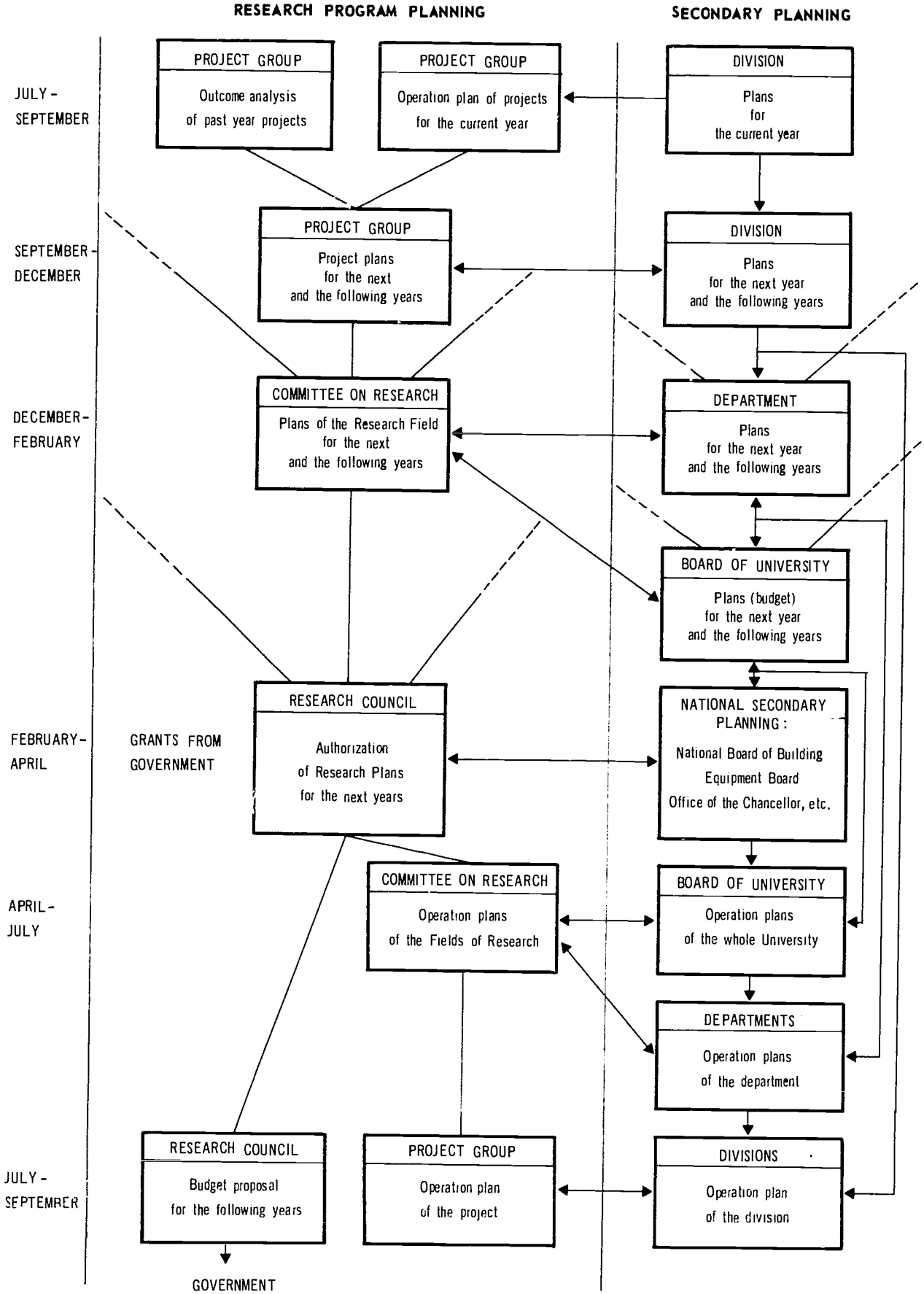
(2) A description of these projects, noting the requirements in man-years and other kinds of resources.

(3) The total financial framework for the field of Research in question.

(4) A list of special investments within the programme.

Figure 6

THE PLANNING PROCEDURE OF THE RESEARCH PROGRAM
IS DESCRIBED BELOW IN CHRONOLOGICAL ORDER :



The Research Councils must also realise that there are lots of planning restrictions because the plans of the Research Fields must cover all research activities at the university. Firstly, participation in the project work of an academic has to be voluntary, for according to the present University Law it is not possible to force a professor to participate in a project. Since the Research Councils are responsible for all research activities, together with the university authorities they must guarantee that a scientist, at a proper level, can continue his work in his research programme without participating actively in authorised projects. This will be a planning restriction in short-term planning.

In the long-term view, however, there are further possibilities for the Research Councils to make policy planning. For example, it may:

- Initiate new professorships (together with the university).
- Change programmes for professorships.
- Grant geographical allocation of research.
- Make investments in buildings and equipment.

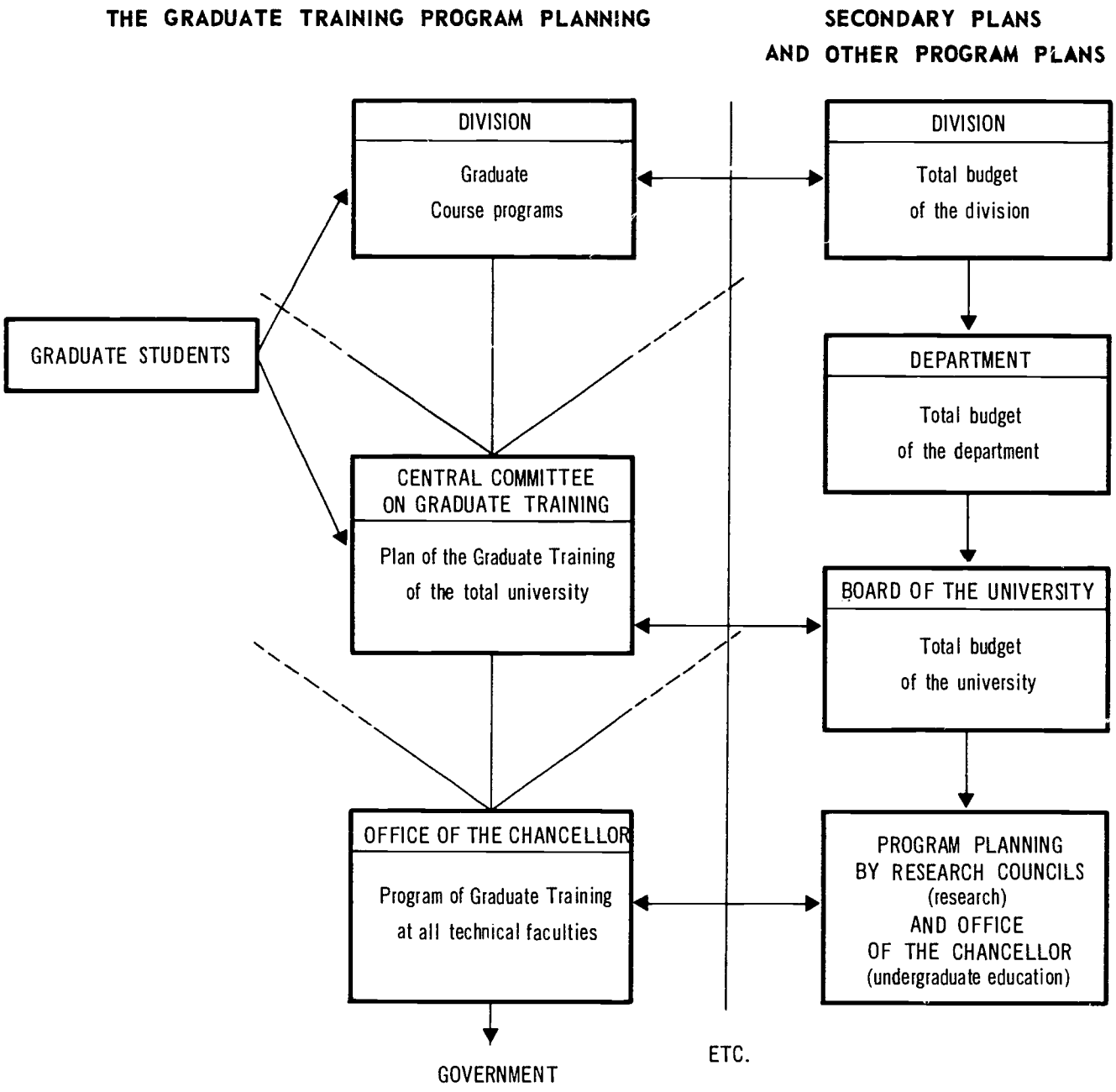
Since a main consideration in the model is that the real programme budgeting evaluation is more relevant in long-term planning at higher levels, it is important to give the programme responsible units at the national level possibilities of doing such long-term planning. Without the long-term aspects it is doubtful whether a programme responsible unit at the national level could fulfil its objectives.

In regular granting of resources from the Research Councils to the university, costs for such non-project activities as library and information costs, "free research", time for the assistants to participate in Graduate Training, etc., must be included in the appropriations. Such costs could not be regulated at the national level, and therefore it is more appropriate to set the financial framework for the Research Fields/Departments in lump sums. The final distribution of the resources to the projects, non-project research activities (library, laboratories, etc.) or service units can then be better performed at the departmental or divisional level.

The Planning Procedure of the Graduate Training Programme

Planning for Graduate Training is proposed so as to follow the general planning structure of the university. Here it will be briefly described.

Figure 7


THE GRADUATE TRAINING PROGRAM PLANNING
SECONDARY PLANS
AND OTHER PROGRAM PLANS
DIVISION
Graduate
Course programs
DIVISION
Total budget
of the division
GRADUATE STUDENTS
DEPARTMENT
Total budget
of the department
CENTRAL COMMITTEE
ON GRADUATE TRAINING
Plan of the Graduate Training
of the total university
BOARD OF THE UNIVERSITY
Total budget
of the university
OFFICE OF THE CHANCELLOR
Program of Graduate Training
at all technical faculties
PROGRAM PLANNING
BY RESEARCH COUNCILS
(research)
AND OFFICE
OF THE CHANCELLOR
(undergraduate education)
GOVERNMENT
ETC.

Comments:

The Graduate Training programme, as was stated above, will only include costs for scholarships, graduate courses and thesis work, and hence the planning of this programme is not as complicated as the planning of the Research programme.

The divisions propose Graduate Training programmes directly to the Central Committee on Graduate Training, which will present a budget proposal to the Office of the Chancellor. Graduate students can also apply for scholarships and special expenses directly to the Central Committee on Graduate Training.

It should be emphasised that the ties of the Graduate programme both to the Undergraduate programme and to the Research programmes are very strong. Local circumstances, such as

- having staff positions for graduate students,
- the number of graduate students,
- the possibility of offering graduate courses,
- having supervisors available,
- etc.

are very variable, and therefore it is of the utmost importance that the university have a lump sum for the Graduate Training programme, within which the university could distribute the resources rather freely among the various purposes and fields of study.

Summary of the Planning System

In the planning system Programme Plans and Secondary Plans need to be co-ordinated at each level.

The responsibility for co-ordination is placed upon the administrative or productive units such as divisions, departments, or universities.

At present, most of the co-ordination is done at the national level, even for detailed questions of university management. However, these management questions, such as co-ordination between:

- education and research,
- research and graduate training,
- equipment and research,
- space and research,
- research and staff,
- graduate training and staff,
- etc.

can obviously not be handled adequately at the national level. A decentralisation of the co-ordination between Programme Plans and Secondary Plans from the national level to the university level is thus

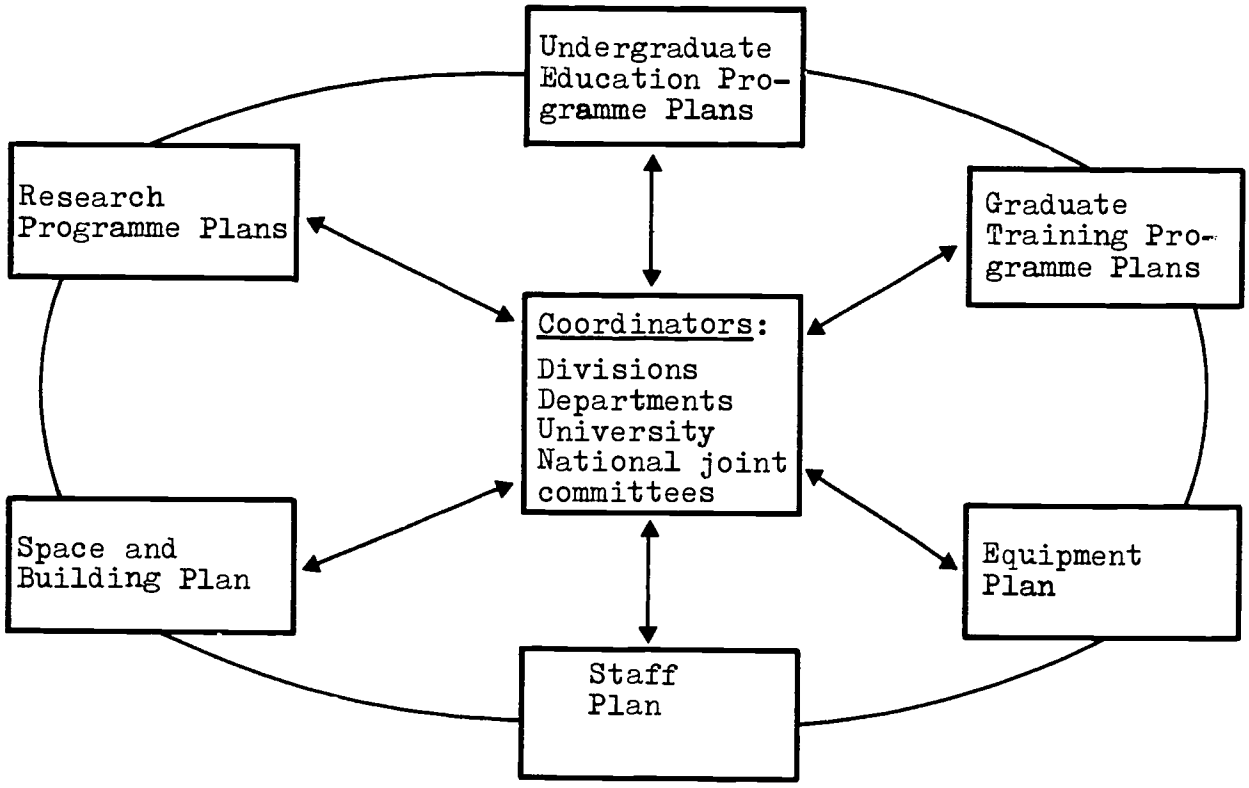


Figure 8

proposed. The programme responsible units at the national level should deal only with programme questions and the Programme Plans should contain the main implications for other programmes and secondary plans.

A Programme Plan for a Research Field, for example, is established within the university (in a Committee on Research) and delivered to a Research Council as a budget proposal. Then, the Programme Plan will contain not only the main parameters of the programme, the research field itself, but also the main implications for:

- Undergraduate Education,
- Graduate Training,
- Staff requirements,
- Space and equipment requirements.

The implications for other programmes and secondary plans in a university Programme Plan are not described more than is needed for relevant decisions within the programme in question at the national Programme agency. Thus, the university will be the main link between different programmes and main resources, even for the programme planning at the national level.

If, however, there is a need for more co-ordinated national planning between the national agencies, national joint committees on various subjects will generally be established.

6. OUTPUT-ORIENTED FINANCING METHODOLOGY

Comments:

The Research programme will use an output-oriented financing methodology by thinking in terms of projects:

(i) the goals of the research are presented,

(ii) the expected value of the project is described,

(iii) the total costs of the project is shown.

Project financing means that resources are allocated from a limited budget to projects, considering the expected output of the project in relation to the costs of the project. Some evaluation methods could be used when deciding which project will be realised.

It should be pointed out that no output measures have been found valuable when judging whether or not a project should be carried out. In these cases so many factors will have influence that it is impossible to quantify possible effects. As a matter of fact, the further effects of research are by definition difficult to predict. If, however, we have a rough definition of the project or research task, there will be better likelihood of judging how and by whom this project should be realised. Here we have figures on time, costs, man-days, etc., that could give us an idea of how to allocate the resources.

Experience and knowledge of research questions are utterly necessary in research allocations. Many decisions in research questions are also based upon the past behaviour of the project leader/project group. Representatives of the Research Councils maintain that the scientist is many times more important than the content of the project.

7. AN INFORMATION SYSTEM FOR CHALMERS UNIVERSITY OF TECHNOLOGY

The formulation of goals for the different programmes and consequent allocation of resources to the cost carriers within the programme areas require an extensive information system. Our investigation has resulted in an outline of how this information system could be constructed.

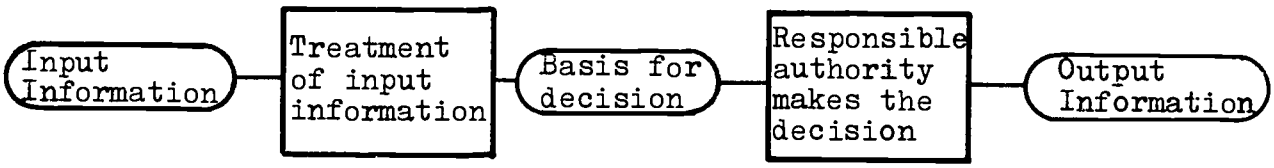
7.1. General theory

We assume that our system (i.e. the Chalmers University of Technology, Programmes of Undergraduate Technical Education, Graduate Training and Technical Research) can be divided into fields of decision.

For each field of decision we define a hierarchical model comprising six levels of decision:

(1) Long-term Planning (3-5 years),
(2) Annual Planning,
(3) Short-term Planning (less than one year),
(4) Operational Decisions,
(5) Current Activities,
(6) Control, Follow-up.

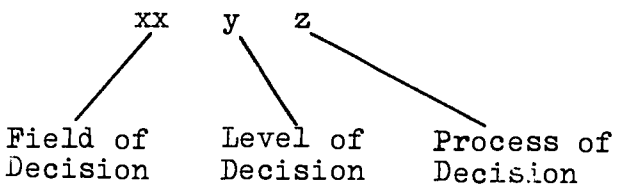
At each level there is one type of decision or more to be made. In general we look upon the interaction between decision and information in a way described by the following diagram.



The input and output information documents may be connected to some level of decision within the system or with some external authority.

7.2. The Decision-making Model

CTH divides into nine main fields of decision each field characterised by the six levels of decision. The types of decisions to be made within the different levels are roughly described in Figure 10. In this table, each process of decision-making is given a code number which in general consists of four digits.



Among the nine main fields of decision we find two that are divided into sub-fields. According to the PPBS model presented above, Undergraduate Technical Education is divided into Schools of Education and consequently each school represents a field of decision-making. In the same way Technical Research divides into Fields of Technical Research. The PPBS model assumes that each field of research can be associated with one Research Council which is in charge of the research programme in question.

7.3. The Hierarchical Models of Decision-making

The hierarchical models in general involve two types of feedback loops.

(1) A fast feedback which directly affects the level of performance. Thus individual research projects and courses are continually adjusted through this feedback information.

(2) A long-term feedback process affecting the goals and the long-term planning of the field of decision-making. The feedback information does not affect the current programme activities but rather the activities to be planned for two or three years ahead or perhaps more. In our decision-making model it happens that this feedback information passes through some auxiliary fields of decision-making. For instance, results from the undergraduate technical education pass on to the field of Educational Administration which produces information for the long-term feedback.

We illustrate these loops by looking at field of decision-making No.20, Graduate Training:

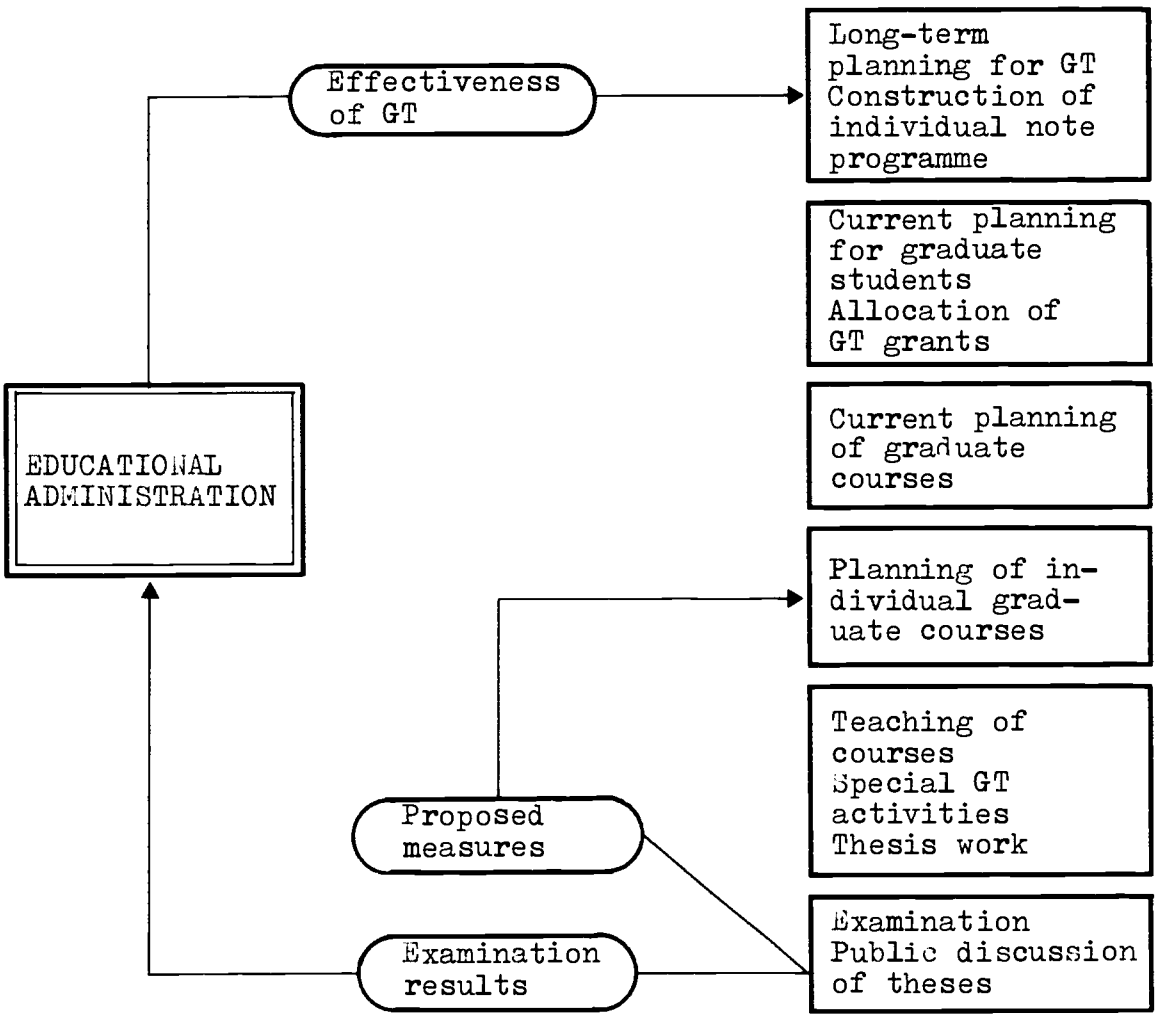


Figure 9

Each document of output information receives a number indicating from what process of information it emanates. By means of the code number we thus show in what way the different processes of decision-making are integrated through the documents of information.

7.4. Documents for information

The information system pre-supposes that certain information is produced by the central agencies. Most of this information exists today and is connected to the allotment of resources. However, as has been pointed out before, the control of the main programmes requires some additional means of control. These parameters correspond to the following proposed elements of information:

Graduate training:

- Rules for controlling the volume of graduate training,
- Rules for calculating need of supervision.

Research:

- National research plans.

The output information of the system consists of two types of reports:

(1) Budget requests which are made up for each field of decision-making covering the main programmes (UTE, GT and TR).

(2) Reports of performances within the programme areas. These reports include individual project reports, examination results and financial records.

7.5. Comments

The information system presented is a static one. At this stage of development it does not take into account the time required for the different reports to be produced or for the decisions to be made. In order to test the system the foregoing relations have to be analysed further.

The processes of decision-making that we define are preliminary. Before we become more definite on this point the goals of the different fields of decision-making have to be carefully analysed. By dividing the ultimate goals into sub-goals, and these sub-goals into sub-sub-goals, etc., we arrive at a number of concrete objectives. Each objective must then be identified with one or more processes of decision-making depending on how far down the sub-divisions proceed.

CHALMERS UNIVERSITY OF TECHNOLOGY

Figure 10

FIELDS OF DECISION VERSUS LEVELS OF DECISION-MAKING

Level of Decision \ Field of Decision	1 Undergraduate Technical Education School (UTE, A)	2 Graduate Training (GT)	3A Technical Research, Engineering Field (TR, A)	4 Economy (Ec)	4 Staff (S)	5 Educational Administration (EA)	5 Research Administration (RA)	5 Planning and Administration of Building (PAB)	5 Planning and Administration of Equipment (PAE)
Long-term planning (5 years)	1A1 Long-term planning for the school	2A1 Long-term planning for GT Construction of individual work programmes	3X1 Long-term planning for the engineering field A	411 Long-term economic planning	421 Summary of requests for offices	511 Calculation of need resources for UTE and GT	521 Long-term calculations of needs for resources	531 Long-term space planning	541 Long-term planning of investments for equipment
Annual planning	1A2 Planning of UTE-schedule Adjustment of the course programmes and budgets Allocation of the TE-grant	2A2 Current planning for graduate students Allocation of GT-grant	3A2 Construction of the division research plan Allocation of research grant to A	412 Budgeting	422 Current planning staff	512 Editing education catalogues	522 Annual report of current research activities	532 Registration of current building projects Allotment of space	542 Current investment planning Allocation of resources
Short-time planning (less than one year)	1A5 Division planning of courses	2A5 Current planning of graduate courses	3A3 Disposal of research appropriations	413 Final allocation of grants Adjustment of budgets	423 Summary of need for new employments	513 Working out schedules for lectures and exams Special education activities	523 Allocation of resources for special research activities	533 Planning for using shared rooms	543 Planning of use of available equipment
Operational Decisions	1A4 Planning of individual courses and thesis work	2A4 Planning of individual graduate courses	3A4 Detailed planning of projects	414 Classification of accounts Routines for accounting	424 Considerations concerning new employment	514 Detailed planning of special activities	524 Planning of UTH-projects Working out PR-programme for UTH	534 Decisions on rentals and hiring of space	544 Decision purchase rentals, hiring
Current activities	1A5 The teaching of courses Thesis work	2A5 Teaching of courses Special GT activities Thesis work	3X5 Technical research	415 Cash- and cost accounting	425 Redeployment of staff	515 Registration of grades and exams	525 Administration of projects and commissions Contacts and information arrangements	535 Administration of buildings Registration of rooms	545 Purchase, renting, hiring of equipment registration
Control, follow-up	1A6 Examination Follow up	2A6 Examination Public discussion of thesis	3X6 Process of reporting	416 Auditing the budgets Balancing the books	426 Time registration Staff registration Follow up personnel capacity	516 Statistical analysis Follow up of effectiveness	526 Collection and follow up of position reports Control of effectiveness	536 Follow up of building plans Control of room exploitation	546 Follow up of investment plans Controls of exploitation of equipment