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ABSTRACT

A method to calculate the need for academic staff per faculty, based on educational programs and numbers of students, is described which is based on quantitative relations between programs, student enrollment, and total budget. The model is described schematically and presented in a mathematical form adapted to computer processing. Its application for the department of psychology at the University of Nijmegen is given. Field research is reported. A concept of education is formulated as a starting point for the construction of a model, and the university is described in terms of systems theory. Proposals are made for: (1) the development of an information model by means of fundamental research on elements and variables that are of special importance to a university policy on education and research, relevant to the type of management that a university requires; and (2) the extension and refinement of the model, relating programs, student numbers and means. (LBM)

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STUDIES IN INSTITUTIONAL MANAGEMENT IN HIGHER EDUCATION
- THE CATHOLIC UNIVERSITY OF NIJMEGEN -

DEVELOPMENT OF A MODEL FOR SOME ASPECTS OF UNIVERSITY POLICY

technical report

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DEVELOPMENT OF A MODEL FOR SOME ASPECTS OF UNIVERSITY POLICY

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PREFACE

The Nijmegen team have now produced a report based on some initial results and have proposed the direction of their continuing effort. The initial result has been the development of a model relating educational programmes, research programmes and student numbers to personnel and space requirements. Only those matters that are more amenable to the application of quantitative models could be covered. But the authors recognise the need to pursue research on the more fundamental aspects of the university, such as the relationship between education and research. Here they have proposed the use of concepts from systems analysis to come to grips with some of the difficult issues of university management.

The Nijmegen project was set up with a three-way financing by the Netherlands Ministry of Education, the University itself and CERI.

The co-operation of the staff at the Department of Psychology was particularly useful to test the parameters and underlying assumptions of the model.

The project has a special significance since the project leader, Mr. Goossens, is also the Planning Officer of the Nijmegen University and will ensure that the methods developed will have practical relevance for university operations. Furthermore, the work of the project is linked with a wide-scale proposal for planning of the post-secondary education system arising from the work of McKinsey & Co.

SUMMARY

A method has been elaborated by the Overbeek Committee - named after its chairman - to calculate the need of academic staff per faculty, based on educational programmes and numbers of students, by means of certain proportional percentages also the number of non-academic staff can be determined. For several years now, the University of Nijmegen has worked with this method. The model underlying the method establishes quantitative relations between programmes, number of students and the total means available.

In Part A of the report the model constructed by the Nijmegen project is described schematically and presented in a mathematical form, adapted to computer-processing.

The model is being applied by faculty. An illustration of its application for the department of psychology of the University of Nijmegen is given here.

Part B provides an account of the field research carried out to list some of the assumptions and calculate the coefficients of the model. Also the methodical problems and limitations of the of the Overbeek method are described as well as the work of the Nijmegen-team to revise and improve the method.

The model has been tested and evaluated on its technical merits in order to determine its applicability as an instrument for management.

In Part C of the report a concept of education is formulated as a starting-point for the construction of a model. The report proceeds to describe the university with the use of the approach of a systems-theory and a suggestion is made for research in two directions. A proposal is made for:

- the development of an information model by means of fundamental research on elements and variables that are of special importance to a university-policy on education and research, relevant to the type of management that a university requires.

- the extension and refinement of the model, relating programs, student numbers and means, as presented in Part A is suggested.

CHAPTER I

OVERVIEW

An outline of the Dutch post-secondary educational system.

In the Netherlands there are 275 institutions for post-secondary education, of which 13 are concerned with university education and 262 with non-university education.

Although there is an increasing need for integration of university education with non-university education in terms of adaptation of curricula, cross-flow of students, allocation of resources etc., at this moment there exists a strict separation. The reason for this is because the political responsibility for university education and the political responsibility for non-university education rests with different ministries of the government.

However, there are a number of recent developments in the post-secondary educational system in Holland that can have far-reaching effects. We have already mentioned the integration of university education with non-university education. Furthermore, there are proposals for a national planning of research and education in which attention will also be paid to the regional planning of education and proposals for a restructuring of university education.

Finally, the place of research within the universities is currently being discussed.

Although important changes on all these aspects are to be expected in the near future, we base our report on the present situation.

Concerning the present situation, we shall pay attention to the programs of education and research, number of students and resources.

1. Formulation of programs

According to the University Education Act "university education concerns the training for an independent pursuit of science and the preparation for the occupation of social positions, for which a scientific training is required or can be of service, and stimulates insight in the relationship of sciences".

The Academic Regulations give a further explanation by each discipline. For example for medical science it is stated as follows:

> Article 25. 1. The candidates examination (undergraduates) consists of:
> a. the theory of the structure and physiology and of the development concerning this of man including its natural scientific background;
> b. the introduction to the disorders in structure, physiology and the development of man;
> c. principles of influence on structure, physiology and development and of disorders thereof.
> 2. The candidates examinations (undergraduate) will be held in at least two parts of which the first part is the propaedeutic examination.
> Article 26. The doctoral-examination (graduate) consists of: theory of disorders in structure, physiology and development of man, recognition hereof and influence.
> Article 27. 1. The qualifying examination for medical assistants consists of the investigation of the knowledge and abilities necessary for the practice of the medical art.
> 2. In order to be allowed to the qualifying examination for medical assistants the candidate has to have given proof of sufficient experience in the guidance of a normal childbirth as well as the appliance of medical help in emergency-cases.
> Article 28. The medical-qualifying examination consists of the investigation of the ability and fitness for an independent pursuit of the medical art.

Within the limits of the Act and of the Academic Regulations the University Departments have a great deal of autonomy in their programming of education. This also appears from Article 59 of the Act:

> Article 59. 1. The task of the faculties, the interfaculties, the subfaculties, the sections, the intersections and subsections shall be the care of the practice of education and the pursuit of science within their own speciality as well as holding examinations.
> 2. They will supply the Senate and the Board of Rector and Assessors with information asked about this matter.

3. The faculty or section and the interfaculty or intersection shall take care of the organisation and proper execution of education under the direction of their Head. Concerning this matter they shall make regulations concerning the duration of the study for each examination, as is normally the most favourable one, and supervise the progress.
When in a certain faculty education and pursuit of science is regulated by a subfaculty or a subsection they have a right of audience in this matter.
4. The structure referred to in the previous section will be made known to the minister of education, the Academical Council and to the trustees and the Board of Rectors and Assessors of the University or College in question.

A remarkable fact about the programs of education is that the total duration of the course within one particular faculty (e.g. medical art) is the same in the various institutions, but that contents and structure of the programs are different.

The proposals for restructuring university education made by Posthumus[1] make no different in this case: they are based also on a uniform duration of study and they leave open the possibility of variable programs.

Concerning the programming of research we do not find any mention in the Act nor in the Regulations. As far as the university research is concerned, there seem to be no fixed rules.

2. Number of students

Influx of students.

The only formal barrier between secondary and post-secondary education is that for certain faculties in post-secondary education, particularly specified blocks of subjects, taught at secondary school, are requested. There is no question about an entrance-examination in order to get permission to follow university education. In principle the students are free to take up a subject at any one of the institutions of university education while often a numerus clausus (a numerical limit) is used for the non-university education. Yet, in a number of disciplines people

1) The University: Goals, Functions, Structures(Posthumus 1969)

try to regulate the influx of students by means of registry-offices. The amounts for registration and tuition fees are remarkably low. The amount for registration is Dfl 10 per annum. The tuition fee is Dfl 200 for the first four years, after which there is no tuition fee. One can only try to influence the influx of students by providing information about the nature of the study and the expected development in the labour-market for particular qualifications provided by university education.

Flow through of students

During their study the students are free, at least in theory, to determine their own speed of study and to change their subject or to go on to another university. A more or less intensive supervision is organised by the faculties which is meant to stimulate the flow of students. The only "hard" factors, that affect the flow of students are:

1. the financial support by means of grants and interest-free loans;
2. the permission for postponement of military service;
3. the financial capacity of the parents;
4. the employment available for students on part-time jobs.

The authorities responsible for the management of education can only partially influence the flow of students by means of the last three factors, and only slightly by means of the first factor.

3. Allocation of resources

The resource needs for education and research are indeed great but their availability is limited. When the resources required exceed availability then to make political decisions as well as the decisions by institutions and faculties it will be necessary to settle priorities. Assignment of financial resources is made yearly by a budgetary Act, in which the legislators make available the finances for each institution of university education separately, specified according to personnel, other current and capital expenditures.

The institutions aregiven full scope in the allocation of those funds over the various disciplines as well as their allocation between teaching and research. The criteria used in making parliamentary assignment of finances to university education are not very explicit. The following table provides data on the expenditures in terms of various significant proportions which reflect the trend in availability of resources for education.

Table 1: Expenditures in University Education in Relation to National and Educational Expenditures

	1950	1960	1966	1971
educational expenditure considered in percentage of the total national expenditure	7.3	16.0	20.9	27.3
expenditures of university education considered in percentage of the total educational expenditure	9.0	14.4	22.9	24.5
expenditures of university education considered in percentage of the total educational expenditures	0.66	2.30	4.79	6.69

Source: National Office for Statistics; figures for 1971 are from the draft budget for 1971.

As regards the expansion of tasks for which expenditures are called for, attention might be drawn to the rapidly increasing number of students (1950: 29.706; 1971: 102.200). Furthermore, because education is being given more intensively now, for example through smaller class size, greater resources are required for staff inputs. Again the many specialities of the university that have been developed recently require resources. Some of these factors are difficult to quantify.

The distribution of the resources over the 13 institutions of university education is based on two criteria: first, equivalent opportunities for development for each institution shall be given, and secondly, staffing among different institutions should be comparable. However, up until now, it has not been possible to apply these criteria in a satisfactory way.

The discrepancy between the resources required and the resources available increases constantly because of the great expansion of tasks in university education. There must, therefore, be a permanent process of deliberation and discussion between the ministry and the institutions and between the institutions and the faculties. An insight in the tasks of education and research that are carried out by the various faculties and their sections is required to serve as a basis for this deliberation.

To summarise:

- a great latitude is allowed to the faculties in drawing up the programs of education and research;
- the influx and flow through of students is hardly regulated;
- there is a lack of fixed criteria in the assignment of funds to education by parliament;
- the discrepancy between the resources required and the resources available increases constantly.

CHAPTER II

THE MODEL

In Chapter I, in which an outline has been given of the Dutch system of post-secondary education, we have pointed out that the assignment of resources to the university education by parliament is made by means of criteria that are not very explicit. But within the university there does exist a set of more or less explicit criteria for the allocation of resources to the faculties. This is the case in Nijmegen, but is probably also the case in other universities.

These criteria are:

1. The need for resources of each faculty calculated according to its tasks namely, its program of research and teaching and the number of students.
2. the relative position the faculty, based on this calculation, relates to:
   - other faculties within the same institution;
   - the sister-faculties of other institutions.

Apart from this there are many other factors that play a part - factors that mostly can be made explicit but that have some sort of ad hoc characteristic (the possibility to engage particular persons, to retain particular people etc.). The calculation of the need for resources for the entire university and its sections as mentioned under 1. is made by aid of the following model:

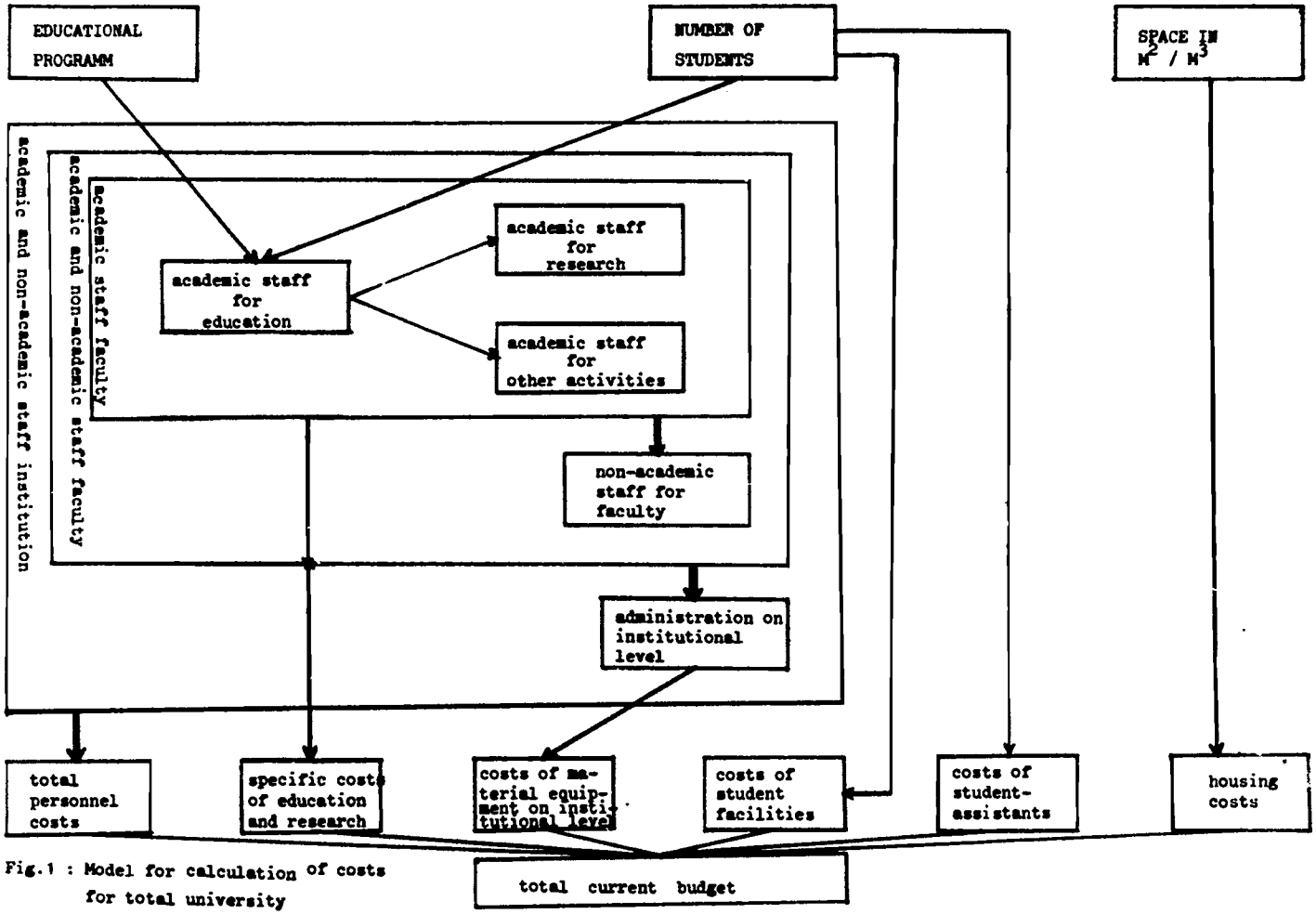


Fig.1 : Model for calculation of costs for total university

The mathematical formula of this model is as follows:

A. The curriculum

The curriculum is dealt with as a set of tasks.
Then for each task the required number of teaching hours is calculated.

indices	l	= consecutive levels in the program (l = 1,6)
	t	= subset of tasks (t = 1,7)
	tt	= subset of tasks, requiring repeated execution dependent on student enrolment (tt = 1,7)
parameters	$P_w(t)$	= weight coefficient to convert curriculum hours into teaching man-hours.
	$P_c(tt)$	= class size
variables	HRS (l,t)	= number of curriculum hours
	S (l)	= number of students
	HRST	= number of teaching man-hours

$$(1)\quad HRST = \sum_{l} \left(\sum_{t} P_w \cdot HRS + \sum_{tt} P_w \cdot HRS \frac{1}{P_c} \cdot S \right)$$

B. The student flow

parameter: $P_f(1)$ = thru-put flow coefficient

variables: So = number of newly enroled students

S(1) = student number in level 1.

C. The need of academic staff

parameters: P_h = average number of man-hours a year for members of the academic staff

P_r = research/teaching ratio coefficient

P_m = management/teaching ratio coefficient

variables: HRST = man-hours teaching from (1)

HRSR = man-hours for research

HRSM = man-hours for management

PSC = number of academic personnel

(3) $HRSR = P_r . HRST$

(4) $HRSM = P_m . HRST$

(5) $PSC = (1 + p_r + P_m) . \frac{1}{p_h} . HRST$

D. Other personnel needs

parameters: P_n = ratio coefficient non-academic personnel to an academic staff member

P_a = ratio administration/faculty personnel

P_s = assistant proportion ratio

variables: PNSC = number of non-academic personnel

PA = number of administration personnel

PS = number of student-assistants.

(6) PNSC = P_n.PSC

(7) PA = P_a. (PNSC + PSC)

(8) PS = P_s. (ΣS(1))

E. Budget needs

parameters: P_1 = average wage-level for personnel

P_2 = wage-level for student-assistants

P3 = equipment expenditures per faculty member

P4 = operating expenditures per administration member

P5 = subsidy cost-level for student facilities

P6 = housing costs per m^3.

variables: BPW = budget for personnel sector

BSA = budget for student-assistants

BEQ = budget for equipment

BEA = budget for administration

BSF = budget for student facilities

BHC = budget for housing costs

(9) BPW = P_1. (PSC + PNSC + PA)

(10) BSA = P_2. PS

(11) BEQ = P_3. (PSC + PNSC)

(12) BEA = P_4. PA

(13) BSF = P_5. S

(14) BHC = P_6. SPACE

Underlying this model is an important assumption viz. the rendering of the need of staff in teaching man-hours is an adequate starting-point and that a weight (E.G. as far as intensity goes) of man-hours spent on the various categories of tasks is not necessary.

The model has two methodological limitations:

(1) it is not so easy to itemize all the categories of tasks (teaching, research, other activities) in a given case. Itemizing one task appears for the time being to be more difficult than to catalogue another and consequently it is the calculation of the needs of academic personnel for teaching that is the starting-point, departing from which a calculation can be made by means of certain relative percentages of the need of academic personnel for the totality of activities;

(2) the categories of personnel (academic personnel, non-academic personnel) cannot be easily itemized; in some cases itemizing one category appears to be more difficult than itemizing another, and consequently the calculation of the need of non-academic personnel is based on relative percentages of the academic staff.

The model has a limitation as far as the possibilities of application go. The model only gives information about the means that are required for the system. This is not a drawback of the model as such, but of its usefulness for the management. Neither the ministry nor the parliament can find arguments in this model why they should not meet the existing need. Nor can the managing

staff of the institution with the aid of this model determine which needs should be met and which should not. The model, as a financial model, does not give an insight in the output and together with this on the efficiency of the system. And the more the insight in this matter grows, the more the assignment and the allocation of means may be made in a more justifiable way.

CHAPTER III

ELABORATION OF THE MODEL

The model calculates the personnel and financial requirements for the university as a whole. The university, however, can be viewed as a set of faculties/subfaculties. Consequently we can narrow down the elaboration of the model to an application to one faculty, without the danger of missing some of its essential aspects. The subfaculty of psychology was willing to serve us as an example. The calculations are carried out using the faculty curriculum for the academic year 1970 - 1971.

The student flow

According to the program a study in pscyhology at the Catholic University of Nijmegen, requires 6 years of studies. The program-years one, three and six are completed by official examinations. The first three program-years (y=1, 2, 3) are made up of general courses in this sense, that every student has to participate in any one of these courses. Every one of these program-years can very clearly be seen as a study-level (1 = 1, 2, 3) expressing the fact that generally students do not become a load for a next level until they have completely passed through the former level. It is not until the program-years 4, 5 and 6 (y=4, 5, 6) that a differentiation in the curriculum courses takes place in accordance to different specialisations. In the subfaculty of psychology one distinguishes 8 specialisations, that will be referred to as field 1, field 2,..., field 8. The individual student has to make a choice for two specialisations and therefore can only participate in a part of the educational program. Within the limits of this choice the student however is free to determine the sequence of the courses he wants to take. As a result is is impossible to view the last three program-years as more than one clearly distinguishable study-level (1 = 4). The number of students in the consecutive program-years have been derived through application of the formula:

$$S^{70}(y) = P_f(y).\ So^{70-y+1} \quad y = 1,2,3,4,5;$$

with So^{70-y+1} = the enrolment for program-year 1 in year $1970-y+1$.

$S^{70}(y)$ = the number of students in program-year y in year 1970/71

$P_f(y)$ = the thru-put flow-coefficient for program-year y.

The result for the academic year 1970/1971 has been summarized in table 2.

Table 2: The numbers of students for program-years and study-levels.

	So	y	$P_f(y)$	$S^{70}(y)$	l	$S^{70}(l)$
1970	337	1	1.00	337	1	337
1969	249	2	0.80	199	2	199
1968	182	5	0.70	127	3	127
1967	105	4	0.65	68	4	225
1966	142	5	0.60	85		
1965	131	6	0.55	72		
		Total S^{70}		888		888

To determine the student load in the 8 fields of level 4 we based our calculations on an estimation of the ratio percentages for the registration numbers in the separate specialisations. The sum total of 200% is explained by the fact that every student participates in two specialisations. The calculation has been carried out for 225 students on level 4.

Table 3: number of students in different specialisations

field	%	numbers
1	16	36
2	18	41
3	14	32
4	50	112
5	4	9
6	58	130
7	34	76
8	6	14
	200	450

The Curriculum

The curriculum is defined as the set of tasks that has to be carried out during a year. In the model the tasks are divided in a subset t(t = 1,7) of tasks that do not require repeated execution dependent on student-enrolment and a subset (tt = 1,7) that does. The Curriculum hours HRS have been expressed in teaching man-hours HRST by weighing them with the weight coefficients P_w. The standard class-size is shown under P_c.

Table 4 gives a survey for the study-levels 1,2 and 3.

Table 4: Survey of teaching man-hours for the levels 1,2,3.

level	t	tt	P_w	HRS	S	P_c	HRST
1	1		3	250	-	-	750
		1	1.66	41	337	12	1919
		2	3	37	337	15	2494
		5	1	13	337	1	4381
					level 1 subtotal		9544
2	1		3	254	-	-	762
		1	1.66	142	199	12	3924
		2	3	112	199	15	4457
		5	1	9	199	1	1791
		7	5	2	199	1	1990
					level 2 subtotal		12924
3	1		3	136	-	-	408
	2		5	63	-	-	315
		2	3	48	127	15	1219
		5	1	6	127	1	762
					level 3 subtotal		2704

For the study level 4 the educational program has been divided in 8 curricula each of which is assigned to a specialisation. This had to be done in order to cope with the differences in student-load per field.

Table 5: Teaching man-hours for the fields 1 - 8

Field	HRST	
	independent of S	dependent on S
1	252	6677
2	190	6626
3	525	5434
4	934	19264
5	950	1296
6	602	22949
7	-	13014
8	1240	2118
level 4 subtotal	82071	

Execution of the complete curriculum requires the capacity of

	9544
	12924
	2704
	82071 +
total teaching man-hours HRST:	107243

The need of academic staff.

The average number of man-hours a year P_h for a member of the academic staff is 2000 hours.

It is assumed that a staff member spends these hours in the following proportions on

teaching	700 hours
research	700 hours
organisational matters	600 hours

Therefore the ratio-coefficient teaching/research $P_r = 1$
and the teaching/management coefficient $P_m = 0.86$
To meet the need for 107243 man-hours of teaching we apply the equation:

$$PSC = (1 + P_r + P_m) \frac{1}{P_h} \cdot HRST$$

and find for the required number of scientific staff members PSC:

$$PSC = (1 + 1 + 0.86). \frac{1}{2000} . 107243 = 153$$

For PhD studies and introduction of new staff an additional percentage of 5.55% + 18.80 %, in total 24.35 % is applied. Then

$$PSC = 153 + 37 = 190$$

Other personnel needs:

non-academic personnel	PNSC = 0.33 x 190	= 63
administration personnel	PA = 0.10 x (190 + 63)	= 25
student-assistants	PS = 0.01875 x 888	= 17

Budget needs:

with	BPW	= budget for personnel sector
	BSA	= budget for student-assistants
	BEQ	= budget for equipment
	BEA	= budget for operating expenditures of the administration
	BSF	= budget for student facilities
and	BHC	= budget for housing costs

The following table gives the results:

Table 6: Budget Needs

Variables	Parameter	Budget
(PSC+ PNSC + PA) (190+ 63 + 25)	P_1 30,400	BPW Dfl. 8.451.200
PS 17	P_2 10,323	BSA Dfl. 175.491
(PSC + PNSC) 190 + 63	P_3 3,089	BEQ DFL. 781.517
PA 25	P_4 4,100	BEA Dfl. 102.500
S 888	P_5 30	BSF Dfl. 26.640
SPACE 105,600 m^3	P_6 9	BHC Dfl. 950.400

CHAPTER IV

THE NEED OF PERSONNEL : THE OVERBEEK METHOD

In the model we presented in the previous chapter, the Overbeek method plays an important part. The model, in fact, has been built around this method which is being used in most institutions for university education, in one way or another for the calculation of personnel required. The method is named after the Chairman of a committee for the Academic Council (Committee for Research of Method for Determination of Need of Personnel). This committee was set up in 1964 and after a number of interim statements it finalised its report in 1970.

As we already indicated in the previous chapter, the calculation of personnel required in an institution is based on the calculated need of academic personnel for teaching. The need is calculated by determining the quantitative amount of staff working hours per annum in the programs of teaching with the given number of students. It appears from what is mentioned below, that the estimation of the need of personnel for the entire institution is based on a calculated part of about 20% in the A-faculties*and 10% in the B-faculties**.

The number of administrative personnel at the institutional level are calculated in terms of certain relative percentage of academic personnel.

* A-faculties are theology, philosophy, literature and arts, social-cultural sciences, psychology, pedagogics and andragogics, law, economics, history.

**B-faculties are mathematics and physics, technical sciences, medical art, dental surgery, veterinary science, agricultural sciences.

The total amount of academic plus non-academic personnel on faculty level are calculated according to certain percentage of academic personnel. The total amount of academic personnel on faculty level is calculated as a certain relative percentage of academic personnel needed for the execution of the teaching program, with a given number of students.

Next we will turn to the basis for the calculations; teaching program and number of students and to the relative percentages of research, non-academic personnel, administrative personnel at the institutional level.

CHAPTER V

CALCULATION OF THE NUMBER OF TEACHING-HOURS: METHODOLOGICAL LIMITATIONS AND DRAWBACKS IN THE OVERBEEK METHOD

1. Definitions and standards

The procedure of the Overbeek-committee has been that it subdivided the educational program into a number of activities and standards based on reasonableness or on existing information for each of those activities with regard to the size of the group and the time required for teaching.

2. Methodical imperfections and fundamental defects

In calculating the academic staff required for the execution of the teaching program according to the Overbeek method we come across some technical limitations and a number of fundamental drawbacks. For the first type of problem we might, though with some trouble, find a solution; for the latter, however, intensive research has to be done.

The methodological limitations are as follows:

In practice there are some other activities to be found in the field of teaching than those which the committee has subdivided. A new form of teaching such as "real time control" by means of a computer is not to be found in the committee's account. This form of teaching requires little time as far as execution goes, the preparation, however, takes up man-years. Moreover, there is no uniformity in the contents of the conceptions that are used. Of course this is the first requisite when we want to create an opportunity for comparison between faculties.

What has been described under the heading: "definitions" has not been defined as such by the committee (probably it is meant as such) but has been formulated in course of time by the people who used these definitions. Especially the team of the Institute of Technology in Delft, that is engaged in the problems concerning this

has made a considerable contribution to this matter.

With respect to the definition of the activities in teaching, however, there are some fundamental problems for which the Delft-team has not been able to obtain a solution either, namely which are the relevant criteria/dimensions of the activities in teaching: size of the group, demands that are made upon the lecturer in terms of skills, effort etc., demands that are made upon the student in terms of skills, effort etc., pattern of interaction between lecturer and student?

A more or less implicit starting-point is that each activity in teaching (a lecture, a lecture with practical work) is performed by only one lecturer. In many cases this is not true. There are lectures (e.g. preliminary lectures) in which 8 or 10 lecturers take a part. Coordination of this cooperation will probably take up as much time as the preparation does for the lecturers individually. The time spent on joint programming (or re-programming) has not been taken into account anywhere. In our opinion this can hardly be ranked under the other activities.

In many cases a number of activities of teaching (.e.g. cursory practical work, essay and examination) forms one block, in which the various parts cannot be distinguished as far as time of the lecturer is concerned. The supervision of a student who does cursory practical work about which he has to render an account cannot be reckoned with one activity nor with another. The same holds for the marking of this account that also is dealt with during the examination.

The standards for the time of teaching are little differentiated e.g. a one-hour lecture for the "kandidaats-studenten" (sophomores) demands two hours of preparation. A somewhat further differentiation in preparational time (time needed for the set-up of and discussion with colleagues about outline, reading of literature, working out of the outline, writing of lecture-notes or syllabus) and in time for preliminary work (time needed to check notes during the period of performance, making technical provisions etc.) has

already the advantage that we in the totality of time of teaching are able to trace parts that differ as far as variability goes. A course that is given for some years running requires a preparation only once, while the preliminary work is done each lecture. With parallel groups for instance the preparational time will remain constant while the time for preliminary work and execution varies. The question still remains as to how far we have to go with differentiation of the time of teaching. In an account of the Delft team we mentioned before the delivery of a lecture and the holding of a pre-examination belonging to them is dinstinguished in nine partial activities (the concept, the working out on paper, the multiplication, preparation of the execution, criticizing the work, checking of the activities, external relations, administrative and technical help for students) and in total 44 sub-partial activities. To what extent does such a refinement give a more trustworthy total result?

In calculating the needs of academic personnel for the execution of a teaching-program in terms of the required amount of man-hours, one implicitly starts from the idea, that the members of staff are largely interchangeable. The teaching program in a faculty with a number of students given requires x man-hours and suppose that a lecturer is able to spend an average of y man-hours on teaching, then it will be clear that for the execution of this program we need x : y lecturers. However, in every teaching program there are subjects that require a very specialised knowledge or skill of the lecturer. But as lecturers cannot exactly be appointed for that special part for which they are needed according to the program, this calculation (x : y lecturers) does not hold. The conversion of the total amount of man-hours into the amount of members of the academic staff will differ from one faculty to another. Therefore the question forces itself on us whether the comparison of the total amount of hours is useful in that case; in spite of the fact that two faculties have a teaching program for the execution of which the same amount of man-hours is required, yet these programs demand a different number of staff.

Among the fundamental defects of the Overbeek method, we would

like to point out the following.

To define the various activities in teaching we need criteria or dimensions that we can use as a basic distinction between one activity in teaching and another. These criteria are missing and therefore we use for the time being those definitions that are developed up to now . Size of the group and preparational time of the lecturer as such are not the relevant criteria because they are derived from something else. Relevant dimensions of an activity in teaching might perhaps be the following. Is it a matter, for instance, of cognitive processes or skill training and if we consider cognitive processes then is it a matter of transferring functional information, imparting insight by means of which the student is enabled to make connections between facts, application of knowledge, etc. On account of this we might formulate the task of the lecturer as well as of the student in terms of time, level of knowledge, skills, degree of engagement etc., and we might formulate demands with respect to the process of interaction between lecturer(s) and student(s) of which the size of the group is one of the elements. Once one is able to to this, it is possible to find the need of personnel in terms other than time (the assumption underlying the model as described in chapter 2). This is not the at the moment.

There is no insight into the efficiency of the applied methods of teaching. A result is that means found in practice are applied in an evaluational way, that averages of calculation, that are not or just far off related to the output, are used as educational standards. These need to be related to the output. The fact that the size of a group in a practical course has an average of 15, becomes a standard namely that the size of a group in a practical course may/must be up to 15.

If in calculating the need of staff for the execution of a teaching-program one considers this program with reference to contents and methods of teaching that are applied as given, then one has to consider also the results as given, even when they show considerable differences within one program or within programs of sister-faculties. For instance, this is the case for the number of

hours of cursory practical work in the non-clinical phase of the medical teaching-program.

CHAPTER V I

CALCULATION OF THE NUMBER OF TEACHING-HOURS; A SUGGESTION FOR AN APPROACH TO METHODICAL IMPERFECTIONS

1. Presentation of a method for itemizing staff-activities*

The method we developed to itemize staff-time has two angles of incidence.

First, we asked each staff-member to indicate p e r p r o g r a m i t e m, what has been his contribution to it.

Concerning this we have made a distinction between rotational activities (1.1.) and non-rotational activities (1.2.).

Second, we asked each member of staff how much time he spent on the various task-categories that together form his complete task as a member of staff (1.3.).

The relation between these two angles of incidence may be rendered thus:

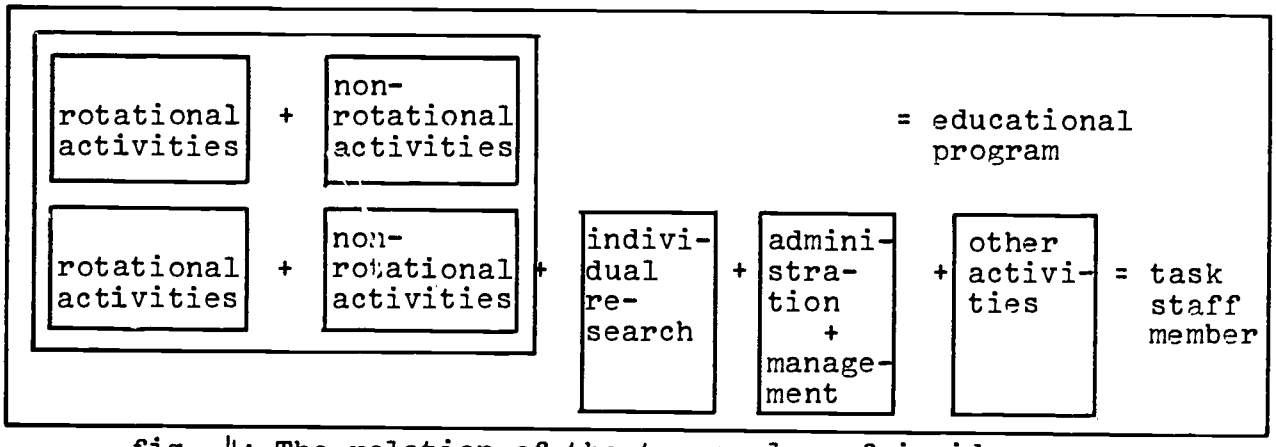


fig. 4: The relation of the two angles of incidence of the itemizing of staff-time;

*In this report we have worked out the method we followed with the help of an example from the subfaculty of psychology in Nijmegen. This subfaculty is part of the faculty of social sciences. During the academic year 1970-1971, 1200 students were enrolled. The number of scientific staff amounted to 78 (distributed over 8 different specialisations, in which one can finish one's studies); non-scientific staff numbered 45.

Total teaching time (time for rotational activities and non-rotational activities) drawn up from the p r o g r a m i t e m s under A have to be equal to the total teaching time (time spent on rotational activities and non-rotational activities) drawn up from the s e p a r a t e s t a f f - m e m b e r s under B.

In our method of itemizing staff-time we actually combine the principles of two existing methods.

The first one is the already amply introduced method of the Overbeek committee which calculates the time required for the execution of the teaching program. The other method is that of the Society of National Statistics. By means of time-keeping (in our method replaced by estimates afterwards) itemized time-spending of the academic staff is determined*

In the case of the latter the advantages are that

(1) there will be an internal check on the gathered information, and

(2) it will be possible to relate much more explicitly staff-member and program to each other.

1.1. Rotational activities.

By rotational activities we understand those activities that are fixed as far as the moment at which they are performed is concerned e.g. for the first term during twelve weeks 2 hours of lecturing.

The rotational activities are itemized on the basis of the following figure.

*The previously mentioned Delft-team applied these two angles of incidence also. The development of this approach that has been developed in Delft and Nijmegen independently of each other. But the two approaches differ in the way in which they are applied.

PART OF THE PROGRAM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
						GROUP SIZE					TEACHERS RANK										EDUCATION TIME														
																					execution			preparation time			preliminary work			correction			undifferentiated		
ACTIVITIES	program-year	executed by section	executed by psychologists, others or mixed	obligatory part of the program for	number of students	real	optimum	maximum	number of groups	number of teachers	full professor	full lecturer	part-time professor/lecturer	senior staff member	junior staff member	senior engineer	junior engineer	assistant	student-assistant	number of groups per teacher	period	number of weeks	number of hours	period	number of weeks	number of hours	period	number of weeks	number of hours	period	number of weeks	number of hours	period	number of weeks	number of hours

fig.5: Schedule itemising rotational activities

Program-Item:

The calculation of the teaching-time required is done per program-item such as, introduction to philosophy, multi-variant analysis, etc.

Activities:

One program-item may include a number of activities. We have adopted, for the greater part, the definitions of the Delft-team.

We define as follows :

lecture	form of teaching in which one or more lecturers deliver a lecture for a number of students about some part of general subject matter of teaching accompanied or not by the use of slides and/or demonstration (lecture = speech, discourse, guest-lecture).
question-hour	form of teaching in which one or more lecturers are available for a number of students to deal with questions about some part of the subject matter of teaching.
practical work	form of teaching in which the individual student can gather practical experience of the application of the acquired knowledge and insight with the help of appropriate aids and appliances (equipment, experimental test-cases; also e.g. the language-laboratory); academic and technical personnel for supervision is available.
skill-training	form of teaching in which the student can acquire certain skills; for this an intensive supervision by academic personnel is necessary.

instruction	same as "practical work" but more directed towards the know how of solving problems (application of acquired knowledge of theory).
practical work in lectures	form of teaching in which a team of students can gather experience of the execution of the concrete tasks (developing of problem statements; generating, working out and selecting of alternative solutions). Here included is also teaching by means of so-called "cases".
project-group	form of teaching in which students as a team can gather experience of the execution of tasks of research, partly set up by themselves.
excursion	form of teaching in which a group of students staff and lecturers pay an educational visit to one or more concerns and institutions or to projects in the stage of execution at home or abroad.
probationary work	form of teaching in which a student gathers practical experience in a concern or institution during a longer period of time (e.g. between two and twenty weeks) of which he has to render an account.
account of probationary work	. . . . .
probationary research	form of teaching in which research is being done by one student or more students forming a team with periodical supervision by academic personnel; the work may be done in the educational institute as well as in practice (e.g. in industry).
account of probationary research	. . . . .

essay paper	form of teaching in which the student practises the study of and tries to make approachable a certain amount of literature, considered from a specific point of view.
colloquium lecture	form of teaching in which one or more students deliver in the presence of their colleagues, lecturers and members of staff and persons who are interested, a lecture about the research they have done being followed by a discussion.
written examination	form of teaching in which the participants get the opportunity to prove on paper their ability with regard to knowledge, insight, skill in some speciality.
oral examination/ preliminary examination	form of teaching in which the participant gets the opportunity to prove orally his ability with regard to knowledge, insight, skill in some speciality.

Curricular Year:

By curricular year is meant the year of the various stages of the complete training (1e, 2e..... phase of graduation).

Executed By:

Within the faculty (e.g. psychology) we can distinguish a number of specialisations in which one can finish one's studies, which at the same time are organizing unities: social psychology, genetic psychology, cultural and religious psychology, clinical psychology, functional psychology, industrial psychology, mathematical and statistical psychology, comparative and physiological psychology.

Executed For:

The program-item may be executed for students of the own faculty, for students of other faculties or combined.

Compulsory For:

A program-item can be compulsory for some students. In that case it belongs to their basic program.

Number of Students:

By this is meant the basic number from which has been started in programmizing (this is not equal to the number of students who are actually present).

Size of the Group:

- factual	from what size of the group did you start in programmizing this.....(activity)?
- optimum	what is in your opinion the optimum size of a group considered from an educational point of view?
- maximum	what is, in your opinion the maximum size of a group considered from an educational point of view, if the characteristics of the activity must not be changed?

Number of Groups:

The number of groups results from the number of students and the size of the group from which has been started in programming.

Number of Lecturers:

Under the number of lecturers has to be filled in how many lecturers have executed this program-item or a part of this.

As appears from the ranks the students-assistants are reckoned among the lecturers too.

Teaching-Time:

- execution	delivery of or assistance at ..... (activity).
- preparation	set up and discussion with colleagues of the outline. reading of literature working out the outline writing of lecture-notes or syllabus.
- preliminary work	the check of reading of lecture-notes/ syllabus or other notes during period of execution.

- non-differentiaded time	time spent on execution/preparation/ preliminary work/marking, when specification is impossible (e.g. when students-assistants are concerned).

Periods:

- period 0	June 21 - September 20.
- period 1	September 21 - December 20.
- period 2	December 21 - March 20.
- period 3	March 21 - June 20.

1.2. Non-rotational activities.

By non-rotational activities is understood those activities that are not determined with regard to time of performance such as supervision of a student who does research for his masters degree.

Especially the program for post-graduates includes in most disciplines a general part that is compulsory for all students and an optional part. Concerning the latter (the optional part) only in the subfaculty of psychology it is set down that it shall consist of a principal subject plus a first extension (in the same subfaculty) plus a first subsidiary subject (in another faculty or subfaculty) and in a given case a second subsidiary subject (in another faculty or subfaculty).

The principal subject includes a period of information and of probationary research in one of the specialities mentioned before.

The probation consists of the participation in research for a minimum of six and a maximum of nine months. This participation is concluded with the writing of an account.

The period of information has a non-rotational character (research in the field of literature plus essay) in one section, and in another a much more rotational character (teams of research etc.). Therefore we find these activities back under the rotational activities.

The first extension includes the same method as the principal subject only with a duration of less months (minimum 3 and maximum 6 months).

The second extension includes in most cases the attendance at lectures plus taking a preliminary examination, and sometimes the writing of an essay about the literature of the subject.

The subsidiary subject has the same contents as the second extension but is mostly taken in another (sub-) faculty.

Among the students belonging to the categories principal subject, first extension and second extension, there may be students who, according to the point of view of their own faculty take up a subsidiary subject in the faculty of psychology, but who need the same supervision by the staff as the students of psychology themselves.

So supervision of post-graduate students includes a great number of non-rotational activities.

Apart from this some members of staff (professors and lecturers) take care of the supervision of people who take their doctor's degree, which also means non-rotational activities.

We have tried to itemize the non-rotational activities on the basis of the following figure.

	Hours per week	Period 0			Period 1			Period 2			Period 3		
		numbers of stud	number of weeks	total number hours	numbers of stud	number of weeks	total number hours	numbers of stud	number of weeks	total number hours	numbers of stud	number of weeks	total number hours
1. Principle subject: information													
2. Probationary research in principle subject													
3. First extension: information													
4. Probationary research in first extension													
5. Second extension													
6. Tentamination													
7. Examination													
8. Coaching of Ph.D.													
Total													

fig. 6: Scheme, itemizing the non-rotational activities.

How the staff-member spends his time.

We have subdivided the task of the staff-member in five partial tasks:*

1. Execution of program-items that consist of rotational activities.
2. Execution of program-items that consist of non-rotational activities, included the supervision of graduates who want to take their doctor's degree.
3. Research directed towards own publications.
4. Activities of management and administration.
5. "Other activities".

Each of these partial tasks consists of a number of activities:

Sub 1: Delivery, organisation, marking, preparation, (included bringing up to date of knowledge, composition of lecture-notes/syllabus etc.) of rotational activities such as:

- lectures
- question hours
- instruction
- practical work in lectures
- practical work
- skill-training
- evaluation of project-groups
- excursions
- colloquies
- preliminary exams/examinations.

Sub 2: Activities for the benefit of advanced under-graduates and post-graduates such as:

- supervision and marking of the essays
- organisation - supervision and evaluation of probationary work outside the institution

* In the medical sector there is a sixth partial task: care of patients.

- discussion about the set up, organisation and progress of research
- making preparations with regard to matériel
- supervise the formation of a store of knowledge for the benefit of research
- supervise the observations, experiments, etc.
- supervise the adaptation and analysis of the results of research
- supervise the making of reports about the results of research
- evaluation and marking of the account.

Sub 3. Activities for the benefit of own research such as:
- discussion about the set up and organisation of research
- making preparations with regard to matériel
- formation of a store of knowledge for the benefit of research
- observations, experiments etc.
- adaptation and analysis of the results of research
- making reports about the results of research
- maintain relations with publishers, editorial staff of papers etc.
- staff-discussions as far as these are exclusively devoted to research
- participation in committees/project-groups, exclusively in connection with research.

Sub 4. Activities of management and administration such as:
- organisation and attendance of staff- and faculty meetings
- dealing with affairs of personnel
- giving advice for the purchase of books
- budgeting (as far as not connected with private research)
- keeping watch over credit (as far as not connected with private research)
- discussions with regard to building and buildings
- management of facilities
- preparation of and attendance at meetings of senate,

teams of a particular speciality, committees within the same university.

Sub 5. "Other activities" such as:

- activities in committees outside the same university
- attendance at congresses, conferences, lectures etc.
- reception and information of guests
- giving introductions, colloquies etc.
- attendance at orations and promotions
- attending courses not directly connected with teaching and research
- participation in activities organised by student's clubs
- giving lessons and holding examinations in non-university education
- giving information about studies to e.g. pupils of secondary schools
- activities in or outside the university that may be reckoned to "service" and that are not reckoned somewhere else.

Starting from an average number of hours, that a member of staff spends on his complete task in the various periods and taking this for a frame we might try to calculate the number of hours he spends on the various partial tasks.

This method we shall see in the following figure:

	Period 0	Period 1	Period 2	Period 3
1. How much time have you spent on rotational activities as mentioned sub 1.?				
2. How much time have you spent for graduate-students, first and second degree, on activities as mentioned sub 2.?				
3. How much time have you spent for your own research on activities as mentioned sub 3.?				
4. How much time have you spent for management and administration on activities as mentioned sub 4.?				
5. How much time have you spent on other activities ad 5.?				

average number of hours per week in total from 1/5.				
35 hours and <				
40 hours				
45 hours				
50 hours				
55 hours				
60 hours				
65 hours and >				

fig.7: Itemizing staff-time

2. Results.

The elaboration of the Overbeek-model in Chapter III showed that by far the greatest part of the total number of teaching man-hours HRST was made up of hours spent on activities dependent on student enlisting.

In fact these activities sum up to 93.6% of the 107,243 teaching man-hours.

This caused the focus-point of our attention to move on to the student-dependent activities and especially to the question how the student flow-model effected the number of teaching man-hours. Therefore for all rotational and non-rotational activities the real number of participating students was measured and used as inputs for the same calculations, as previously carried out in the elaboration of the model.

Table 8 shows the effect.

Table 8: Number of teaching man-hours with measurement of student enlisting.

		S out of student flow model		S out of by measurement	
level	field	HRST		HRST	
		independent on S	dependent on S	independent on S	dependent on S
1		750	8794	750	9389
2		762	12162	762	12644
3		723	1981	723	1444
4	1	252	6671	252	4469
4	2	190	6626	190	8894
4	3	525	5434	525	7386
4	4	934	19264	934	9583
4	5	950	1296	950	1114
4	6	602	22949	602	13534
4	7	-	13014	-	6776
4	8	1240	2118	1240	1772
		6,928	100,315	6,928	77,005
		107,243		83,933	

The next step was to try to measure the number of teaching man-hours executed in the academic year 1970/1971. Therefore an itemizing of the psychology curriculum in program-items has been carried out and each staff member has been asked to indicate per program-item his contribution to it in man-hours. The organisation of the curriculum is such that each specialisation takes care of the execution of a number of program-items. The distribution of teaching man-hours over the 8 fields is shown in table 9. A distinction has been made between rotational and non-rotational activities. For comparison the corresponding figures from the Overbeek-model with real student numbers are presented.

Table 9: Number of teaching man-hours with itemizing staff-activities. Subfaculty of Psychology.

field	teaching man-hours HRST			
	Overbeek-model		Itemizing staff-activities	
	rotational	non-rotational	rotational	non-rotational
1	4366	1716	4419	2016
2	2658	7152	4974	2880
3	14668	3912	14605	4200
4	10362	6264	4278	2808
5	4396	1114	8008	560
6	9787	5224	8216	4500
7	5279	3264	5002	3444
8	2107	1464	2092	1104
	53,623	30,310	51,594	21,512
	83,933		73,106	

Another test we performed was on the distribution of man-hours over various task categories and the average number of man-hours a year. The Overbeek-model makes a distinction in 3 task categories for a member of the academic staff: teaching tasks, research tasks and management/administration tasks.

We have subdivided the overall task of a staff member in five categories:

1) rotational teaching activities

2) non-rotational teaching activities including the supervision of student research
3) research activities directed towards own publications
4) management/administration activities
5) "other activities"

The average percentages of time spent in each of these five categories for 59 members of the staff is shown in table 10.

Table 10: How a staff member spends his time, in percentages.

	period 0 summer	period 1 autumn	period 2 winter	period 3 spring	year average
rotational teaching	29	37	31	22	30
non-rotational teaching	15	15	18	19	17
research	32	27	28	33	30
management administration	12	10	12	13	11
other	12	11	11	13	12

The categories rotational and non-rotational teaching may be said to correspond with the Overbeek teaching category. The same assumption holds for the category management/administration including "other activities" and the Overbeek-management and administration category. Then table 11 makes a comparison and also shows the effect on the teaching/research and teaching/management parameters P_r and P_m, that play an important role in the Overbeek-model.

Table 11: Staff-time Distribution.

	Overbeek	Psychology
teaching	35 %	47 %
research	35 %	30 %
management administration	30 %	23 %
P_r	1.00	0.63
P_m	0.86	0.49

The staff-member average for man-hours per week was found to be 48 hours. The Overbeek-method states that there are 47 effective weeks in a year. Under the same assumption the average number of man-hours in a year is then 2250 hours (Overbeek 2000). In combination with the percentages of staff time spent on rotational and non-rotational activities we can use this figure to make another calculation of the number of teaching man-hours HRST.

Table 12: Number of teaching man-hours through percentage of time spent on various categories.

subject fields	teaching man-hours HRST			
	Itemizing staff-activities		out of the percentage of time spent	
	rotational	non-rotational	rotational	non-rotational
1	4419	2016	3650	3457
2	4974	3880	6810	2999
3	14605	4200	12598	4508
4	4278	2808	5411	2117
5	8008	560	8310	647
6	8216	4500	10045	4410
7	5002	3444	5864	2222
8	2092	1104	2388	1223
	51,594	21,512	55,076	21,583
	73,106		76,659	

3. Methodological problems.

In the foregoing we compared some of the results obtained by application of the Overbeek-method to the educational program, with the results obtained by using our method. But we did not consider the validity and the reliability of our instruments. On one hand we do not think it useful to discuss at length, within the structure of this report, the methodological difficulties that crop up concerning the measuring-instruments we have developed. On the other hand we think it cannot be justified if we brush the difficulties completely aside.

It will be sufficient for us to indicate here the main questions that arise concerning our instruments.

3.1. The internal consistency.

Our method of itemizing consists of three parts:

(1) Itemizing time spent on rotational activities
(2) Itemizing time spent on non-rotational activities
(3) Itemizing time spent by the members of staff on their complete tasks of which two out of the five partial tasks are:

execution of rotational activities and non-rotational activities.

A complete consistency would be a fact when the total teaching-time, itemized starting from the program-items would be equal to the total teaching-time itemized starting from the separate staff-members. What degree of inconsistency may we assume as being tolerable without having to draw the conclusion that our measuring-instruments have become invalid?

3.2. Item-consistency.

Taking the rotational activities we have mentioned such factors as the number of students, number of hours of preparation, execution, etc. Is the figure, filled in in one column under the heading, number of students, a similar kind of figure as a figure, filled in in another column? Some figures are found by measuring (we can exactly determine the number of students that have taken an exam) others by estimation (we have a more or less exact idea of the number of students who are supposed to attend this or that lecture).

The same applies to the number of hours. The number of hours one has to spend on lecturing, can be determined exactly.

The number of hours spent on preparation or preliminary work is an estimation.

This item-consistency becomes even more doubtful, when we ask ourselves whether the various respondents have understood the same thing by the items.

Notwithstanding the fact that these items are defined as exactly as possible, a considerable margin remains for interpretation.

We defined, for instance, maximum sizes of the groups as the maximum number of students that can be allowed without changing the characteristics of the activity (a lecture with practical work changes into a normal auditive lecture when a particular number os students is exceeded).

In giving the definitions of educational activities we already came to the conclusion that the educational activities can not (yet), uniformly be distinguished from each other.

This means that we cannot exactly indicate the-changing-of-characteristics and this in turn means that the notion, maximum size of the group is likely to have been interpreted in a different way.

3.3. Content-validity.

When we talk about the content-validity of a measuring-instrument, we ask ourselves whether the instrument really measures what it is meant to measure.

In our case we intend to measure over certain periods the spending of time of the staff on various partial-tasks on one hand and the time spent on teaching on the other. It could be possible that in fact we have measured something else.

For example, the interviews at the subfaculty of psychology have been made by four interviewers. Perhaps we might come to the conclusion that a method such as we have developed is very sensitive to the way of interviewing (the amount of "cues" that are given and how); or that this method is very sensitive to the position of the interviewer in the organisation (three student-assistants and one member of the university-office).

Secondly, the periods that are given by the respondents are estimates. What we have measured could be therefore: the systematical distortion of the perception of time that occurs in estimates in this way that what the respondents thought the most attractive activities, gets the main stress or what has been done last still has the strongest influence.

Thirdly, the spending of time, that is given by the staff-members is probably determined in the same degree by what they consider as a generally accepted way of spending your time as a member of staff (as for total periods of time per week and distribution over the partial tasks) as by the, as responsible as possible, estimation of the time they have spent.

3.4. Reliability in time.

The reliability of a measuring-instrument still has a fourth dimension namely whether a method remains stable in the course of time.

The procedure of a test - retest is, that a group of persons is tested twice by the same test and that the correlation is given between the observations made at the first and at the second test.

The reliability of the measuring-instrument in terms of a stability-coefficient is determined by the correlation between the two test-observations.

When during a pause the change has taken place in what is measured (in a given case the teaching-program and the way in which the staff-members spend their time) this method for determination of the reliability of a measuring-instrument is questionable.

The determination of validity and reliability of a measuring-instrument, such as we have developed in terms of internal consistency, item consistency, content validity and reliability in time, demands a few years. This could mean that in the meantime in the field of management, nothing may be done with the results that are obtained by this method. If we would have to do with research only, this point of view would be entirely correct; for the managing authorities it would hardly be attractive of course.

The compromise will be to use the result with restrictions, and go on with testing the instruments in the meantime, which may not be too satisfactory (and not always without danger) but certainly offer the most reasonable solution.

4. Applicability of the method.

As stated above, to itemize the time-spending of the academic staff there are three methods:
First there is the Overbeek-method, that with the help of a number of standards calculates the education-time required to execute the educational program a certain number of students given and then fixes the total staff-time on three times the education-time.

Secondly there is the method of the Society of National Statistics that determines by means of time-keeping during a number of weeks spread over the year the number of working hours of the member of staff per annum and the distribution among the various partial tasks.

Thirdly there is the method followed by us that renders the time spent, at an estimate, on the educational-program and the total amount of working-hours, spent, at an estimate, by a member of staff per annum and its distribution among the various partial tasks.

From what has been said above it appears that certain demands are made upon the method applied concerning validity and reliability if this method should be useful as an instrument for collecting data.

To be useful demands are made upon such a method also from quite another point of view namely demands concerning the applicability.

In the attempt to itemize the staff-activities one comes in this field across a number of objections that hinder the collection of the necessary information. With respect to this our experiences go further than only the subfaculty of psychology.

These objections can be different in character. For example
"any attempt to itemize the doings of the staff is wrong as such"
"the methods developed up till now are not adequate"
"cooperation requires too much time"

With s o m e people there exists objection against whatever method is proposed for itemizing staff-activities.

They mistrust the "technocrats" who with their techniques can direct and regulate everything no matter whether it is about a military, industrial or university organisation.

Even deeper is the distrust of the "managers" who use the services of these "technocrats".

With regard to the first group - the technocrats - the sceptics are prepared to admit that there is a certain narrowness, though not a harmless one; the second group however - the managers - are expected to direct consciously with particular objectives (and the underlying values and ideologies). That is their task.

Consequently it will be of the greatest importance who these managers are and even more important within which structure of management they function.

This problem - the ideological implications of the use of technical instruments (material and immaterial) - in thinking about planning has already been distinguished long before (e.g. by Mannheim in 1935 in his Mensch und Gesellschaft im Zeitalter des Umbaus). The fact that this problem has been signalized already long ago does not mean that it should not be taken seriously every time it crops up.

It is only to be hoped that this problem will not have a paralysing effect, for there is a great need of planning.

In the post-secondary education in the Netherlands people have for a very long time taken the line that the needs of education sufficiently speak for themselves, in other words that in the distribution of the national budget these needs do not require elucidation. More and more it becomes clear, however, that in the struggle for the tight means available all sectors of government-care (defense, roadbuilding, national health, education etc.) have to "sell" themselves in the sense that they will have to prove that the needs are real and that the resources are spent in an efficient way which is possible with the aid of management.

O t h e r people have objections because the methods of itemizing, developed up till now are inadequate.

The main objections are that the various categories of activities (education, research etc.) cannot be distinguished from each other and that the methods applied relate everything to one single dimension, namely time, in which furthermore the line has been taken that one hour spent on one activity is the same as that what is spent on another activity. In other words there is such a strong reduction that the question rises what we can do at all with the results.

As a matter of fact science constantly applies reduction to reality. The question in this case is only whether the result obtained with the aid of the reductions applied, has any relevance when this result has to be: to determine and to control

the boundary-condition within which the precesses of education and research are performed.

F i n a l l y there were objections as a result of the fact that the cooperation of the members of staff, at least in their opinion, should take up so much time:"gradually I spend the greater part of my time on indicating how I spend my time". Although this is meant jestingly of course we should try to prevent as much as possible that the same kind of information will be asked by an authority on faculty-level and by an authority on institutional level and by authorities on national level.

There are objections against the methods of itemizing staff-activities. Because of a very practical argument already mentioned, namely that one is dependent on the cooperation required, it is necessary to pay attention ot these objections.

In relation to this we will pay attention to the applicability of the Overbeek-method, the method of the Society of National Statistics and the method we followed; the reliability, validity and the usefulness of the results is not our concern here.

In this respect the Overbeek-method is by far preferable.

With the aid of the curriculum-guide plus some additional information from one or two members of staff (e.g. a study-coordinator) we can calculate the educational time for a faculty and together with this the total staff-time.

The time required by the cooperation of the faculty is about 10 hours of the study-coordinator provided that he is sufficiently informed about the educational-program and the people who execute it.

The method of the Society of National Statistics requires, on one hand, a high degree of cooperation because they have to keep consciously during a number of weeks how much time is spent on the various activities and on the other hand a high degree of self-discipline because they have to try to prevent that the weeks in which the measures are taken become "extra-active". The time required for the cooperation of the members of staff is 10 hours per member of staff (half an hour a day during three weeks).

(The non-response on the inquiry of the Society of National Statistics of 1969/1970 was considerable.)

The method of the Nijmegen-project consists of an interview with all the staff members of about 1 or 1½ hours with the aid of the information-schemes on pages 35, 42 and 46.

When also the members of staff prepare themselves for the interview it takes up about 4 hours per member of staff in total.

The existing objections considered, we think that an oral interview is by far preferable to an inquiry on paper.

The situation of an interview gives the advantage both to the staff-member and the interviewer that all kinds of difficulties in interpretation ("have we to reckon this with research or with education?" etc.) can be solved during the interview.

It gives the opportunity to the interviewer to explain the objectives and restrictions of the method applied, and to help the staff member, if necessary, to cross the deadlocks.

(in the subfaculty of psychology there was no non-response.)

CHAPTER VII

STUDENT - NUMBERS

From what precedes it has become sufficiently clear that the number of students in the Overbeek-method plays a very important role.

Therefore if one wants to apply this method on the level of management, determination of the number of students is of the utmost importance.

In what follows a short survey will be given of the method usually applied in our country for the projections of the number of students and a short survey of the difficulties one meets when trying to determine the number of students on faculty-level at a given moment.

1. Projections of the number of students.

Before November 1961 the precalculations of the number of students were made by the Committee of Statistics of the Organ for Inter-university Contacts.

After the installation of the Academic Council (November 1961) these activities were taken over by the Committee for Statistical Research of the Academic Council. Its task is - among other things - as follows:

"The committee shall make calculations concerning the need of and the demand for university-educated people. With a respect to this task also they shall make estimations of the development of the number of students and graduates for every discipline and for every institution for university education, collectively as well as individually."

In the following sections an explanation will be given of the method, applied by the Committee for Statistical Research (C.S.R). In order to avoid too abstract an argumentation, we will use the figures of the latest estimation by the C.S.R. for the beginning of 1971.

1.1 Key-data.

Table 13: Numbers of first-year students 1980 and 1990
x 1000

Admission to A.V.O.	Transition to V.W.O.	Transition to W.O.			
		1980		1990	
		high	low	high	low
high	high	31	28	47	43
	low	28	25	43	39
low	high	28	26	39	36
	low	26	24	35	32

A.V.O. : Continued general education.
The U.L.O. (Advanced Primary Education) in the old and the M.A.V.O./H.A.V.O. (Post Primary and Secondary School) in the new structure of the Dutch School system.
V.W.O. : Preparational university education.
W.O. : University education.

1.2 From total influx first-years to influx first-years per separate discipline.

Next, the total influx of first-years, of which a high and low estimation has been made, is split up according to the separate disciplines.
This resulted in the following division:

Table 14: Netherlands First-year-students per discipline x 1000.

	1968	1980 high	1980 low	1990 high	1990 low
Theology	0.3	0.4	0.3		
Arts	1.1	3.2	2.5	5.5	4.0
Law	2.1	3.7	2.7		
Social sciences	1.3	3.6	2.5		
Economics	1.6	3.1	2.5	22.5	15.0
Psychology	0.9	1.8	1.4		
Geography	0.4	0.6	0.5		
Others	0.6	2.1	1.5		
Mathematics/Physics	2.0	3.6	2.8		
Technical sciences	2.8	4.5	3.7	12.5	8.5
Medical Arts	1.8	2.6	1.9		
Dental surgery	0.4	0.5	0.4	4.5	3.0
Veterinary science	0.2	0.3	0.2		
Agricultural science	0.5	1.0	0.7	2.0	1.5
TOTAL	16	31	24	47	32

1.3. From influx per discipline to total number of students per discipline.

The question how an influx of first-years accumulates to a total number of students, composed of the successive year-classes, depends on factors such as term of enrolment and numerical efficiency.

The following estimates of the total number of students are based on data concerning progress of enrolment of first-year students according to discipline, as calculated by the Society of National Statistics.

Table 15: Netherlands, number of students per discipline x 1000.

	1968	1980 high	1980 low	1990 high	1990 low
Theology	1.9	2.5	2.5	37	26
Arts	8.0	18.0	15.5		
Law	9.7	23.0	18.5		
Social sciences	6.7	19.5	15.5	147	102
Economics	9.0	16.5	14.5		
Psychology	4.7	11.0	9.5		
Geography	1.5	3.5	3.0		
Others	2.4	11.5	9.0		
Mathematics/Physics	11.5	20.5	17.5	75	56
Technical sciences	13.6	24.0	21.5		
Medical Arts	11.7	16.0	13.5	30	21
Dental surgery	1.6	2.5	2.5		
Veterinary science	1.2	1.5	1.5	11	8
Agricultural science	2.3	5.0	4.0		
TOTAL	84.8	175	150	300	215

This means that the total number of students, that amounted to 84,800 in 1968 and according to the latest report of the Society of National Statistics has meanwhile passed the 100,000 mark in September, will reach a number between 150,000 and 175,000 in 1980.

In 1990 this number is expected to have been mounted up to minimum 215,000 and maximum 300,000 students.

1.4. From universities collectively to individual universities.

In the description of tasks of the C.S.R. given in Section 1, ("they shall make estimations of the development of the number of students ..... for every discipline and for every institution for university education") one can read also that the

pre-calculation of the distribution of the estimated number of students among the separate institutions for university education, is entrusted to them.

The practice up till now, however, is that the institutions themselves, on the basis of the latest estimates of the C.S.R., determine their own part in the total estimated number of student population. We will describe the broad lines of the method applied in this matter.

First of all a calculation is made of the part in the total number of students, the institution concerned has had during a period of five or ten years. This results for the Catholic University of Nijmegen in this survey:

Table 16: Total number of students of Catholic University and the Netherlands.

	C.U.N.	TOTAL	Total part in percentages C.U.N.
1961/62	3371	43669	7,7
1962/63	3820	47377	8,1
1963/64	4287	52348	8,2
1964/65	4900	58361	8,4
1965/66	5566	64432	8,6
1966/67	6349	70840	9,0
1967/68	7134	78306	9,1
1968/69	7861	85113	9,2
1969/70	8727	93302	9,4
1970/71	9829	102219	9,6

The Nijmegen-portion appears to have risen considerably during the last ten years; although a bit less sharply in the last few years than in the period 1961-1966. The question how this number will develop in the period, the estimation is meant for, is of the utmost importance for an estimation as reliable as possible.

Especially this question is important how those processes

which are recognized by the C.S.R. as the determining factor in the number of students, will develop in the area from which the Catholic University gets its students.

It would carry us too far to consider here all those considerations that have led up to the concrete estimation of the number of students in Nijmegen. Suffice it to say that the Nijmegen-portion in the total population of students is expected to keep rising. However, it is expected that the rise will be less than in the last decade.

This same approach is used when the Catholic University estimates the number of students per faculty or discipline.

2. Number of students at a particular moment.

The determination of the number of students at any given time is not without difficulty.

This is particularly so when we ask for the number of students of any section of any faculty.

Table 17: Numbers of students according to the students-registration on university-, faculty-, section level.

	university			
	data from manual compilation	data from computer	faculty	section
31/12/1969	-	-	535	-
1/ 2/1970	486	-	-	-
1/ 5/1970	496	-	-	-
1/ 8/1970	549	607	-	560

Where do these differences come from?
In our opinion there are three factors:
The first is the definition of the term: student

The second is the adequacy of the students-registration on the various levels
The third is the moment of measurement

2.1. Definition of the term "student".

The concepts "enrolled students" and "students applying for education" do not fully conform to each other.

On one hand there are m o r e students asking for education than enrolled students, because there are students who
(a) attend, optionally or obliged, lectures of a particular subject while they do not need to be enrolled in that discipline
(b) switch over from one subject to another without having themselves enrolled again
(c) attend lectures without having themselves enrolled at all

On the other hand there are l e s s students asking for education than enrolled students because there are students who
(a) hardly aim at any achievement in their study but have themselves enrolled because of the facilities that go with it (tax-relief, children's allowance, favourable tariffs for travelling, holidays and insurances etc.)
(b) have to do some parts of their study again in a particular phase, which then for the greater part comes as self-activity.

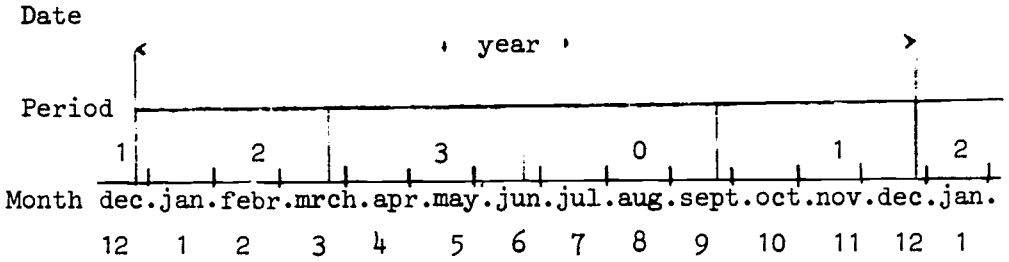
The problems of determining the number of students applying for education can be solved as follows:
The enrolment of students will take place per component of the curriculum instead of per complete curriculum divided up in phases. This is the logical consequence of a development towards a larger choice in the complete set of subjects (certainly in the graduation phase) on the one hand, and more obliged components of the curricula of other disciplines on the other. From these enrolment-data over a progression of years we obtain a view of the flow of students as to t i m e and their d i s t r i b u t i o n among the various items of the curriculum.

Corrections of these data should be made on one hand by a certain proportional additive percentage because of the fact that there are more students who apply for education than enrolled students and on the other hand by means of a certain proportional reducible percentage because of the fact that there are less students who apply for education than enrolled students.

Punching sheet STUDENT CARD

Data		Code	Card column
1. Code card			1
2. Registration number student			2-6
3. Starting level of the study			7
4. Interruption of the study	from		8-10
	till		11-13
5. Ending of study without P	date		14-16
6. P-examination	date		17-19
7. Ending of study without K			20
	date		21-23
8. Second year curriculum	date		24-26
9. Third year curriculum	date		27-29
10. K-examination	date		30-32
11. Ending of study without D			33
	date		34-36
12. Principal subject			37
13. First extension			38
14. Second extension			39
15. Graduation phase			40
	date		41-43
16. Graduation phase			44
	date		45-47
17. Graduation phase			48
	date		49-51
18. Graduation phase			52
	date		53-55
19. Graduation phase			56
	date		57-59
20. Graduation examination			60-62

LIST OF CODIFICATIONS PUNCHING-SHEET S T U D E N T C A R D



999 = date unknown

3 Starting level of study

1 = starts with propaedeutic

2 = starts with undergraduation (kandidaats)

3 = starts with graduation (doktoraal)

9 = unknown

7 Study ended without K

1 = study ended

2 = switched over to other subject

9 = unknown

11 Study ended without D

1 = study ended

2 = switched over to other subject

9 = unknown

12 Code Principal Subject. First extension. Second extension

13 1 = industrial psychology

14 2 = cultural and religious psychology

3 = functional psychology

4 = clinical psychology

5 = mathematical and statistical psychology

6 = genetic psychology

14 7 = social psychology
8 = comparative and physiological psychology
9 = unknown

15 Code graduation phases

16 1 = preliminary examination principal subject

17 2 = preliminary examination first extension

18 3 = probationary work principal subject

19 4 = probationary work first extension
5 = preliminary examination subsidiary subject/second extension
9 = unknown

2.2. The adequacy of the students-registration at the various levels.

When one has found out which data are of importance the determination of the number of students is principally a question of a correct students-registration.
On this ground it should also be possible to determine, in a fairly exact way, what the relation is between enrolled students and students who apply for education.
Because of the fact that the students'card contains much more data than would be of importance in this context we show with the aid of the punching-document students' card that we have developed.
In our view the closer the information related to the level of the educational program is executed the more reliable is this information.

2.3. Time of measurement

For the punching-document students'card, the choice of the date of the test is of the utmost importance for the picture that one obtains. This choice is not difficult when fixed examination-dates are given.

CHAPTER VIII

RESEARCH

1. The linking of teaching and research in the Overbeek-method.

From the description of the model in Chapter II, it appears that in the Overbeek-method research is considered to be an independent variable component.

The program of research, that is represented just like the educational-program by the number of staff-hours required, is linked with the educational-program in this way: when the number of staff-hours required for education (calculated by aid of the method described before) is known, then the number of staff-hours required for research is known at the same time (namely in the relation 1 : 1).

So this linking of teaching and research is not based on the content but only exists in terms of staff-hours. It will be made clear in what follows that we start from the idea that there does exist a relationship as to the content between education and research.

But we do not believe that it is possible to find arguments to link education and research when they are described exclusively in terms of time that has been spent.

Starting from research there are no arguments to be found in favour of it, because the fields of science do not set bounds to asking questions, this means, they do not set bounds to research in terms of staff-hours that should be spent on it.

It would be possible within given constraints, to decide how much time should be spent on research by each discipline or faculty, but the subject of research itself does not set these limits.

Can we derive these arguments from education?

Is it a matter of fact that the extension of the task of education means an extension of the task of research?

Why could we not extend the staff with "teaching-specialists" (instructors), with the increasing number of students?

71

Have all lecturers that are teaching also to do research and vice versa: does a diminution of educational-task mean a diminution of research-task?

In presenting the model we have already stated that itemizing the various task-categories produces a varying degree of complexity; therefore the link.

The impression is that this is actually the only argument, in which the ratio 1 : 1 seemed to be a reasonable one. But in that case the relation education to research can be 1 : 2 or 3 : 1 as well.

It does not make any difference in the method of calculation, no more than about the reasonableness of these standards actually used.

Therefore the need still remains of an approach to research as an autonomous datum.

Just as there has been talk of educational planning as part of an educational management there is a need of planning of research as a part of the management of research.

To find an example for management of research as far as the university is concerned, we are often inclined to look at non-academic institutions for research.

Bearing in mind two important differences between university-research and most non-university-research we can state the most important problems the management (and planning) of university-research as the delimitations of projects of research and the relation education and research.

2. <u>The delimitations of projects of research</u>.

In the widest definition of planning that can be found it is necessary to distinguish between t h e p r o c e s s e s o f p l a n n i n g (information, programming, implementation, evaluation) and the s t r u c t u r e o f p l a n n i n g.

Such a broad conception of planning (as found in the McKinsey-proposal for post-secondary education in the Netherlands) is not always to be found in the discussion of the subject.

Planning is often restricted to the processes of planning and even there it was often, until recently, further narrowed to programming.

Planning involves at least two elements

(1) formulation of the objectives.

(2) statement of the expenditure in terms of manpower, space and equipment.

Thus it must be possible to formulate clear-cut objectives and to determine the expenses in advance in a sufficiently exact way.

We would like to define research that shows these characteristics as research-projects.

Consequently it is sufficient, if not necessary, for the planning of research, that research is done within the framework of research projects.

In practice we find within the university there are not so many p r o j e c t s of research. These are mainly the projects that are financed by a source of financial support outside the university.

And also concerning these projects the question still remains, whether they come within the definition we have given, for it turns out quite often that in course of the investigation a completely different direction has been taken and/or an application has to be made to get extra finances.

A condition for delimitation of the objectives in such a way that it becomes possible to translate these objectives into concrete tasks is that one has already acquired a sufficient knowledge of the subject, within which those aims are formulated. In other words it is supposed that one knows what one is researching for.

And this is not always a reality.

In the Frascati Manual we find for a general definition of research as follows.

Research and experimental development may be defined as creative systematic work, undertaken to increase the stock of scientific and technical knowledge and to devise new applications.

Then a number of specific definitions follow:

B a s i c R e s e a r c h : original investigation undertaken in order to gain new scientific knowledge and understanding not primarily directed towards any specific practical aim or application.

> Basic research is generally performed by scientists who enjoy some latitude in organizing their work and setting their goals. In pure basic research it is generally the scientific interest of the investigator which determines the subject studies. Such research tends to be confined to universities and some non-profit organisations or government laboratories. In oriented basic research the organisation employing the investigator will normally direct his work towards a field of present or potential scientific, economic or social interest.

A p p l i e d R e s e a r c h : original investigation undertaken in order to gain new scientific knowledge directed primarily towards a specific practical aim or objective.

E x p e r i m e n t a l D e v e l o p m e n t : the use of scientific knowledge in order to produce new or substantially improved materials, devices, products, processes or systems.

Also on the basis of this definition we can draw up the following figure:

	PURE BASIC RESEARCH	ORIENTED BASIC RESEARCH	APPLIED RESEARCH	EXPERIMENTAL DEVELOPMENT
what is the character	original investigation	original investigation	original investigation	use of scientific knowledge
what output is wanted.	new scientific knowledge, not primarily practical	new scientific knowledge, not primarily practical	new scientific knowledge, primarily practical	new products or "tools"
who determines the direction	investigator	organisation	crganisation	investigator organisation
within what organisation	university (non-university)	non-university	non-university (university)	university non-university

fig.8: definitions research.

Basic research is being done without any clear view of the output.

As this view is not present it will be difficult to determine exactly the direction of the investigation, in other words, the investigation determines its own direction.

In this way planning of this kind of research is actually a contradiction in terms, because one is supposed to be able to delimit what one does not know yet.

As a matter of fact research done at the university is often started around a certain issue without the knowledge of a (provisional) end.

If one wants to keep the planning of research this has rather to be found in the f r e q u e n t a n d s y s t e m a t i c a l e v a l u a t i o n of what is being done than in the exact programming of what one wants to do.

Even this last remark sounds more self-evident than it really is, because the evaluation of what one has to do includes that one is able to measure its output.

When it is impossible to determine in advance the objectives of the investigation, it will also be impossible to fix in advance the criteria for measuring the output, and they will have to be formulated afterwards.

Concerning the quality of the information produced Dr. Le Pair says in his article "Coordination of scientific management in physics":
"it is too elusive to tell anything about it. Only very detailed studies like the one of the Illinois Institute of Technology of the (crucial) 'events', on which certain technological developments are based, can teach us something about it. Such studies are made retrospectively, because then the relevancy of certain events has appeared from a later development. The report quoted shows us that "events" emerging from pure scientific research usually bear technologically fruit only after 20 or 30 years (.....). Yet an evaluation of natural scientific research in the light of its expenditure, is really desirable. For a rational management it is even not to be avoided in the long run".

75

Notwithstanding the fact that there are no "hard" criteria for measuring the output, one still has to try to evaluate current investigation as frequently and as systematically as possible.

Another problem that crops up in all kinds of places is that a frequent and systematic evaluation of a current investigation is of no use when the possibility of correction does not exist.

This correction presumes that there is a certain flexibility in the use of means (manpower, equipment, space). The investment in the various categories and its alternative use determine the degree of flexibility. Not in all cases is the direction of the investigation a determining factor for the use of the means; but also the availability of certain manpower, equipment and space will determine the direction.

There is a huge risk, that in the struggle for certain means those needs, which can be made "hard" are sooner answered than those needs of which it would be impossible to make them "hard".

Basic research belongs to the last category. Therefore the managing authorities have to decide, concerning this basic research, to make available a certain amount of means on the ground of "non-hard" arguments.

The only argument is that the policy-making authorities t h i n k that in certain specialities basic research of a certain level and of a certain dimension should be done.

It has become quite clear, that for this reason basic research is very sensitive to changes in the socio-political atmosphere of which the judgement of the conjunctural situation forms a part.

3. The relation between education and research.

When it comes to the training for independent research-workers in non-university institutes for research, we have to point out that this training is certainly not a primary function, but for the universities this function is a primary one indeed, as appears from the Education Act.

As we have said in the introductory chapter, scientific education includes the training for an independent pursuit of science and preparation for the occupation of social positions, for which a scientific training is required.

Put in another form, the university takes care of two kinds of professional training, namely, the training for professions for which scientific training is required or may be of service, and the training for an independent pursuit of science.

The educational activities focussed on the last, are executed for the benefit of the student from the moment that he takes up a subject until the moment that he gives proof of his ability as independent research-worker.

(E d u c a t i o n a l - a c t i v i t i e s are those activities that are consciously focussed on bringing about changes in a pupil/student/post graduate in the spheres (to be further determined) of cognition, attitude, motivation and skill).

During this process, however, the student more and more develops research-activities.

(R e s e a r c h - a c t i v i t i e s are those activities that are consciously focussed on bringing about changes in a certain speciality in the sense of supply of new information, development of new methods/techniques).

When the student has passed his graduation or his qualifying examination, his training for a profession for which a scientific education is required or may be of service, is finished, and for an important part also his training for independent pursuit of science.

When he has taken his doctor's degree, his training for independent pursuit of science is entirely finsihed.

If he should stay in the university after his doctor's degree (no matter in what rank), his occupation with respect to research will be the supervision over the research done by others.

To be able to do this properly, one's own research (that means directed towards own publication), will be necessary in most cases.

Summarizing what has been said before we might say that research-activities (and together with this research in the university) has directly or indirectly a function in education*

*By university-research is meant research financed by university-resources. Apart from this there are workers who co-operate with the university in doing research that is financed by the flow of funds from outside. This kind of research cannot be said to function primarily for education.

Directly, when research within the framework of the training for the research-worker himself is concerned; indirectly, when supervision over research of others within the framework of their training is concerned, indirectly as well when one's own research is done as necessary condition to be able to give a qualified training.

The question still remains whether the relation between education and research, in our opinion f o r m a l l y correctly indicated here, is also acceptable members of the scientific staff.

The pressure, exerted by the development in the speciality, for which reason one is sooner delayed if one does not pay sufficient attention to research, the hidden or open competition between colleagues may lead to the situation that the subsidiary function of research, namely boundary-removal of science, becomes the principal function.

It could even lead to the fact that training of other people (education) is gradually felt, because of the time and attention it requires, as the disturbing element in the course of research.

When this feeling is widespread, the next stage is perhaps that the creative part of research (boundary-removal) is taken out of the university and thus the reproductive part (educational research) is left over.

The tissue of the university of which education and research are woof and weft would be ruined that way.

Expressed in less lyrical terms than Posthumus does, it would mean that university education is not even the first part of its aim of training for independent pursuit of science.

An argument that has been used unjustly quite often in this context is that not all the research should be done in the faculties of all institutions, especially not when very great expenses are involved (e.g. energy physics). This argument can only be used for the establishment of i n t e r - university institutions but cannot be used for the establishment of e x t r a - university institutions.

From what has been said it must be clear now that a policy to establish inter-university institutions is not exclusively a

policy of research but aldo educational policy.

A number of problems of policy precede the planning and budgeting of university-research :

First, what kind of research (in terms of level, field, period of time, etc.) has to be done within the framework of the training for independent pursuit of science.

Output, in this case will be an account of study rendered by students who finish their studies and dissertations of graduates who take their doctor's degree.

Second, what kind of research (in terms of level, field, period of time, etc.) has to be done by members of staff who already have taken their doctor's degree as a precondition to be able to give a qualified training. The expected output here is publications by members of staff.

Within the answer to the questions given we can formulate a program of education and research that consists of:

(a) A part that is characterized by the fact that the members of staff transfer information, teach skills etc. to students.

(b) A part that is characterized by the fact that members of staff supervise students in their research projects.

(c) A part that is characterized by the fact that members of staff who already have taken their doctor's degree supervise members of staff who have not c.q. a part that is characterized by the fact that members of staff who have not taken their doctor's degree are doing research almost fully independently, that is directed towards own publication (dissertation).

(d) A part that is characterized by the fact that members of staff who have already taken their doctor's degree are doing research that is directed towards own publication

We started already when we itemized the staff-activities from such a structure of the program.

The rotational activities ' ' ized by help of the figure on page 35 form the first part.

The non-rotational activities itemized by help of the figure on page 42 , form the second part.

The time spent on the third and fourth part, we find back in the figure on page 46, sub 3.

80

CHAPTER IX

NON-ACADEMIC STAFF

1. Non-academic staff on faculty-level.

To make a rough middle-term planning in the form of a financial scheme, that is drawn up every year for a period of four years, the ministry has worked from about 1961 with a proportional ratio that fixes the number of non-academic staff for the faculties in total, at 75% of the total number of academic staff. We have derived the following data from the comparison between the budgets of the universities of Leiden, Utrecht, Groningen, Amsterdam, Amsterdam Free University and Nijmegen of the years 1967, 1968, 1969 and 1970.

Table 18: Non-academic staff as percentage of the academic staff in the faculties of six universities 1967-1970.

	1967	1968	1969	1970
Leiden	79	79	79	79
Utrecht	81	80	80	80
Groningen	69	70	73	67
Amsterdam	53	56	55	56
Amsterdam Free University	62	58	57	60
Nijmegen	86	87	78	75
Sum-total of the 6 institutions[1)]	71	72	71	70

[1)] Sum-total of non-academic staff of the six institutions as a percentage of the sum-total of academic staff of those institutions.

The percentage of 75, applied by the ministry, turns out to be in average higher than the actual situation in the universities examined.

In other words, the universities have appointed relatively less non-academic staff. The average percentage of non-academic staff

81

in relation to academic staff turns out to be rather constant in the last four years.

The differences among the universities themselves are great and also fluctuate in some universities in the course of time. The national ratios as used by the ministry are of little relevance to the policy because the planning has to be made at faculty and departmental levels.

In the Overbeek-method the ratios for the estimation of the need of non-academic staff are further specified by faculty/group of faculties.

In the A-faculties* a ratio of academic to non-academic staff will be 4 : 1, for the social sciences the ratio 3 : 1 and in the B-faculties (excluding medical art and dental surgery) 2/3 : 1, using the Overbeek method. With the budgets of the universities of Leiden, Utrecht, Groningen, Amsterdam, Amsterdam Free University and Nijmegen as a basis we have also compared these relations with the actual situation in the last four years.

Table 19: Non-academic staff as a percentage of academic staff in the A-faculties of six universities 1967-1970.

	1967	1968	1969	1970
Leiden	18	18	19	21
Utrecht	30	30	30	32
Groninger	25	25	33	33
Amsterdam	23	25	24	24
Amsterdam Free University	17	15	18	17
Nijmegen	27	26	27	27
Sum-total of these 6 institutions	23	24	26	25

* In the foot-note on page social-cultural sciences, psychology, pedagogics and andragogics are names as A-faculties, but actually they form a group apart.

Table 20: Non-academic staff as a percentage of academic staff in the faculties of social sciences of the six universities 1967-1970.

	1967	1968	1969	1970
Leiden	35	34	33	36
Utrecht	35	35	37	37
Groningen	41	39	39	32
Amsterdam	29	30	30	30
Amsterdam Free University	35	34	33	34
Nijmegen	41	41	44	45
Sum-total of these 6 institutions	40	35	35	35

Table 21: Non-academic staff as a percentage of the academic staff in the faculties of sciences of the six universities 1967-1970.

	1967	1968	1969	1970
Leiden	114	113	114	114
Utrecht	95	94	90	90
Groningen	120	122	125	123
Amsterdam	92	96	95	102
Amsterdam Free University	155	152	144	134
Nijmegen	188	188	165	159
Sum-total of these 6 institutions	114	114	111	112

As far as the A-faculties and the faculties of social sciences are concerned the actual situation with regard to the average percentage appears to agree rather well with the ratios of the Overbeek-method. Concerning the faculties of sciences the

83

average percentage differs considerably from the Overbeek-ratios.[1)]

But also here counts that the differences between the faculties of the various universities are great.

The figures, given before, of the relation non-academic/academic personnel are not entirely exact. The figures have been derived from the budgets of the institutions and the budgetary distributions of academic and non-academic personnel does not entirely agree with reality.

The method for determination of the number of non-academic staff by means of a ratio to the number of academic staff, has also been applied in our model presented in Part A.

Such a ratio that has been derived from historical data, does not give insight for university-policy in the actual need of non-academic staff and has a tendency to fix historical relations even when changes take place in the way in which the tasks of teaching and research of a faculty are actualized.

Before making an attempt to indicate in what ways the need of non-academic staff - anyway of some important categories of it - might be determined, we draw the attention to the fact that the distinction between academic staff and non-academic staff has been based to a great extent on a historically grown division of tasks. The question remains whether this division of tasks is really the best one possible.

A planning of non-academic staff that has been based on fixed ratios to academic staff gives little inducement to a further consideration of that question.

For an alternative approach, non-academic staff on faculty-level can be subdivided according to its task and place in the organisation.

For the task we can distinguish personnel, directly involved in

1) The ratios of the Overbeek-committee, are in principle derived from empirical material, on the understanding that concerning the faculties of sciences the committee based the ratios on the desirable situation.

education and research and personnel, indirectly supporting educational and research-activities.

The term "directly involved in education and research" includes non-academic staff, carrying out partial tasks of educational and research programmes.

Non-academic staff, indirectly involved in education and research includes those who create the possibility for the execution by other people of educational and research programmes.

Concerning the place in the organisation, a distinction can be made between personnel directly employed in a department and personnel who work in the central service for the benefit of more than one department, or a faculty as whole.

Certain tasks are carried out on a central level for the benefit of several departments, because the tasks are central in character, or on grounds of efficiency require centralization.

In the Nijmegen University for a faculty or group of faculties, those functions that are not necessarily to be carried out within the scientific department themselves, have been placed in central services.

For each faculty - if required - there are central services available for servicing of equipment, technical maintenance, audio-visual services etc. The scientific departments place orders in the central services and the costs are passed on to these scientific departments on the basis of tariffs that are fixed every year.

The following diagram shows some examples of the division into four categories:

	A working on department level	B working on a central level
1. directly involved in education and research	analyst technician programmer	central service experimental laboratory
2. indirectly involved in education and research	secretary	services for adaptation and maintenance of grounds, buildings and installations

Figure 9: Categories of non-academic staff

Non-academic staff working on departmental level and directly involved in education and research is by far the biggest group in Category A.

We intend to itemize the need of this personnel in an analogous way as for the academic staff (see Part B, Chapter). For this category of non-academic staff we have not elaborated the method, developed in that Chapter.

Some random tests, taken in various scientific departments indicate that this method of itemizing is not impossible. Non-academic personnel, who are indirectly involved in activities of education and research and who work on departmental level (A-2) are small in number.

Here mainly administrative and secretarial personnel and other supporting-functions are involved. We presume that this category may be brought into the model by means of a ratio to the academic staff, to be determined for each faculty.

The need of non-academic staff members, who are directly involved in tasks of teaching and research and are placed in central services (B-1) can very well be approached on a projection-basis.

In many central service-departments on faculty-level within the Nijmegen University a full account of time-spending is done by the

personnel. The total costs of the orders given by the scientific departments are pre-calculated and passed on to the department concerned after the orders have been carried out.

All hours and materials used in carrying out the orders are chargeable. A further specification for each project is possible and is being prepared. At the same time the scientific department, that makes an order, will indicate what the character of the project the order relates to is, i.e. - teaching, research, teaching and research combined, others.

The consequences, in terms of data-processing of this kind of systematic registration, should not be underestimated. The data on time spent and materials used by the central services must be recorded and worked out as to the inputs: scientific departments, projects and to the aspects of teaching, research, teaching and research combined, others.

There are a large number of scientific departments, the number of projects is many times greater. The project-adminsitration, as described here, needs to be computerized.

Within the framework of the project we have analyzed more fully the account of the central services of the department of psychology for the first half year of 1971. A total productive-time of 10,741 hours appeared to be used as follows:

- teaching projects 17%
- research projects 35%
- teaching and research combined 32%
- remaining hours, such as upkeep 16%

The system described above offers the opportunity of planning and preparing accounts of the central services by each faculty based on the programmes. Carrying out such a system requires wide administration-technical and organisational accommodations.

Lastly we have mentioned the category of non-academic personnel that is indirectly involved in teaching and research and that is working in the central services (B-2).

To this category belong the functions dealing with housing for the faculty, library, administration etc.

Within the university of Nijmegen the man-hours needed for the maintenance of grounds, buildings, equipment and inventories are fixed per assignment.

This system is best worked out in the medical department. Here the technical service consists of seven sub-departments having a coordinating office.

By introducing the principle of preventive maintenance a planning of the personnel required has appeared to be possible by rendering in man-hours the works of maintenance laid down in advance. The system of preventive maintenance based on a yearly planning, leads to a relative lowering of the amount of man-hours required for maintenance. The system requires a very well qualified managing-office. In the medical department the number of personnel in the services for technical maintenance needed for the period of 5 years lies between 0.110 and 0.125 per $1000m^3$ building-volume or between 0.28 and 0.32 per ƒ 1.000.000 invested amount for building (on basis of prices in 1970).

The task-setting is directed nowadays towards a lowering of these figures. The concrete figures that now are to be used in the planning for each faculty depend on the limits of tolerance that have been set with respect to preventive maintenance and on differences in ways of building and installation-technical facilities.

We have not yet succeeded in finding a method to quantify the other functions, that are fulfilled in the central services and that are indirectly involved in education and research, on the basis of task-setting.

2. Non-academic staff on institutional level.

For non-academic staff the Ministry of Education has set up for each institution a norm of 10% of the sum of academic and non-academic personnel in the faculties.

Also the Overbeek-method uses this proportional ratio.

Concerning this category of non-academic staff the use of proportional percentages, in relation to the staffing in the faculties, is hardly a satisfactory method for planning. But planning for this group on the basis of task-setting is extremely difficult.

88

We have not yet succeeded in developing methods for calculation of the number of this important group on non-academic staff in a systematical way.

CHAPTER X

STUDENT-ASSISTANTS

For several of the activities of staff-members, that have been described in Part B, Chapter VI (pages 33-58) student-assistants may be called in.

In that case these assistants get an appointment on a part-time basis (at the utmost half-time), to a post in the university. They receive salaries, they come under the pension-facilities for personnel and other social arrangements.

On the strength of rules drawn up by the ministry of education a separate year-budget is allotted to the university and the appointment of these so-called student-assistants can be debited to this budget. This budget is limited.

The formula that has been drawn up by the ministry for a calculation of this budget, runs as follows:

For the faculties of arts:
- 1.25% of the number of enrolled students x average year-salary

For the faculties of social sciences
- 1.875% of the number of enrolled students x average year-salary

For the faculties of sciences:
- 2.5% of the number of enrolled students x average year-salary

The method of calculation of the Ministry has been based on relations, empirically found in the past.

A few years ago these percentages have been raised slightly because of the argument that the call-in of student-assistants could slightly compensate for the shortage of academic staff. The budget for student-assistants in the Nijmegen University, as it has been determined by means of the aforesaid method, comes to a considerable amount - in 1971 this was about DFL. 2.2 million or about 2% of the total university-budget of current expenditures.

For this reason the budget for student-assistants has been related in our model directly to the number of students. The average year-salary is adopted yearly to the general pay-increase.

It is easy now to make a pre-calculation on a middle-long term of the sum-total of the budget, available for the university on the basis of estimated number of students and estimated pay-increases.

The method of calculation of the ministry is explicitly meant for the determination of the total university-budget for this purpose.

The allocation to the faculties is left to the university. Actually the faculties derive the same rights from the method of calculation of the ministry. We can distinguish three levels in the activities, executed by the student-assistants that correspond with levels of payment.

Student-assistants carry out simple activities, such as preparing bibliographies, catalogues, simple data-collection and administrative activities. A functional relation with the subject the student studies is not always demonstrable.

Further student-assistants are called in for more scientific activities and for educational tasks, in which the level of the activities corresponds with the yes or no possession of a kandidaat-sexamen (undergraduates).

The average amount of hours, for all faculties that is spent on these activities by the student-assistants, is more than 75% of the total amount of working-hours of the student-assistants.

The need of student-assistants could possibly be determined, following the method for the measuring of staff-hours, described in what precedes.

The fact that in our model the number of student-assistants, notwithstanding their important task in education and research, has not been determined on the basis of the calculation of academic staff has, in the first instance, a formal-budgetary reason.

On the other hand there is no clear insight in the relation of the task-setting of staff-members and student-assistants. To what extent is the call-in of student-assistants functional with regard to the study of the student concerned and with regard to the function

concerned in the field of education and research. In a given case, to what extent does the call-in of student-assistants result from the availability of staff-members?

For the time being we are of the opinion that, in comparing the need of staff-time to the staff-time available, the participation of student-assistants should not be totally ignored.

The weight coefficient to be applied in this matter to the participation in hours by the student-assistants has to be determined by means of further investigation.

CHAPTER XI

SPACE REQUIREMENTS

In our model, that has been presented in Chapter , part A, the space available has been included as an independent cost-determining category.

For the middle term planning, the expenditure that goes with the space has to be considered as a constant. These costs use a fixed amount of the total budget of the university in middle term planning.

Also the expenditures for space that has not been built yet but that is in a certain phase of preparation, are to be considered as given for the planning for a middle-long term. The process of preparation of new buildings, that has advanced up to a certain phase can only be stopped at the cost of considerable losses.

The construction-process of a building can be distinguished in a number of phases:

- establishment of a programme of requirements and the procedures of appropriation that go with it
- drawing up of a draft-plan
- working-out of specification plans
- the construction process

The process from programming till building-phase takes about 4 years. Formally there is a freedom of decisions, concerning rigorous changes in, or stopping of the project up to and including the third phase of the process. For the sake of a continuous process of building in terms of an economical use of technical capacities available, decisions are taken over a period of about 4 years.

For this reason the factor "space" can only be brought into relation with programmes of education and research and student numbers within the framework of long term planning with respect to its influence on the current expenditures in total.

Further planning of space requirements should not be based on the needs that exist on the moment the building is delivered but they should be based on developments many years ahead. In this way developments concerning curriculi, numbers of students and the

specialistic direction in which a certain discipline is practised, play an important role.

These considerations lead up to a search for simple, easy to apply standards serving as space-determining factors in the planning on a long term of space-facilities of university-laboratories and institutions. In the draw-up of specificational plans within the framework of the planning of building on a middle-long term these rough standards are the framework.

The rough standards generally chosen are the number of students and the average net floor-space per student. The use of an average amount of m^2s per student as a standard includes very important reductions. These reductions concern first of all the fact that the space-requirements can roughly be distinguished in the categories:

1) General space for education, such as lecture-rooms or rooms for practical work.
2) Rooms for library or reading-rooms.
3) Work-rooms for academic- and non-academic staff members.
4) Rooms with special equipment for education and/or research.

The space-categories 1 and 2 can be related closely to number of students, especially to undergraduate students. The need of space-categories 3 and 4 is related to the staffing and also to the number of post-candidates and post-graduates. As appears from our data concerning the need of academic- and non-academic staff, there is no linear relation between the number of students and the number of personnel, so that the space requirements, caused by the staffing, cannot be simply be reduced to the number of students.

Also between the number of students and the common rooms for education there is no linear relation. The average amount of m^2s of education space per student decreases with increasing size of the lecture room. This is shown as follows:

number of places per lecture room	average amount of m^2 per student
40	2
<40 - 100	1,2
100 - 300	1
300 - 1000	0,8

The number of education-rooms is further determined by the curriculum and the acceptable/attainable number of hours that the room is being used.

For more basic studies about developments in curricula and the space requirements related to activities of staff-members and students, we refer to the publications of the "Arbeitsgruppe Bedarfsbemessung wissenschaftlicher Hochschulen in Finanzministerium Baden-Wirtumberg und Zentralarchiv für Hochschulbau Stuttgart". The method, they have developed, uses simulation-models.

As long as the results of such basic-studies are not available, the determination of an average amount of m^2s per student will be based on empirical and comparative data. Although the standard of an average amount of m^2s per student, in which all the rooms have been taken into account gives already a very rough approximation, we should also pay attention to the fact that the relation between number of students and the amounts of m^2s floor-space is not linearly proportionate.

The amount of m^2s per student decreases with an increasing number of students. As an example we give a graphic reproduction of the space requirements of some departments of the faculty of sciences, drawn up by the director of that faculty for the plan of development.

The model, we have presented in part A, tries to determine the total budget of current costs of a university. The costs, resulting from the use of space, form an important part of this total budget. In the model these costs are related to the space available. For the middle term planning the space available and the space in preparation have to be considered in the model as an autonomous datum. For long term planning the space requirements can at this moment only be brought into the model as derived from the number of students to be expected and an average amount of m^2s per student per discipline.

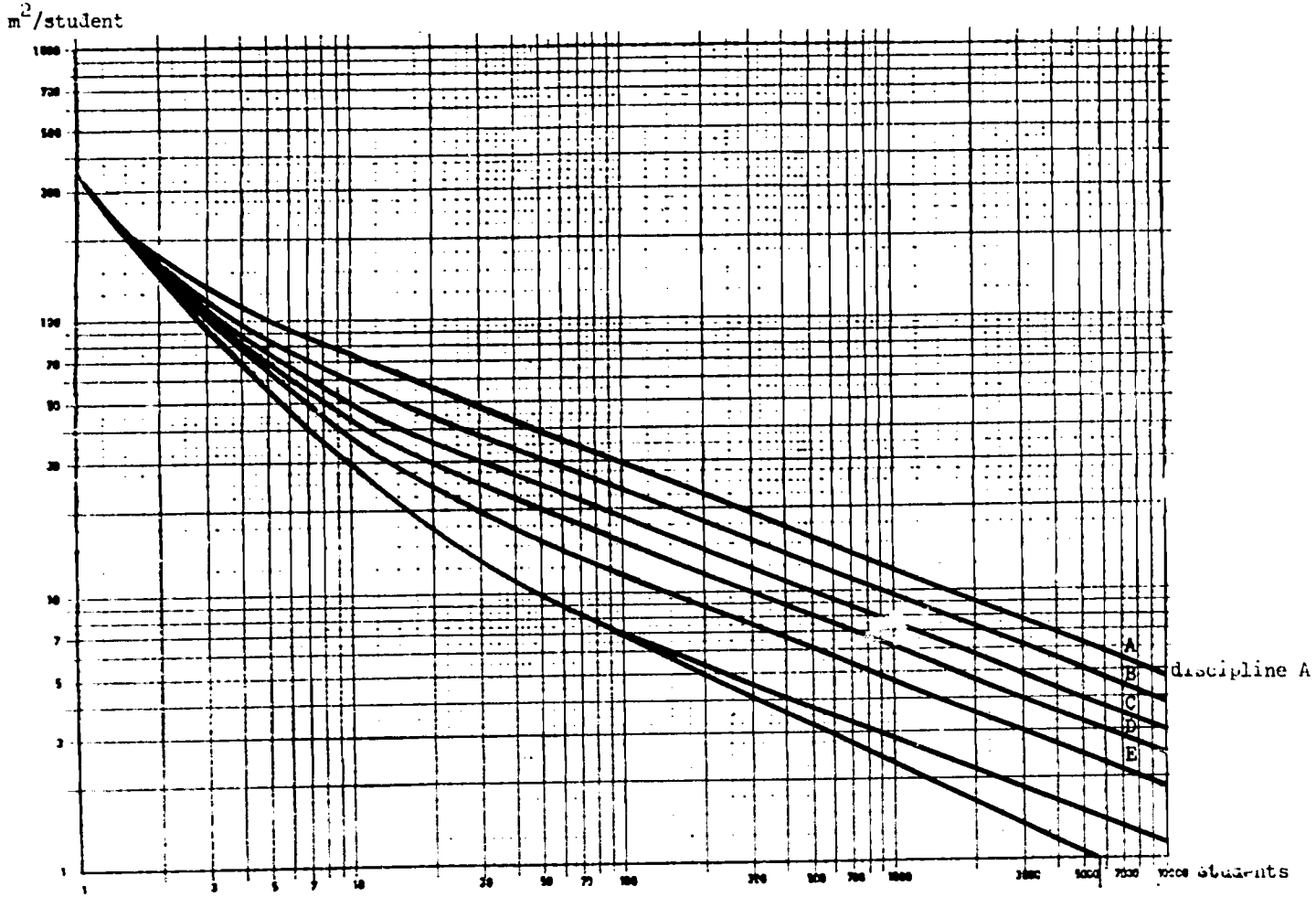


fig.10 : Relation of net m^2 per student and number of students (precandidate)

CHAPTER XII

CURRENT EXPENDITURES AS TO NON-PERSONNEL COSTS

The yearly working budget of the University of Nijmegen for the calendar year 1971 (excluding the academic hospital) amounts to DFL. 110.000.000.
The personnel budget forms the greatest part of that total. In the remaining costs the relative weight of the cost of housing is quite substantial.
In the following table we give the distribution of the budget among the categories of expenditures during the period 1967 through 1971.

Table: 22 Distribution in pencentages of the budget among the categories of expenditures.

	1967	1968	1969	1970	1971
1) Total expenditure personnel	80	81	80	79	80
2) Student-assistants	1	2	2	2	2
3) Costs of housing	5	6	6	7	7
4) Specific expenses education/research	9	7	8	7	6
5) Office-expenses Travelling expenses	3	2	2	3	2
6) Subsidies students' activities	1	1	1	1	2
7) Others	1	1	1	1	1

Among non-personnel costs, the costs of housing are quantitatively the most important but are not specific for academic planning. With regard to costs the university buildings are comparable to buildings for other purposes.

To the category of housing-costs belong, first of all the costs of interior and exterior maintenance, costs of maintenance of roads and grounds, premiums for insurances and taxes on real property. From empirical data, concerning our university, in which the maintenance has been programmed, and from empirical data, concerning non university buildings in the Netherlands, it appears that this category of expenditures requires an average amount per annum of 1% of the replacement-value of the buildings.

For the Nijmegen University this replacement-value is determined every four years by means of a valuation by specialists.

The replacement-value of the buildings also includes the equipment. The calculation of the replacement-value may also be done in between by making use of index-figures which are regularly made public by the National Bureau of Statistics. The average building-expenses of the psychological laboratory of the Nijmegen University amounted to about Dfl. 200,-- per m^3.
The construction started by the middle of 1967, when the index-figure of the building-expenses was 85.

The index-figure of January 1971 is 120. It has become clear the expenses of maintenance of buildings and grounds keep pace with the rapid rising building-expenses; they both take up a high amount on wages.

We have not included in our model interest and depreciation, which is linked with the policy regarding subsidies of the Dutch Ministry of Education.

A second important category of expenses as to the housing-costs is the expenses of use of energy, such as heating, electricity and water. This has been calculated in physical measures and is introduced in the model on the basis of an amount per m^3 which can be adapted to price-changes. As a matter of fact the amounts vary per building.

The cleaning costs of buildings are calculated on the basis of task-setting on an amount per m^2 floor-space. These costs vary according to the style of building. These have also to be revised regularly to take into account changes in wages and prices.

The total housing-costs are derived from the preceding components, and stated as one amount per m^3 to which is also added a small proportional amount for other costs.

Information about the amounts of m^3-volume and m^2-floor-space, gross as well as net, is available for the buildings already in use and the buildings still in the phase of preparation.

There is an urgent need for the construction of an automatized data-handling system concerning space-facilities.

For the planning of the specific expenses for education and research (in which also books are included) and for office-expenses, travelling-expenses, etc. time-series have been drawn up for the group of A-faculties, of social sciences and for the B-faculties, in

which these costs are stated as an amount per staff-member.

The series discussed so far require a further analysis as to internal consistency and as to the influence of extension and intensification of education and research.

The proportional share of the several categories of expenses of non-personnel costs in the total budget of the University (see table 22) plays an important part in the decision about the degree of refinement of the analysis.

CHAPTER XIII

EVALUATION OF THE MODEL

The model as presented in Chapter II A and explained in the subsequent chapters, can be evaluated within the context of this report in two different ways:

First - as an instrument for the calculation of the resources required for the university, it can be looked upon critically with regard to its defects and assumptions so that it may be improved.

Second - one can ask oneself what have we been able to do with this instrument in practice? What has been the influence of the use of this model, with the Overbeek-method included, upon the assignment and allocation of resources?

1. Technical evaluation.

As to the first step of evaluation we have already said in Chapter II:

1.1. that this model is based on two important a s s u m p t i o n s namely:

1.1.1. that the estimation of the need of personnel in teaching man-hours is an adequate starting-point

1.1.2. a weight (e.g. as far as nature and intensity of activities go) of man-hours spent on the various task-categories is not necessary.

1.2 that the model has three m e t h o d o l o g i c a l r e s t r i c t i o n s, namely:

1.2.1. that the task-cateogries (teaching, research and other activities) are not all of them to be itemized in an equally easy way. In a given case itemizing one item turns out to be more difficult for the time being than itemizing another and on this account the calculation of the need of academic personnel for teaching forms the starting point for the calculation by means of certain relative percentages of the needs of academic personnel for the totality of the activities.

1.2.2. that the categories of personnel (academic, non-academic personnel) are not always to be itemized in an equally easy way. In a given case itemizing one category is for the time being even more difficult than itemizing the other and on this account the calculation of the need of non-academic personnel is made by means of certain relative percentages on the basis of the number of academic personnel.

1.2.3. that for current expenditures on non-personnel costs average amounts per staff-member or per m^3 space are used, which prevents making calculations on the long term.

1.3. that the model has a l i m i t a t i o n a s f a r a s t h e p o s s i b i l i t i e s o f a p p l i c a t i o n g o, namely, that the model only gives information about the means required and does not say anything about the effectiveness of the working of the system (in whatever terms possible).

With regard to the assumptions we have made clear that actually we do not think that these starting-points are adequate. In our opinion this is too strong an assumption because the qualitative aspects are overlooked. The question remains in how far we will be able to render the need of personnel also in other terms than in the number of teaching man-hours required only. We have to try it anyway.

With regard to the methodical restrictions mentioned under 1.2.1. we tried to explain in Chapter VIII that under these restrictions the usefulness of the model becomes doubtful. In the same chapter we pointed out in what way we would propose to remove this restriction.

We tried to clarify in Chapter IX that the usefulness of the model is considerably diminished by the methodological limitation mentioned in 1.2.2. In this same chapter some concrete proposals were made to lift that restriction.

Generally programmes and student-numbers are considered to be given and the means to be derived. If student-numbers and means are supposed to be invariable the consequences for programmes, in terms of teaching man-hours available, can be calculated. The model could, in principle, serve as a student-capacity model - programmes and means are considered to be fixed and the number of students to be derived.

The model has been used several times for indicating the means as the consequence of the given programmes and the student-numbers (see paragraph 2.2.). The application of the model in the other directions has not been tried out as yet. An application of the student-capacity calculation has been attempted for the disciplines of medicines and of biology. The results played a minor role for reaching a decision by the Board of the University concerning the question whether the disciplines under consideration could accomodate a certain number of first-time entries.

Further, we tried with the co-operation of some departments of the faculty of languages, to come to a calculation of a far-reaching re-structuralization of teaching programmes in terms of means, with the number of students given.

The methodological limitations concerning the current expenditures on non-personnel costs (1.2.3.) can be met with to a certain degree as proposed in Chapter XII.

With regard to the problem of the applicability, we may say that the function of the model is not meant to be more than giving information about the resources required. That is, the reason why we have not made this as a limitation of the model as such, but as limiting the usefulness of such an instrument.

As far as the validity of the results for decision-makers is concerned we refer to the remarks on this subject on pages 54 & 55.

2. The use for management.

Two questions can be posed.

In what different ways the model can influence or has influenced the decision-making of management?
On what levels of decision-making has the model been used or in what terms of evaluation did the managing authorities express their opinion about the usefulness?

2.1. In principle the model can be used in three directions since it describes the relations between the three categories : programmes, student numbers and resources; Restructuring programmes depends on the reformulation of objectives and reshaping the system of university education. The components of student-numbers and

resources cannot be expected to be constant. A comparison of the means required for the present situation with the means required for the new system is allowed, provided that one takes into account the starting-points of the two systems concerning the programmes and the student-numbers. The model has been used and has influenced faculty decisions concerning minor changes in programmes. These are for instance decisions on changing over from a method of education in general lectures to a programme based on education in small groups.

2.2. What use has been made up to now of the model for decision-making and what were the opinions of the managing authorities about the applicability? This way of evaluation concerns the influence the instrument has in practice on the allocation of resources both
on the faculty- and university level and
on the national level.

2.2.1. In the Nijmegen University we have tried in 1967 for the first time to calculate the need of man-hours of a faculty by a quantification of teaching programmes.

The faculty of social sciences had been treated up till then the same as the A-faculties as to the allocation of means.

The faculty of social sciences claimed that, education and research in the social sciences require special facilities.

The calculations, made by means of the operative programme made clear that there was indeed a gap between the staffing, required for the actualisation of the programme and the staff available on that moment. The Board of the University has drawn conclusions from that result at that time as to the allocation-policy.

For the distribution of means to the sub-faculties, the faculty of social sciences still applies the quantification of staff-time according to curricula. Calculations have been made in the same way for several disciplines within the university of Nijmegen in the

years after.

The managing authorities of the university have decided at that time after deliberation with the senate to have this approach play a part in the policy of allocation. However, restrictions concerning the method were pointed out.

In the proposals for budgeting at the university, comparisons are included per faculty/sub-faculty between the need of calculated staff and the staff available.

The resulting "actualisation-percentage" should be brought as much as possible on the same level for all faculties.

This policy has been abandoned rather quickly, because the defects of the method showed clearly also in practice. The outcome of calculations in teaching man-hours differ considerably in accordance with the teaching methods being used and no criteria with respect to the various form of educational processes are available.

The results of the calculations are only used at this moment for subsidiary information of the managing authorities.

Extreme values, resulting from calculations, have consequences for management.

2.2.2. At the national level in the Netherlands the discussion about the Overbeek-method is of current interest. With respect to the influence of the Overbeek-method on the policy of the Ministry, the Minister has declared to be willing only conditionally to replace the staff/ student ratios that are operative now, by another method.

He mentioned the following conditions:

first, that the new standard will be "generally acceptable"

second, that the "generally usable methods", which have to be found, are not utterly decisive, but co-determining for

the ratios that are to be applied

third, that the method leads also to "results, acceptable from a financial point of view."

On one hand a committee under the auspices of the Academic Council has tried to elaborate the Overbeek-method and its standards; on the other hand a combined ministry/university committee, that deals with general aspects of quantitative personnel-policy, has occupied itself with the Overbeek-method. The first condition of the Minister, to be "generally acceptable" played an important part in this. Also here the problem-statement centered around qualitative questions concerning the educational process.

The committee has advised the Minister to stimulate the direction of educational research in Holland towards the fundamental problems of teaching programmes in relation to the quantitative determination of the need of personnel in university education.

CHAPTER XIV

INTRODUCTION

1. Reflections

It may have become clear from the preceding chapters that, apart from the methodological imperfections, the model applied shows a number of fundamental defects. One of these relates to the motivation for developing and applying the model. For purposes of institutional management in higher education, the model to be developed must procure information concerning education and research, which makes the better management of the institution possible. The model, framed around the Overbeek method, gives information concerning the resources required by the university system. For better management, this one-sided information is inadequate, because it is only concerned with the input of the system, and even then only with those input-attributes that can be put in financial terms.

2. Reformulation of the final result.

A model is needed that describes the university as a system of education and research, both input and output elements, and relates them to each other, making it possible to define the effectiveness of the system, and make its steering possible. In other words: a model is needed that relates educational programmes, research programmes and students to means, in terms of staff, space and equipment. To realise such a model we need to:

a. know, and be able to describe the quantitative and qualitative aspects of input and output;
b. examine how far the qualitative aspects can be measured quantitatively;
c. have a clear insight in the working of the system as a process of its own special characteristics.

This means that the model must describe the contents of both education and research, and that it also must be able to give the relationship between input and output of education and research.

2.1. Dissection and restriction.

Because of the complexity a procedure is suggested, by which in the first instance, the model is developed with the emphasis on education. This is followed by the development of a model emphasizing research. We are conscious of the fact that by this dissection we run the risk of approaching education and research as two separated fields of activities. To avoid this danger we suggest that in the development of the "model of education" its relation to research is clearly pointed out, and also that in the development of the "model of research" its relation to education is defined. In the third instance the models that are mentioned must be put together in an integral model, describing a group of activities in the field of education and research related to each other. For the moment we will concern ourselves with the problem in the project centering around the development of the "model of education."

2.2. Extension

Starting from the re-formulation of the final result and from the restriction considered necessary in 2.1., a deeper and wider analysis of education will be necessary. For the model, as turns out in 2., must be based as well on the input and output elements that constitute education as an educational system as on the relation between those elements. It is obvious that this analysis means an extention compared with an analysis that remains restricted to the aspects of expenditures only. On the grounds of this analysis one can develop a model of education from which information can be gathered which is needed to determine the best possible relation between objectives, methods and means in the various phases of the system. This means that the model framed around the Overbeek method is reconstructed as a model that gives information about the educational and economic aspects of higher education, in such a way that it becomes possible for the managing authorities to determine the relation between the costs and benefits (in the broadest sense). The economic concept cannot be an independent datum, but it should be formulated as a consequence of the cost-benefit of the system in its educational setting. Starting from this idea the relation between costs and benefits is defined as the effectiveness of the system, i.e. the degree in which the objectives are fulfilled. The efficiency (the shortest way in which theobjective is fulfilled) is

subordinated to the effectiveness of the system. We may observe that in the case of the educational system the relation between effectiveness and efficiency is not necessarily linear.

2.3. Dissection and extension in summary.

As to the development of the proposed model the following procedure is suggested:

1) the model is dissected into two sub-models: an educational sub-model and a research sub-model. A sub-model is defined as a model in which attention is directed towards a certain part of the phenomenon from several points of view.
2) Each of the two sub-models will be described from two different points of view: economic aspect and the educational/research aspect.

3. Starting-points.

If we plan to carry out the analysis proposed under 2.2,and if on the grounds of its results we want to develop an educational model, we will have to formulate first a frame of reference in terms of a concept of education. A concept of education should be directed to identifying the elements of education and the relation between those elements. This would be a descriptive model. This being so, the concept includes the whole of the ideas on what education should be; then one would call it a normative concept which is developed from a clear conception of man and society. In this context we might perhaps indicate the relation between descriptive and normative as follows: the educational process that we want to describe as such is preceded by a number of normative statements and decisions. A concept of education includes, as has been said before, a number of views. There is a theory behind these views, but this theory is not explicitly stated. On the ground of these views one can develop a hypothetical model, that one, by means of an investigation, hopes to turn into an empirical model (one comes upon this view of the relation theory - concept - model - empiricism in the works of philosophers of science like Popper, Nagel, among others). But a different view is quite possible. We think there is a necessity to formulate a concept of education. For both the analysis and the model will vary, according to the differences in view people have of education. If the concept of education is to be of any support to

this analysis and the framing of the model, it must meet at least the following requirements:

- it must be valid for all levels of education (primary, secondary, tertiary) and all forms of education;
- it must be able to integrate all educational research, in other words, it must be possible to place any project of educational research within this concept.

CHAPTER XV

THE CONCEPT OF EDUCATION

1. The concept

1.1. When we ask ourselves of what elements does education consist and what are the relations between these elements, we can think of:

- the levels of education (e.g. primary, secondary, post-secondary);
- the institutional structures within which education takes place;
- the process of education in which teacher and student participate.

We are chiefly concerned with the last point, education as a process (defined on executional level.

1.2. As far as we have been able to ascertain, two approaches can be roughly distinguished within the process view of education:

- education as a teaching process;
- education as a learning process.

Teaching process can be described as a body of activities of the teacher, the effects of which are measured in terms of changes of behaviour of the students. Learning process can be described as a body of activities of the student in which the teacher continually must create conditions which allow optimum activities. We propose to describe education as a process of interaction. Within this process of interaction "teaching" and "learning" cannot be separated, and must be distinguished as complementary poles of the process. Only with this restriction can education be described as a process of interaction in terms of a teaching-learning process. Defining the process of education as an interaction process implies that we look upon the educational process as a whole of related activities of student and teacher. Differences in forms of education mean that something different is required of both teacher and student (input) which implies a different interaction-process between teacher and student (in a given case implying a different interaction-process as to the relation "teaching-learning")

as a result of which something different happens to the teacher and to the student individually (output). The concept described is presented schematically in the following diagram:

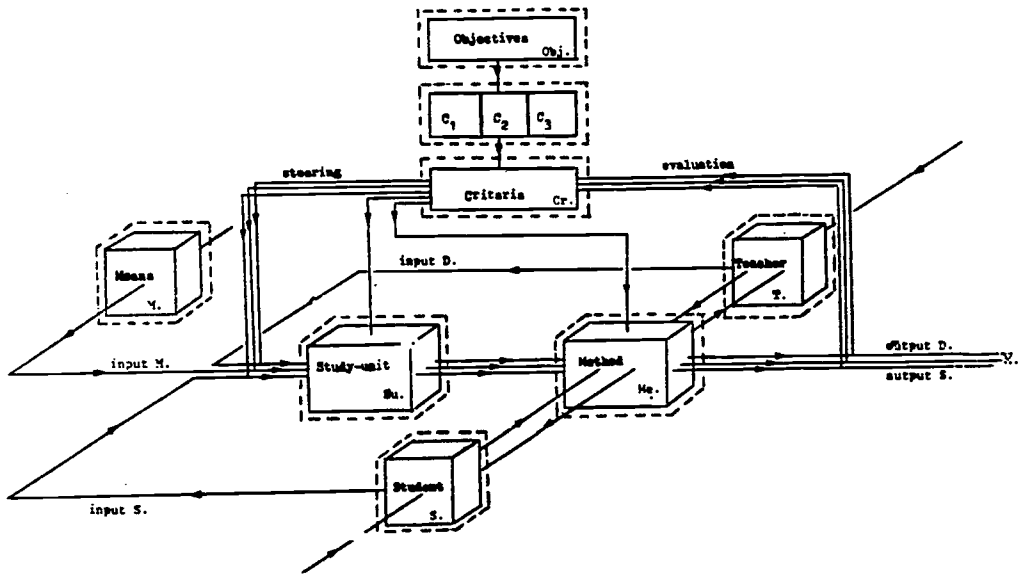


fig.: 11. scheme of the concept of education on execution-level.

2. Description of the concept

Note: the elements of which the process of education consists (objectives, output, etc.) are generally made explicit to the student only as to their contents, and even then only partially. We have illustrated this in the diagram by drawing a rectangle or cube with unbroken (continuous) lines within a rectangle or cube with broken lines. For example: the working and function of a certain program item may be that:

- the student gathers some knowledge
- the student acquires a number of skills
- the student develops a number of attitudes and enjoys his study etc.
- the teacher gains a better insight into the subject matter he teaches
- the teacher develops a skill in making contacts
- the teacher finds satisfaction in his job etc.

However, the explicit objective of this subject matter of study is to impart to students this knowledge of facts and insight into the relation of these facts (on a set level and field). By testing this objective one finds out whether the educational process has led to the desired result (output). Why this restriction?

- one does not realise that the process has more output than what one has measured
- one does not realise that the process has more output than what one has measured but one does not think this output relevant
- one does realise that the process has more output than what has been measured and one thinks this output relevant but one does not know what to do with it: with regard to both the educational process itself and the social-economic context.

Perhaps more reasons for this restriction can be given. What matters is that in our opinion it is necessary to give in the first instance the contents of the broken rectangle or cube as much as possible both as to the students as to the teachers. After this one can confine oneself to closed rectangles or cubes. The criteria applying here are:

a. How big can the closed rectangle or cube be without losing sight of the educational process (e.g. concerning technique of research)?
b. How small can the closed rectangle or cube be without running the risk of not saying anything essential about the process of education?

By following this procedure we might trace elements in the educational process that have not been paid enough attention to, but that are of great importance for the development of this process. It may even be that these elements are incorporated within the objective by an iterated process. For example,it appears that education is affective with regard to acquiring insight into the matter one teaches. This acquiring of knowledge can then be comprised within the objective. The effect produced by this objective-component in practice could be that systematically in a certain phase of the course (not because there happens to be a shortage of money for instance) the teaching of a previous phase is left to the students.

2.1. Objectives (Obj.) can be formulated at different levels, e.g. the objective of education or of graduate-, sophomore-, propaedeutic-programme or programme of a subject throughout the course of the study or at a certain moment in the course of education (e.g. practical work in lecture) etc.

Note 1.
There do not exist such things as educational objectives. Objectives can only be the focus of a process of alteration that we call education. They are, however, handed over to us from a cultural, social, economic and political context from outside education. (see for example, K. Posthumus, Onderwijs: Heilsverwachting, spraakverwarring, beleid pagine 8).

Note 2.
The remark that elements comprising the educational process are in general only partly made explicit implies the following: with regard to objectives, and besides those objectives made formally explicit, there are also:
a. formal objectives not made explicit
b. the objectives of the parties involved whether made

explicit or not, may coincide with the formal objectives.

We will make clear what the consequences may be by using an example. Insight into the relation between facts (a part of the objective that is made explicit) implies in many cases only a statistical insight. This means that, if this is not made explicit, a certain input (e.g. causal insight) is thought to be present in the student implicitly, which has not been formulated in the entrance requirements.

2.2. Components into which the objective formulated in 2.1 can be divided (given as C_1, C_2, C_3, in figure 11):

2.2.1.Knowledge: to know a certain total of facts and to be able to relate these facts.

2.2.2.Attitudes: a orientation towards the subject-matter of study, to be described per subject.

2.2.3.Skills: the techniques dealing with the subject.

2.2.4.Work-satisfaction: the degree in which the teacher's expectation, still to be specified, is realised in the educational process.

2.2.5.Study-satisfaction: the degree in which the student's expectations, still to be specified, are realised in the educational process.

2.3. Criteria (Cr): These are derived from the objective-components and are used as principles, with regard to directing the input, and as touchstones in the evaluation-process.

2.4. A study-unit (Su) is a rounded part of the subject (program-item as a moment within the total curriculum and is used as a means to actualize the objective-components. This actualisation must be based on criteria that are made explicit.

2.5. By method (Me) we mean a formalised structure of interactions between teacher and students, that is the body of related activities

of teacher and student, which contributes to the realisation of the objective. In this body of activities we can distinguish structure of the subject-unit, instruction, assimilation of the subject-matter by memorising, training, discussion etc., evaluation and feed-back. Both the individual activities of student and teacher and the behaviour of student and teacher in the inter-action process should be covered by this. Methods differ on the point of participation of teacher and student in the process of education. These differences in participation can be brought about by:

a) the difference in output of teacher and student individually;
b) the difference in the relationship teacher-student in the interaction process.

Interaction processes are made observable by:

1) frequency of interactions
2) regularity of interactions
3) scope of interactions (how many situations, how many subjects)
4) coordination of interactions
5) one-sidedness of interactions
6) directness of interactions.

The processes of interaction can be characterized according to the cognitive, emotional affective and motivational spheres, where they take place. Between these spheres there is a functional relation: the exactitude of thinking about subjects, that are relevant for the person involved, is linked up with for example the intensity of emotions and needs. The relation of teacher to student can now be described in terms of:

a) social distance: the extent to which student and teacher are in each other's social proximity.
b) social integration: the degree of harmony/disharmony in the relation teacher - student.
c) social rank - the extent to which there is a question of difference in rank of teacher and student (e.g. on the grounds of difference in expertness).

As soon as we do not have any more to do with the relationship between one teacher and one student - and in most cases this is so - we go to social <u>density</u> - social <u>integration</u> and social <u>hierarchy</u> of

the group involved in education. The relationship between teacher and student does not stand on its own but functions in a certain social context. This social context is determined by values, generated within this context itself, values that can be defined as behavioral motives (respect for each other's property, knowledge, wealth, obedience, human relationship etc.). In the following figure we make clear that there are (at least) two ways in which a number of these social values influence the relationship between teacher and student.

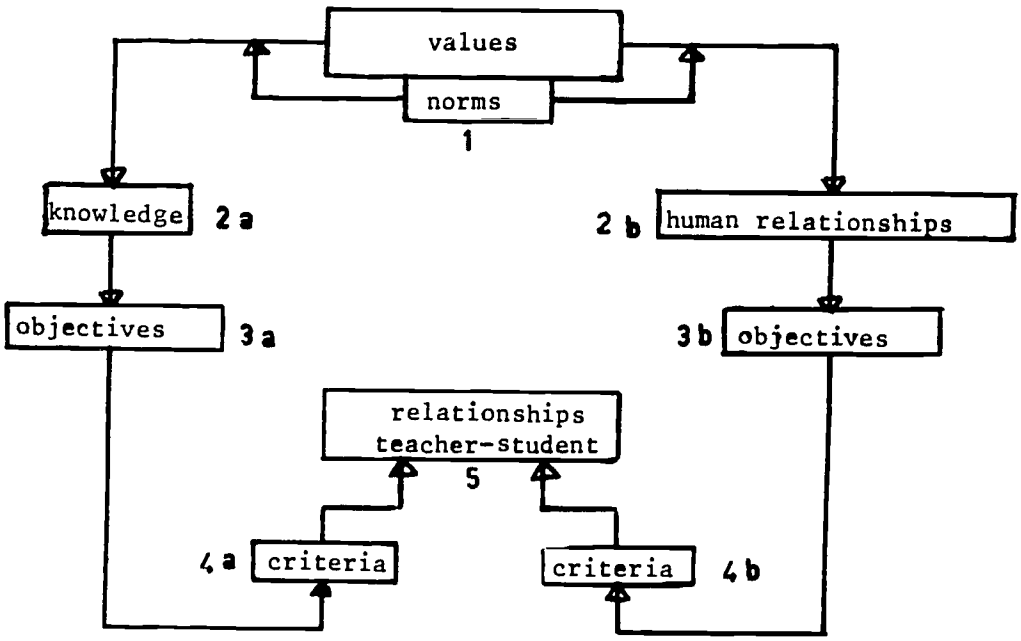


fig.: 12. : influence of values on the relationship teacher-student.

Within institutional frameworks we find these values back in more or or less concretely formulated objectives. One of the objectives of an educational institution is: transference of knowledge (3a).Given the objective, some people (the "wits") determine in the process of transference of knowledge (5) the alternatives in the behaviour of others, (the "nitwits") to a higher degree than vice versa. This happens on the ground of criteria of effectiveness of the process (4 a). These criteria serve the purpose of the objective and its underlying value, in other words, the relationship between teacher and student in terms of social distance, social integration and social rank, has to be understood in the light of the objective, that initiates this relationship. The value: (friendly) human relationship (2b) is not the same for everybody. For, some people think, that those who are older, stronger, more clever, richer etc., should determine the alternatives of behaviour of those who are younger, more delicate, less clever, poorer etc. They base this on, according to their own opinion, functional arguments.

Other people, however, think it in almost all cases, unacceptable that somebody should determine the alternatives of behaviour of someone else, because in their opinion,it should never be possible to base this on functional arguments. It is the discussion about "authoritarian" versus "non-authoritarian" relationship. Basically this discussion refers back to differences in the hierarchy of values people have in mind (2a higher than 2b or just the other way around) and consequently to differences in views on man and society. Starting from this hierarchy of value and the view on man and society people also formulate criteria with respect to the teacher-student relationship, (4b). From what has been said before follows that, within the teacher-student relationship there can exist a disharmony about the nature of that relationship. It will not be difficult to illustrate this with examples found in the practice of education.

2.6. For the case of convenience we speak of student (S) and teacher (T) as the interacting moments of the educational process. They are the uneverpoles of the process of interaction in which one pole possesses more knowledge, abilities etc., in a more or less clearly defined field, than the other one. With this uneveness they condition each other and in as far as they both see the relevance of the process,

they constitute the process of interaction. We think that we can cover with this terminology the less usual forms of education. For example: X studies pages 1 - 20 of some book and Y the pages 21 - 40.
X has to acquire the contents of pages 21 - 40 by means of inquiry.
Y does the same with regard to pages 1 - 20.
Now we have to do with a process of interaction in which both alternatively play the part of "student" and "teacher".

2.7. Input is that which student and teacher contribute to the educational process from the beginning of this process on. A part of the input results from the requirements of the aims that are made explicit. The rest of the input is the result of other objectives. Student-input and teacher-input in terms of time, abilities, knowledge, motivation, attitude, means etc. Process input means the demands for the educational process in as far as they are not to be ranked under input-student and input-teacher. Here we refer to space, equipment, size of the group.

2.8. Output is that which the educational process produces for the student and the teacher from the beginning of this process. In the first instance we have to define the output as the extent to which the objectives, formally made explicit, are or have been actualised. Apart from this, there can be an output as subsidiary effect, that is related to a) the formal objectives;
not made explicit
b) the objectives, yes or no, made explicit by the people involved, in as far as they do not coincide with the formal objectives.
The output (and together with this the effectiveness) contains elements that cannot be reduced to one simple dimension. If this were so, it would be such a general denominator (a great reduction), that it would not mean much anymore.

2.9. Total student-output is output related to the formal objectives made explicit, plus other output of the student. Total teacher-output, is output related to the formal objectives made

explicit plus other output of the teacher.

2.10 Student-effectiveness is the relation between student-input and student-output. Teacher-effectiveness is the relation between teacher-input and teacher-output

2.11 Total effectiveness is student-effectiveness and teacher-effectiveness related to each other in one way or another.

2.12 Of course, by means of the analysis suggested here, the nature of the relation between the elements has to be made clear. Suffice to indicate by means of lines that the relations really exist, and we can indicate the direction by means of arrows.

General remarks

The elements sub.2.1. up to and including 2.12 are described on a relatively abstract level. The rendering of those notions in very concrete terms will be done when a curriculum is developed.

CHAPTER XVI

EDUCATION AS A SYSTEM AND THE PLACE OF THE CONCEPT IN THAT SYSTEM

The concept of education as developed in the previous chapter is a description of education as a process of interaction, such as takes place in the concrete educational situation (on the level of execution). The concept as formulated can hardly be called relevant for the execution of an educational policy, because education on the level of execution has been formulated independently from its organisational context. That means that the relation between this process and the formal frameworks are not indicated in the course of conception. This includes that the model to be developed, cannot be based on the concept, formulated in this way, although the elements that are formulated within it (objects) will have to be represented in one way or another. Policy deals with education as an institutional and organisational system, in which the concrete educational situation is the smallest element. Although management is ultimately directed towards realisation of education as a process of interaction, it has to direct relationship to it. The relation between management and the concrete educational situation is determined by the way in which education as a process is represented within the institutional and organisational frameworks. This representation takes shape in the sets of activities that are performed within those frames in different places at different moments.

In other words the relevance of the concept for model-construction is to a large extent dependent on the structure of the whole complex of tasks to be executed, under the assumption that a set of activities as a whole is directed towards realisation of education in the concept given. In order to make it possible to build the model as suggested we shall have to trace the relation between the educational process and the institutional framework and to proceed by analysing it in detail. We think an approach based on the system theory is adequate and functional for this problem.

1. Definition of the system

In this paragraph we use the word "university" to indicate an organisational unit of education. This "unit" definition implies that it makes sense to draw a boundary line between the university and what can be imagined around it. The description: "what can be imagined around it" is condensed in the system theory in the notion: environment. Now, if we define a system as an entity, that in our mind can be separated from an environment, a description of a university as a system is possible in principle. The advantage of this definition is that it forces us to introduce explicitly the relations between the system and its environment. Elements of the environment, that influence the system in a one-way direction and not vice-versa, are called input-elements. Analogically, elements that from within the system influence the environment and not the other way around are called output-elements. In reality these strictly one-way directed influences hardly ever occur and we find quite often mutually linked elements. This has consequences for the choice of input- and output-elements and for the choice of the boundary of the system. Only elements that within certain limits answer the ideal of a "one-way directed" relation, will be considered, or that can be treated as such by letting them operate only under explicitly defined restrictions. Such a ststriction could be, that an "independent" manipulation using that element is allowed only when the degree of the expected retroactive effect is taken into account. When the retroactive effects have become very big this usually is an indication of an unfortunate choice of the boundaries of the system.

In what follows the university is seen as an open system, dependent on input-elements of its environment, that vary in time. The description of a university as a system has now simply become the description of the transformation of input-elements into output-elements. A specific function may now be attached both to environment and system.

The environment settles a number of broad requisites, the "ends" that have to be met by the output-elements. It also determines in most cases in the form of "constraints" on the input- and output-elements the limits within which the transformation process has to proceed. Finally the environment has to fulfil a function in the supply of people, information and means. The function of the system is to define a kind of overall objective in such a way that at least the "ends" are met in the light of "constraints" that are set on the system by the environment and that by means of giving a concrete form to it step by step, realisation becomes possible. Definition of the boundaries of the system is not usually very easy.

For example in a dynamic situation, the translation and the transformation of the external ends into an overall objective for the system is not a unique event. A possible result of this might be the regular needs for re-defining the boundaries of the system. Likewise the nature of some output-elements is not always fit for direct application or workability in the environment. In that case a procedure of adaptation is required, that in most cases has to be carried out partly by the system and partly by the environment in a mutual interaction. For these reasons it seems to be useful to attach explicitly another function, both to the system and to the environment namely a function of regulation of boundaries and a function of adaptation.

2. The model

The definition of the system given is, due to its generality, not operational and transformed the university into nothing more than an unopened black "box", in interaction with its environment. When we open this box, we can spot in the university a number of processes and a number of sets of individuals, groups, activities, means and spaces. To deal with this complexity it is necessary to divide the system into subsystems components and elements with decreasing complexity. The smallest entities that still occur in the description

as independent units are called objects. In our system these objects are the elements that are found in the concrete educational situation on executional level. The set of the smallest elements is called the object-set O:

$O = \{O_1, O_2, -- O_n\}$

Consequently , a subsystem is a set of objects, that form a subset of O.

Objects are thought to be somewhat more than just plain entities. A number of attributes are associated with each object; the object derives its meaning from the set of its attributes.

$A(O_i) = \{a_1, a_2, -- a_n\}$

It is only possible to relate objects to each other or to compare them through their attributes. Relations between objects can only be expressed by means of relations between their attributes.

$R_i = R_i \{a_{i1}, a_{i2}, -- a_{in}\}$

A qualitative model of the system now can be defined as the set of attributes

$A = \{a_1, a_2, -- a_n\}$ and a set of relations $R = R_1, R_2, -- R_m$

The way attributes are measured distinguishes them into three types. First of all an operational attribute, that has to be defined from the world of experience; part of the definition of this type of attribute will therefore consist of measuring instructions. Next a formal attribute, that only can be defined by a relation. Finally there are combined attributes, that can be defined by an instrument as well as expressed in a formal relation. The step from a qualitative to a quantitative model is taken by measuring a process. We could define measuring here as an attachment of numerals to attributes, according to a rule - any rule will do. This rule is the rule of correspondence or measuring-scale, that renders the set of attributes A into a set of numerals W. After measuring we can speak of a quantitative model if to each attribute a_i, number w_i has been attached and if the relations have been replaced by mathematical operations or equations.

In the case of the quantitative model, however, the attributes in set A are variables, that means, elements that in principle can be measured or can be determined by means of a calculation with

the aid of formal relations.

According to the role played by the variables in the model (so not according to their character) we can classify them in different types.

(1) input variables: variables, practically always emerging from the environment that determine directly or indirectly the output by means of state variables. For the system they are not to be manipulated and they are independent.

(2) state variables: they determine the state of the system at a particular moment.
All relevant historical information is as it were enclosed in these variables. They are needed at any moment of time to calculate uniformly the output with the help of the input-variables at those moments. They may occur as dependent and independent variables.

(3) decision variables: variables that change or influence the state variable on account of a decision. They are independent variables and can be manipulated.

(4) intermediary variables: variables that remain within the system and that simplify the calculation of other variables or the mathematical relation between them.

(5) output variables: those independent variables which have a value, directed towards the fulfilment of the objective of the system.

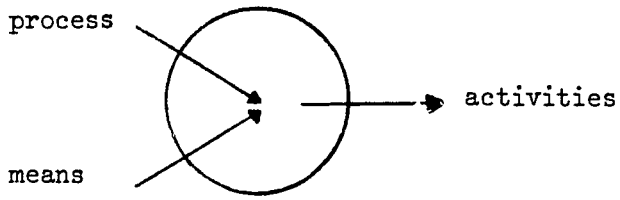
In the study of a complex phenomenon, it is often useful not to vary all the variables at the same time. Dependent on the angle of incidence from which the phenomenon is being looked at it is useful to fix in mind a number of variables at a particular value. Then a specific input and output relation is studied under certain conditions. These variables then play the role of parameter. In this way the "ends" that are required of the system by the environment will vary in time, but for an analysis of an educational system within the period of one year they surely can be imagined as fixed, and can be treated as parameters.

So parameters express the boundaries, within which a phenomenon is being looked at or within which a certain degree of freedom of

variation exists. A number of parameters become variables again after crossing the boundaries. It is useful to the study of the internal function of a system to represent the variables of the environment as parameters.

3. Structure

Up till now we have only talked about the smallest elements, the objects, characterised by the attributes. The presence of a set of relations between these attributes was already sufficient to speak of a model. By means of a further analysis we will try to discuss the structure in the set of relations and objects. If a relation describes dynamic working between objects we call this a process. So processes describe the transformations of attributes in terms of quantity and quality. Seen in this light the processes are the technology, through which, or by which, a transformation takes place. Transformations are effected with the aid of means. This junction of processes and means finds a concrete form in the shape of the sequence/set of activities, pictured as follows;



For tracing the different processes in a university it will be sufficient then to distinguish different sets of activities.

A first inventory produces pretty soon a long enumeration of these sets of activities such as: education, research, administration, meetings, recruitment of personnel, planning, maintenance, social contact and management. These distinct sets of activities, differ from each other as to objective, scale of evaluation, technology, assumptions, character and expectations of the participants and factors in the environment. As yet it is impossible to place all these dimensions in a logical structure of all these sets of activities. For the time being we limit ourselves to a division based on two dimensions: mission and technology (the character of the process).

Concerning the university we can distinguish in the dimensions of the mission:

I education
II research
III supporting functions for I and II.

According to the character of the processes we distinguish in the technological dimension:

A.	Policy:	the translation of the "ends" and "constraints" of the environment into objectives and sub-goals, followed by functions such as evaluation and coordination.
B.	Programming	the translation of objectives and sub-goals into programmes and projects as well as the steering of the distribution of people and means among these programmes.
C.	Execution	the realisation of programmes and projects.

For analysis and model-building we think of the university as a system built up from three sub-systems: education, research and supporting functions. Within each of these sub-systems we can distinguish again a structure on three levels: policy, programming and execution. Each of these levels can be described again as a

subsystem on which a submodel or module can be made. The concept given in Chapter XV is a description of the execution-level.

For the description of the relation between these three modules we assume a ranking order. We base this ranking order on two characteristics:

1) the priority of an action on a higher level to that on a lower level.
2) to function properly a higher level is dependent on information about the working of a lower level.

The relations between the modules can be studied in terms of input/output relations and feed-back loops; by way of a summary we may picture this as follows:

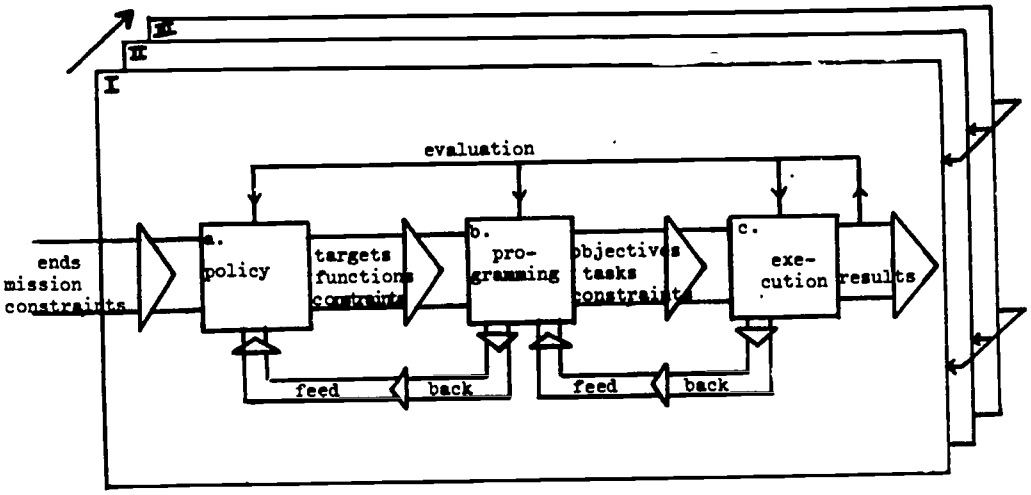


fig. 13 : University described on the mission-dimension and the technological dimension.

remark: mission-dimension: I education
II research
III support-function

technological dimension: a. policy
b. programming
c. execution

CHAPTER XVII

PROPOSAL FOR FURTHER RESEARCH

1. Introduction

If one would come, starting from the system-approach, to the construction of the model suggested of the university as a system, one has to consider as the most basic elements of the model, the objects (being the smallest elements of the system that has to be put in a model) and the attributes, that are to be associated with them.

After this remark there are now two ways of realising the construction of the model, within this project:

1) By means of basic research within the university as a system, one can make a search for the model-elements and the mutual relations. That includes, that starting from a theoretical concept, in which among others the collections of objects and attributes are denominated and defined, one tries to find out by means of a critical analysis of the university as a system, which object could play a role within the system, and which attributes that are relevant to the system.
When once theobject - and attributes collection, according to the necessity for the model and their relevancy for the concept within the university as a system - have been itemized and made operational, then the model can be developed, based on these elements. That means that the relations between the objects by means of scaling of the attributes are defined and modelled.

2) More focussed on practice one may start from the model that has been developed with the Overbeek method for a basis and that has already been applied for some time. One could try by means of a critical analysis to extend the object and/or attributes-collection, included in that model. On the basis of this extension the modelling of the relations between the elements (among others: the relation education-research, the need of non-academic staff, material expenditure and facilities can be refined, so that this model can be improved

step by step as well as with respect to functional adequacy as to the concept. We suggest that a parallel course should be taken both for basic research and the practical approach, because we are convinced of the fact that this dual approach will produce better results. Furthermore it is an advantage for the managing authorities, that in this way the model, already applied, will be continually adapted, which improves its usefulness again and again. However, in the proposals that follow, the emphasis lies on basic research.

2. Motivation

2.1. Starting from the presuppositions that the University as a system can be described after the scheme given in figure 13, one could differentiate this system, with respect to the mission-dimensions, on the grounds of processes indicated in the following section, in among others, three sub-systems:

- a process in which, given on one hand the objectives and constraints on the other, the tasks and also the conditions are created to actualise education as a process of interaction on executional level.
- a process in which, given on one hand the objectives and the constraints on the other, the tasks are formulated in such a way and the conditions created as to actualise research projects on executional level.
- a process in which, given the objectives on one hand and the means on the other, the tasks are formulated in such a way and the conditions created as to actualise supporting activities, such as administration, technical departments etc., for the benefit of education as well as of research on executional level.

Note: we would like to identify the first two processes as the mission of the system and the last process as the mission support.

2.2. Within each of three sub-systems three processes can be distinguished with respect to the technological dimensions:

- policy
- programming
- execution.

2.3. In the first instance, limiting ourselves to the sub-system that performs the educational mission, it will be necessary for the construction for an educational model, to itemize objects and attributes by means of a critical analysis of the educational sub-system. We suggest that we should start from the concept of education as a process on executional level, and to find out in which attributes the objects formulated in that concept are represented on the levels of policy, programming and execution. In a later stage we will try to identify, by means of an investigation, the relations between the elements of the model and to model them by means of scaling of the relevant attributes.

2.4. If one wants to be able to make this inventory, then an insight into the following points must be acquired starting from this diagram:

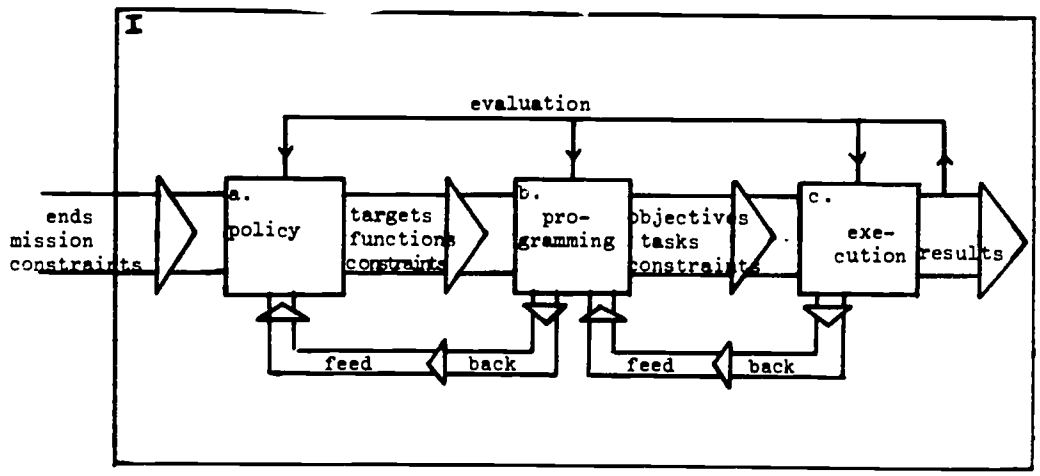


fig.14: University as educational sub-system dissected on the technological dimension.

2.4.1.The definition of the "executional processes" in terms of the educational concept that has been formulated. This includes that one has to determine empirically, into which elements (objects) the executional processes can be differentiated and which attributes have to be associated on empirical grounds, to these objects. In the first instance we have to do then with:

1. the process of interaction, according to its character, extent and course.
2. input-categories such as students, academic staff, non-academic staff, space and equipment.
3. output-categories to be defined in terms of objectives, that in the form of criteria are the basis for the process.

   Note: one of the central points is the problem of making the elements (attributes) operational, further indicated in this question: will we be able to indicate the attributes in such a way that we can apply arithmetical operations, to them without too strong a reduction.

2.4.2.Descriptions of the process of programming. In an investigation we will have to go further into:

1. the "steps" into which this process can be divided up
2. the sequence of these different "steps"
3. the result obtained in each of the "steps" and in which terms of the concept this result may be described.

2.4.3.Description of the policy as a process. Attention will be paid to:

1. the activities into which this process can be divided up.
2. the structure, under which decisions are taken.

3. Restrictions

It will be clear now that an analysis of the university as a system concerning both the mission-dimension and the technological dimension is much too complex to be carried out within one and the

same investigation. We suggest to accept the following restrictions:

3.1. We will restrict ourselves with regard to the university as a system to the section. By section we mean an organisational unit within which a certain degree of autonomy, education, research and supporting functions are actualized for the benefit of the training for an academic degree.

We permit ourselves to make this restriction because it is reasonable to presume that the section may be considered to be representative, with respect to the mission-dimension as well as to the technological dimension, for the university as a whole. In other words within the sections the mission-dimension as well as the technological dimension can be described in a sufficiently clear way.

3.2. As far as the mission-dimension is concerned, we will limit ourselves in what follows to the subsystem concerning the educational mission.

3.3. As far as the technological dimension is concerned, we will limit ourselves for the time being to the levels of execution and programming.

General remarks: we will have to find out to what extent these restrictions can be allowed as to the relevancy and as to the possibility of carrying out further research.

4. Further actualisation

4.1. On the grounds of what precedes the objective of the investigation in its first phase is formulated as follows:

1) itemizing of the objects and attributes, being the most fundamental elements for the construction of the educational model of the section as an educational system according to levels of execution and programming.

Note: If we want to be able to make this inventory an adequate procedure of investigation a proper investigation instrument must be developed previously (For this reason our project will have the character of a pilot study in this first phase).

2) Description of the relation between the objects itemized and modelling of these relations by means of a scaling of the attributes.

4.2. The consequence of the formulated objective is, that within the section as an educational system:

1) empirical research will be made into the character, extent and sequence of the process of execution, in terms of the concept, developed in chapter XV.
2) empirical research will be made as well into the character, extent and sequence of the process of programming.
3) we will try to find out, with the help of other historical material by means of what attributes the objects in which the executional process has been differentiated are represented in the process of programming.

4.3. For the benefit of the analysis that we will make of the executional process, we will start from the scheme of this process as given in figure 11. For the time being we can formulate the following objects per phase of study:

1. Student: S.
2. Teacher: T
3. Study-unit: Su
4. Means: M Means for instruction: Mi.
   Other means: Om
5. Method: Me.
6. Objectives: Obj
7. Component of objective: C_1, C_2, C_3.....C_n.
8. Criteria: Cr.

Starting from these objects we will try to ascribe to them the attributes that are relevant for the executional level.

Note 1: if one is able to indicate the relations between the objects S, T, Su and Mi (by means of the attributes ascribed) then one is able to describe the method (Me) by means of profiling.

Note 2: The result of this analysis will give us also an insight into the reality-value and the usefulness of the educational concept that has been formulated.

4.4. For the benefit of the investigation how theobjects that have been formulated on executional level are represented on the level of programming by means of their attributes, we suggest,

1. First of all to differentiate the process of programming in a sequence of "steps" of programming.
2. We will try to find out by means of a "blow up" of the separate"steps"by means of what attributes the objects have been represented in these "steps".

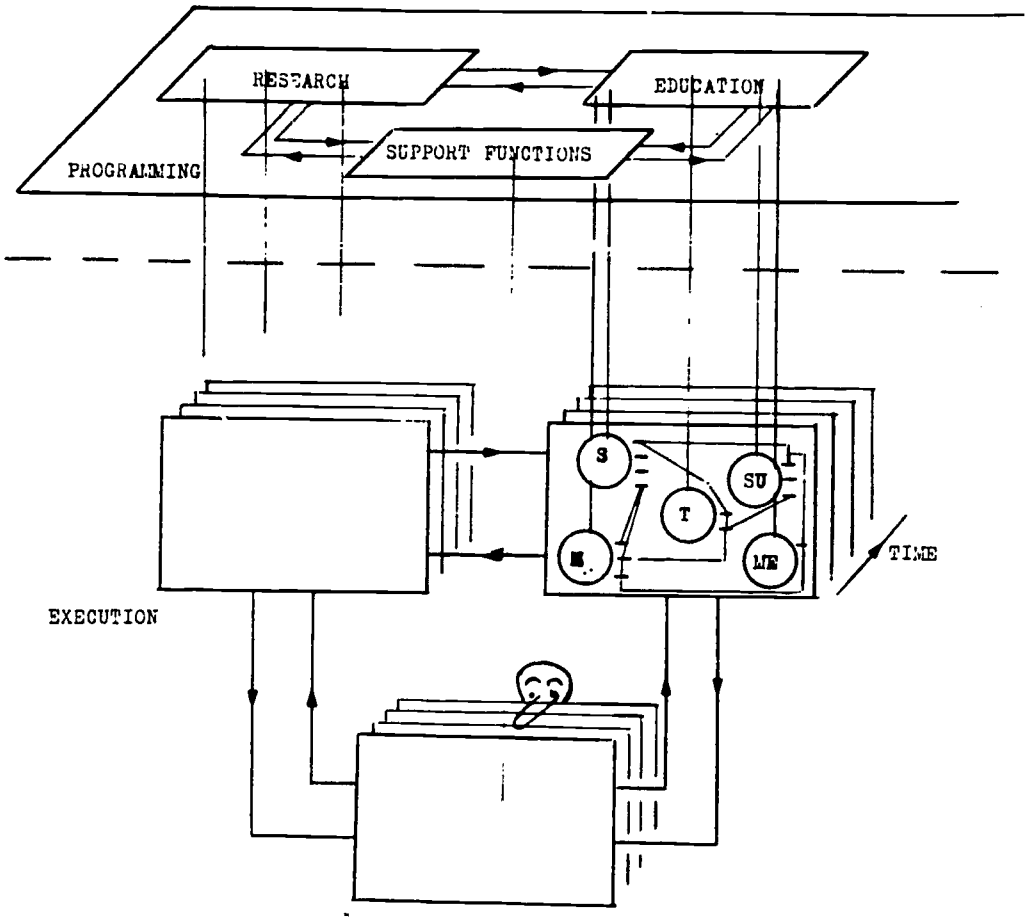


fig.15: Objects and attributes on level of execution and programming.

5. The relation between the proposal and the final result

5.1. Preliminary remark

There is a danger that because of the dissection in the beginning of Part C and the restrictions suggested, there rises a misunderstanding concerning the final re ult, as it has been formulated, namely concerning the relation between education and research within the university. We emphatically state here, that in the procedure suggested, education and research are at most distinguished and not separated. This means that in our way of thinking these two university-missions belong tothe same dimension (the mission-dimension) and they are only distinguished, in as far as they occupy their own positions on this dimension. The dissection (disconnection) and restriction is made only for research-technical reasons. The ultimate aim remains: an integral information-model of the university as an education and research-system. This model should be a synthesis of the education-model and the research-model, that has been dealt with in what precedes, as sub-models.

5.2. Desired development and phasing

For the actualisation of the construction of the integral model we think of the following phasing within the project:

1) development of the education-model, starting from an educational concept.
2) development of a research-model, starting from a research-concept.
3) development of the integral (information) model starting from a concept of the university as an educational and research-system.

Due to this phasing, emphasis is laid here on the development of the educational-model. If we want to be able to actualise the integral system in a later phase we will have to take into account, in developing the sub-models mentioned before, the fact that these models cannot be separated in reality. We do so by indicating continually, in the analysis to be made the relations between education and research, especially where itemizing of objects and attributes

and the scaling of those is concerned. When the educational model is actually constructed the research-model will be developed in an analogous way. Given the sub-models, the elements of the model and their mutual relations will be integrated into a single system.