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Symposium on the Development of the Plastics Fabrication Industry in Latin America

Bogotá, Colombia, 20 November - 1 December 1972

LABORATORIUM FUER KUNSTSTOFFTECHNIK - LKT - A POSSIBLE MODEL FOR INSTITUTES OF TRAINING, TESTING AND RESEARCH OF PLASTICS[1/]

by

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Vienna Austria

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SUMMARY

LABORATORIUM FUR KUNSTSTOFFTECHNIK, A POSSIBLE MODEL FOR INSTITUTES OF TRAINING, TESTING AND RESEARCH OF PLASTICS.

by

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According to Millendorfer-Gaspari, education, capital and structure are basic factors for the development of a region. A steady growth of these three factors is necessary for any development. In countries with a literacy of more than 60% there is a direct connection between secondary education and per capita income. In this connection the region of South Eastern Europe may, in some respects, be compared with the region of Central and South East America. This secondary education is considered as a vital role in this report.

The Laboratory for Plastics Technology in Vienna, LKT, can conveniently serve as an example for South Eastern Europe. It demonstrates how the various activities of secondary education, training, testing, research and development may be co-ordinated

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by an efficient matrix organization to form a complex unit of high efficienoy, in the field of plastics technology. The LKT is, on the one hand an Institute for Higher Teohnological Education, Post Secondary College for Plastics Technology and a Federal Testing Station for Chemicals and Plastics under the Federal Ministry of Eduoation and Art and, on the other hand an organization for oourses and seminars relating to training and vocational training and a research institute for trade and industry within the framework of the Association for The Promotion of Plastics Teohnology, which is a private organization supported by 180 member firms.

The LKT employs 70 full time staff and has an annual budget of $1,000,000. At present it has more than 400 students and vocational trainees.

This institute may be taken as a model in respect of a possible range of research and development topios, energy, materials and management requirements and study oosts.

CONTENTS

1. Fundamental principles of development - education, capital, structure

The latest Austrian studies on development research have come to the conclusion that only a balanced growth and reciprocal action of the three factors — education, capital and structure — guarantee a steady total development. Millendorfer and Gaspari have shown that countries may be grouped into large geographic zones according to the criterium of their efficiency of education. These zones make sense from a historical as well as from a cultural point of view and the resulting regions are not scattered all over the globe but represent rather compact geographic areas. (Fig. 1) The economic efficiency of education in developing countries was found by regression analysis of the relation between per capita income and literacy expressed in percent of the population (Fig. 2). The level of regression lines could be interpreted as economic efficiency of education. It depends, inter alia, on "social technology" i. e. development a system of social data processing, and the motivation structure. Within each large zone, the influence of these factors on the economic output seems to be equal. This however, does not mean that social technology and the motivation structure within the large zones are always identical for every country Fig. 3 shows the situation in Latin America. According to a tentative theory of development from Millendorfer-Gaspari, the process starts with the development of "social technology". The second period is characterized by the widening of the internal system of communications with the aid of education. When literacy has reached about 60% of the population, industrialization becomes the most urgent problem. Industry must now, in this third period, be able to absorb the labour force made free by the continuing improvement of efficiency in agriculture.

1. 1. Secondary education

From an investigation in the South-East European region — including Austria — a definite correlation between per capita income and secondary education has become obvious (Fig. 4).

There is a real bottleneck in the field of secondary education as compared with university educated graduates , tertiary education. A 1 to 6 ratio of university educated and secondary school educated graduates is internationally considered as normal. In the South-East European region this ratio is as high as 1 to 3.5.

According to Behrendt, some developing regions make the serious mistake of forcing university education because of prestige reasons and of neglecting a sufficiently fast development of secondary and primary education.

Especially for semi-advanced regions as Central America and South East America, a fast expansion of secondary education is of particular importance.

1.2 Research work on all levels

It seems that the developed countries have reached another new phase of growth where research becomes one of the most important activities of social development.

Fig. 5 shows the capital and education share per capita as fictitious income depending on research expenses in per centage of the GNP.

In advanced regions there is a close connexion between these values. The cost of basic research, applied research and experimental development are also considered as research expenses.

1.3 Testing - quality control

Research and development work aims at new fields of technology, whereas the application of quantitative measuring methods to agreed tolerance ranges of properties is termed testing and quality control. In this field, it is necessary to agree on clearly defined tolerance ranges which are generally achieved by standardization. For better reproducibility it is convenient to agree on testing methods as well.

It is not to be expected that far-reaching quality control is achieved by standardization alone. Experience has shown that standardization is restricted to established products and techniques. The main task of a testing station is to determine negative results, to ascertain causes of deviations or, in positive respects, to suggest methods of avoiding future deviations. This task is often similar to "scientific criminology" which is necessarily based on experience and knowledge of the means of eliminating deviations.

2. Plastics technology - a circular process

Many papers contain a comprehensive survey of the classification of plastics technology. These range from the production of intermediates via fabrication to waste and recycling. At present, the problems of plastics technology can be illustrated by a precise analysis of moulding methods in order to achieve a quantitative determination of all characteristics depending on three dimensional distribution, on time and on thermodynamic characteristic values like pressure, temperature and density. Only then it may become possible to combine an optimum material quality with an approximately optimum technique for the production of a plastic article. This again may lead to designing appropriate fabricating equipment, since the main thermodynamic principles may point out a basic

conflict between quality and economic considerations. Recent developments have indicated the necessity of including aspects of environmental protection into this optimization process.

The main objective of every training, research and development activity in the field of plastics, is to achieve an orderly, efficient and rapid development in plastics production, fabrication, use and recycling including quality control and economic aspects.

Fig. 6 shows the distribution of the most important sections of information in individual branches of technological plastics processes based on general technical information.

3. LKT - an Austrian institute for training, research and testing

"After having been isolated from international events for years, Austria is at present highly esteemed all over the world and regarded as one of the most consolidated countries with respect to its foreign and internal affairs". This is a quotation by Waldheim before his election as Secretary General of the United Nations.

Two factors probably contributed to the establishment of this particular laboratory for plastics technology in Vienna. One, Austria's status of political neutrality and the other a tradition of more than two hundred years professional training which was initiated during the 18th century.

3.1. Tasks of the LKT

The "Laboratorium fuer Kunststofftechnik" - LKT, founded in 1957, has four main task to fulfill:

(a) Secondary and post-secondary education at the "Technologisches Gewerbemuseum", founded in 1879:

Plastics technicians are trained according to their preliminary education:

- in two years, after university or professional qualification;
- in three years, after completion of an apprenticeship or after having qualified of an appropriate vocational school; and
- in five years, after completion of compulsary schooling.

In addition, special seminars, for example, for vocational teachers, are held.

(b) National Testing Station for Chemistry and Plastics:

This station had its origin in the authorized testing stations for paper, founded in 1866, for material investigation and material protection founded in 1920, and in the testing station for plastics materials, founded

in 1957.

The station serves industry and local authorities in the solution of technical problems and issues "Gutachten", test certificates which can be used in applying for Austrian certificates of quality.

During the period of July 1945 to July 1972 some 16,742 "Gutachten" were issued only 13 of which were contested.

(c) Research Institute of the Association for the Promotion of Plastics Technology:- OFKT:

This institute, which has been established within the LKT and in agreement with the articles of the Association, has to undertake economically important problems for industry. It carries out trade research as well as scientific research within the scope of its articles. It is the Association's duty to achieve rapid but acceptable solutions to the problems posed.

The Association is a private institution supported by 180 member firms in Austria and abroad. It aims at a close co-operation with industry, university institutes, responsible ministries, the research promotion fund of industry and trade, the promotion fund for scientific research, the jubilee fund of the Austrian National Bank and other pertinent institutions. 49 research projects of the Association are listed in Appendix.

(d) Vocational training

Since 1958, post school courses for working people have been arranged in co-operation with the trade promotion institutes of the Federal Chamber of Industry and Trade. In this regard, the co-operation between LKT and the Federal Chamber has been particularly successful. These evening courses and day seminars are the most important basis for the vocational advancement of working people in trade and industry. Since the foundation of the Association in 1963, advancement prospects for working people have been expanded by establishing permanent courses for foremen in plastics technology and by arranging seminars for industrial firms.

The UNIDO/Austria Training Programmes in Plastics Technology for Developing Countries are a special development in this field of training. 41 participants form Latin American, Asian, African and East European countries have taken part in these Training Programmes which have a duration of six weeks and are to be continued at the LKT. Since 1972, seminars entitled "Cours d'Instruction des Plastiques" are being held in French.

The programme of these courses corresponds approximately to the programme of the five years course with necessary modifications. At present, thirty courses besides the course for foremen are offered by LKT.

3.2 Organization of LKT

The LKT owes its efficiency to the successful co-operation of the Austrian plastics industry, trade and commerce as well as the administrative authorities and trade corporations. This requires a solid organizational framework in order to make optimum use of staff capacity and available equipment. In 1972, LKT had a staff of 70 full-time members and the budget was around 1 million US$.

It is rather difficult to co-ordinate the different structures and levels of a training system and a research system in an economic way. Thus the LKT is organized according to two different points of views: divisional and functional. Basically, it is subdivided into divisions and sections, but these are overlapped by the respective functional necessities.

(a) Functional organization

Four main activities govern LKT —

education
testing
training
research.

Organization chart 1 gives a schematic view of these activities and their distribution among the staff.

Education is covered by the Federal Institute of Higher Technological Education and by the Post Secondary College for Plastics Technology.

Testing is carried out by the National Testing Station for Chemistry and Plastics. This station is integrated in the TGM, Federal Institute of Higher Technological Education and Federal Testing Station.

These two activities are controlled by the Federal Ministry of Education and Art accroding to the Austrian federal law of education.

Research is under the aegis of the GFKT - Association for the Promotion of Plastics Technology. The research group includes the Research Institute of Trade and Industry. The representative of the

Research Institute is the Association GFKT according to its articles. The LKT carries out both submitted projects and innovative research.

Vocational training is covered by the Association GFKT in co-operation with trade promotion institutes: they co-operate in organizing vocational courses, arranging intensive training programmes in German, English and French in co-operation with international organizations, e.g. UNIDO.

(b) Divisional organization

Technically, the LKT is subdivided into six divisions:

general information
special information
general services
laboratories
workshops.

These six divisions fall into 18 sections thus allowing for well defined responsibilities and necessary staff relations. LKT can satisfy requests for various services as it includes education, testing and research. It resembles an "instrument for playing different tunes". Each seaction has its manager, deputy manager and, according to its size and requirements, scientists, assistants, technologists, assistant chemists and subsidiary workers.

(c) Integrated organization

The functional and divisional organizationsunited in a matrix diagram result in the integrated organizations shown in Fig. 3. Organization chart 3 demonstrates first of all the close co-operation between the divisions,the reason for the high degree of efficiency of an institute of this size. In the field of education, training, testing and research only qualified people are employed. They have their well defined position within their section. Both section Managers and staff are responsible for the smooth running of a section.

Besides the activity in his section,an LKT staff member may have functions in other sections or divisions, for instance, he may be a form master at the Institute of Higher Technological Education. Then he is responsible for the co-ordination of the various divisions in order to reach optimum instruction of students. In this case he is directly responsible to the Director of LKT and is so in the functional not technical respect superior to his Section manager.

In the testing field a similar function is given to the so-called

expert whose task is to co-ordinate the various sections within the National Testing Station for Chemistry and Plastics in order to execute a "Gutachten".

In the research field, the project manager is reponsible for prosecuting a research project.

In the training field, the instructor is responsible for organizing a particular course.

By means of these organizational principles, the LKT staff members and the equipment are fully employed and make optimum use of their capacity. There is an intense mutual effect in all sections which results in a creative and stimulating atmosphere.

4. Suggestions for the establishment of plastics technology centres

4. 1 Subject list

According to the demand for theoretically and practically well qualified technologists a Higher School for Plastics Technology with qualifying powers should be set up.

At the same time, an adequate level of general education is required in order to enable the graduates to fill key positions in industry or administration.

The graduates of a Higher School for Plastics Technology should be able to take key positions in plastics processing industries and trade, due to their intensive training in mechanics and all aspects of plastics technology. They should be capable of planning, applying and designing in plastics. Furthermore, these graduates should be able to work in the plastics processing industry and in development. Thus a Higher School for Plastics Technology serves the purpose of imparting higher knowledge in the special field of plastics and at the same time, allows the graduate to enrol in the same field or a related field at a university.

After successful graduation from the Institute of Higher Education in Plastics Technology in Austria, and complying with other condition, the title "Ingenieur" is granted, according to Austrian law.

(a) General information

More emphasis is placed on technical subjects than in normal secondary schools Nevertheless, considerable importance is attached to the need for a broad general education which embraces continuing studies in the fields of humanities, sciences, languages and the arts.

(b) Technical information

The second large group of subjects concerns the technical basic knowledge according to the principles of mechanical engineering: mechanics, machine units and construction exercises, mechanical technology, machine tools, science of industrial organization, science of industrial management, mechanical drawing, and hygiene and prevention of accidents.

(c) Special information

The so-called special subjects teach those technical disciplines which deal only with plastics and their fabrication. Both any narrowing down to close specialization is avoided and the rule of broad general technical knowledge in the field of plastics is adopted.

In plastics chemical technology a definite mastery of the chemistry of raw materials, intermediates, polymers and ancillaries is stressed. The importance of trends in development is also emphasised

Mechanical technology conveys a broad general knowledge of the characteristics of the individual plastics materials in the light of the various fabrication methods ranging from compounding to conversion and after-treatment.

Plastics mechanical engineering embraces applying the principles from both chemical and mechanical technology as fundamentals in mould and machine design. Construction exercises are employed as a means for applying due importance to such aspects as machine units, devices, moulding apparatus, surface treatments, mould and die design, and materials of construction.

In finishing, the knowledge of reasons for corrosion, corrosion protection methods and the surface treatment with a view to the properties of the individual plastics and the galvanotechnical mould design are explained.

Electrical and control engineering are particularly important for automatic and semi-automatic machinery. Here the possibilities of electrical driving, measuring and controlling methods and other possibilities of controlling (mechanical, electrical and hydraulic) are taught.

(d) General services

This division includes public relations, documentation and administration.

(e) Laboratories

The laboratory gives a solid training in the operation of semi- and fully automatic plastics processing plants. It is also concerned with raw materials, semi-finished and finished product testing. The training includes the adjustment of thermoset compression moulding machines, transfer moulding machines, sheet presses, and pneumatically, mechanically or hydraulically operating injection moulding machines. Practical instructions on the setting up and starting of extrusion based processes including tubular film, blow moulding, pipes, profiles and sheets. Auxilliary processes such as drying and mixing are also included.

The principles underlying the reasons for quality control are studied and instruction given in chemical, mechanical, electrical, thermal and optical testing of raw materials, additives, semi-finished and finished goods where appropriate.

Group training schemes are organised for such studies as machine setting, adjustment and operation record keeping and test result evaluation.

In fact, the plant laboratory, treated as an essential bridge between theory and practice, represents the culmination of the students' training.

(f) Workshop

The practical work in the workshop includes a thorough training in skilled craftman techniques and methods of working metals and other materials considering the functional, organisational and operational aspects of an up-to-date production plant, rational operation, useful working sequence and economic precision. After a general introduction, in workshop science and metrology, the basic training in machining, wood pattern shop, mechanical workshops, foundry, forge and welding shop is started. The student learns tool making, apparatus construction, tempering and electroplating. To complete his workshop training, he is engaged in mould making for extrusion, injection moulding, thermoset processing and processing of semi-finished articles including reinforced plastics, hot and vacuum forming, rotational casting and flame spraying.

The LKT subject list in table 1 may serve as a guideline for a 5 years course.

4.2 Post secondary studies

The training covers four terms, main emphasis being given to technical and practical subjects. The graduates therefore have a good general education plus a concentrated professional training according to the level of an "Ingenieur" in Austria.

The LKT subject list for these studies is given in table 2.

(a) Equipment requirements

This kind of education in workshops and laboratories requires additional energy which exceeds that common to traditional technical training. The present additional energy requirements of LKT may serve as an example:

	Machine units	Energy requirements (KW)	Student group	Students
Compounding	6 - 10	70	2	8 - 10
Injection moulding	8 - 10	180	3	12 - 15
Extrusion	6 - 8	180	3	12 - 15
Compression moulding	4 - 6	70	2	8 - 10
Control techniques	20 - 30	10	2	8 - 10
Testing	30 - 50	80	3	12 - 15
Foaming	2 - 3	10	2	8 - 10
Mould making	20 - 25	25	4	16 - 20
Reinforced plastics	6 - 8	15	4	16 - 20
Machining and forming	15 - 20	60	5	20 - 25
	117 - 170	640	30	120 - 150

In addition to these requirements a water consumption of 2,500 liter per hour and a compressed air consumption of 2 m^3 at 8 Kp/cm^2 is needed.

The materials consumption per one worker-year is as follows:

PVC	12.0 tons
Polyolefines	4.5 tons
Polystyrenes	2.0 tons
Other thermoplastics	1.3 tons
Expandable plastics	0.7 tons
Phenolics and aminoplastics	0.5 tons
Reinforced plastics (fibres included)	2.0 tons
Semi-finished goods	0.5 tons
Additives	3.5 tons
	27.0 tons

Thus theis field of studies is approximately 30 % more expensive than other fields of studies for executives without university training.

When training approximately 120 - 150 students in seminars and courses, in the Higher School for Plastics Technology probably 30 % of the available energy will be usedat the same time, i.e. approximately 200 kW. But this value is reached when facilities are made available in the hall for injection moulding and extrusion.

Compared with other technical schools, this not only creates an essential increase in technical personnel for maintenance but also higher energy costs. The required plastics material of approximately 25 - 30 tons per year has also to be mentioned in this context.

(b) Costs of studies

Studies are free in Austria. The Austrian state has to pay US$ 3,000 to 5,000 per year for each student for cost of materials and personnel. Therefore the total cost of studies when the student graduates after five years is approximately US$15,000, after three years US$12,000, and after the two years course US$10,000.

(c) Management requirements

As mentioned above, an optimum utilisation of staff and equipment is only achieved if the whole institute is ready to fulfill such demands as education, quality control and research.

The matrix organization described is a management method to achieve not only a high degree of efficiency but also interesting working conditions for staff.

With increasing industrilization many fields are concerned with undesirable accompanying phenomena such as "stress" chich can only be kept under control by constant revision of the organization. This form of organization includes an active participation of industry and trade, the support of which must be earned by the institute's full consideration of their problems.

According to our experience, national organizations alone will never achieve this dynamic operation. Industry and trade need a neutral testing station for obtaining advice, and vor carrying out researc and development projects.

The novel ideas gained in this manner are passed on to the students who are t thus better equipped for involvement in their chosen field.

Let us remember Ortega y Gasset's quotation: "Engineers should know that for being an engineer it is not enough to be an engineer". We should never forget that a transfer of know-how, of technological knowledge through lectures, demonstrations and discussions does not yield any useful results unless both sides are ready for real engagement.

Let us keep in mind that the future — including technical and economic developments — can only be mastered by a social policy that is definitely optimistic. The demand for a division of labour should be taken seriously in order to achieve a distribution of material and spiritual goods throughout the world. Our only chances for the future are to recognise that we all have to share only one common world.

APPENDIX

Table 1

LKT - Subject list for a 5-years course (secondary education) in plastics technology

Subject	Grade	hours per week I	II	III	IV	V	Total
Scripture		2	2	2	2	2	10
German		3	2	2	2	2	11
Modern foreign language		2	2	2	2	2	10
History and social sciences		1	2	2	2	-	5
Geography and economy		2	1	1	-	-	4
Civics		-	-	-	-	1	1
Political economy		-	-	-	1	-	1
Mathematics and applied mathematics		6	4	5	2	-	17
Computation engineering		-	-	-	2	-	2
Descriptive geometry		4	3	-	-	-	7
Physics and applied physics		4	2	2	-	2	10
Chemistry and applied chemistry		2	2	-	-	-	4
Plastics chemical technology		-	-	2	2	3	7
Mechanics		-	3	5	4	2	14
Machine units and construction exercises		-	6	6	-	-	12
Plastics mechanical technology		-	-	-	3	3	6
Plastics design		-	-	-	1	1	2
Plastics mechanical engineering and construction exercises		-	-	-	5	5	10
Finishing and corrosion protection		-	-	-	-	2	2
Mechanical technology		-	2	4	-	-	6
Machine tools		-	-	2	2	-	4
Electrical engineering		-	-	2	-	-	2
Control engineering		-	-	-	3	4	7
Organisation and calculation		-	-	-	-	2	2
Management and law		-	-	-	-	3	3
Mechanical drawing		3	-	-	-	-	3
Workshop practice		14	10	6	6	-	36
Plant laboratory		-	-	-	6	8	14
Chemical and physical laboratory		-	3	2	-	-	5
Works hygiene and prevention of accidents		-	-	-	-	1	1
Physical training		2	2	2	2	2	10
		45	46	46	46	45	228

Not compulsary subjects for the 2-years course

Second modern foreign language
Shorthand and typing
Additional physical training
Special topics
Chemical exercises
Exercises in physics
Working group for general practice

Table 2

LKT - subject list for the 2-years course (post secondary education) in plastics technology

Subject	hours per week		
grade	I	II	Total
Applied mathematics	3	-	3
Introduction to computation engineering	-	2	2
Physics of high polymers	-	2	2
Plastics chemical technology	2	2	4
Mechanics	4	2	6
Machine units and construction exercises	8	-	8
Plastics mechanical technology	3	3	6
Plastics mechanical engineering and construction exercises	5	5	10
Mechanical technology	2	2	4
Machine tools	-	1	1
Electrical and control engineering with exercises	3	3	6
Economics	-	3	3
Workshop practice	6	4	10
Plant laboratory	4	8	12
Environment protection and prevention of accidents	-	1	1
	40	40	80

Table 3

List of research projects

(RP = Research Project)

RP No.	Project title	RP No.	Project title
1	Burning behaviour	26	Rheology
2	Internal stresses	27	Micro-structure
3	Electrostatics	28	Ultra sound
4	Hollow bodies	29	Agriculture
5	Stress crazing	30	High pressure moulding
6	Extrusion	31	Reutilisation
7	Radiation	32	Powder resin
8	Vacuum forming	33	Construction of houses
9	Influence of temperature	34	Thermal behaviour
10	Reinforcing	35	Manufacture of apparatus
11	Trace analysis	36	Waste utilisation
12	Design	37	Plastics alloies
13	Control engineering	38	Quality optimisation
14	Polymers with high molecular weight	39	Corrosion by plastics
15	Elastomers	40	Production control
16	Polymer concrete	41	Abrasion
17	Corrosion	42	Insulating bandages
18	Low temperatures	43	Non-destructive testing of plastics
19	Dynamic behaviour	44	Processing analysis
20	Long term behaviour	45	Medicine in sport
21	Habitation units	44	Processing of structural foams
22	Molecular weight	45	Programmed training
23	Foams	46	Microscopy of electrons
24	Injection stamping	47	Cascade control
25	Drainage		

Grouping of projects in order of importance

Subject	Percentage	RP No
Engineering procedure	35 %	2, 4, 6, 8, 9, 13, 15, 18, 23, 24, 30, 32, 38, 40, 44, 46, 49
Applications	20 %	10, 12, 16, 21, 25, 29, 33, 35, 42, 45
Testing	15 %	5, 19, 20, 34, 28, 41, 43
Physics of polymers	12 %	3, 7, 26, 27, 37, 48
Polymer chemistry	6 %	11, 14, 22
Environment protection	10 %	1, 17, 31, 36, 39
Training methods	2 %	47
Total	100 %	

Research projects under work: 23, 25, 28, 34, 36, 38, 41, 42, 44, 46

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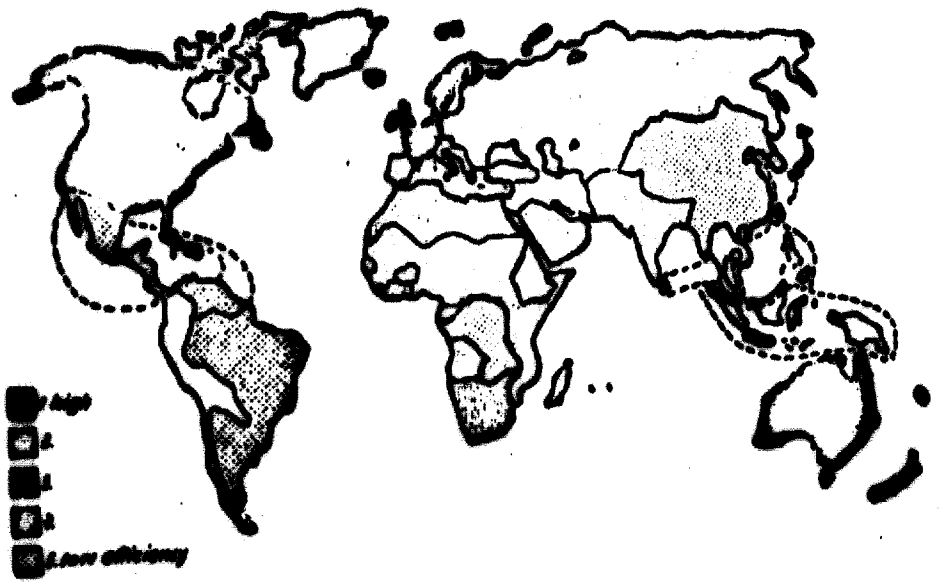


Fig. 1. Grouping of countries into large geographic zones according to the criterion of efficiency of education(2) (Courtesy H.MILLENDORFER, C.GASPARI)

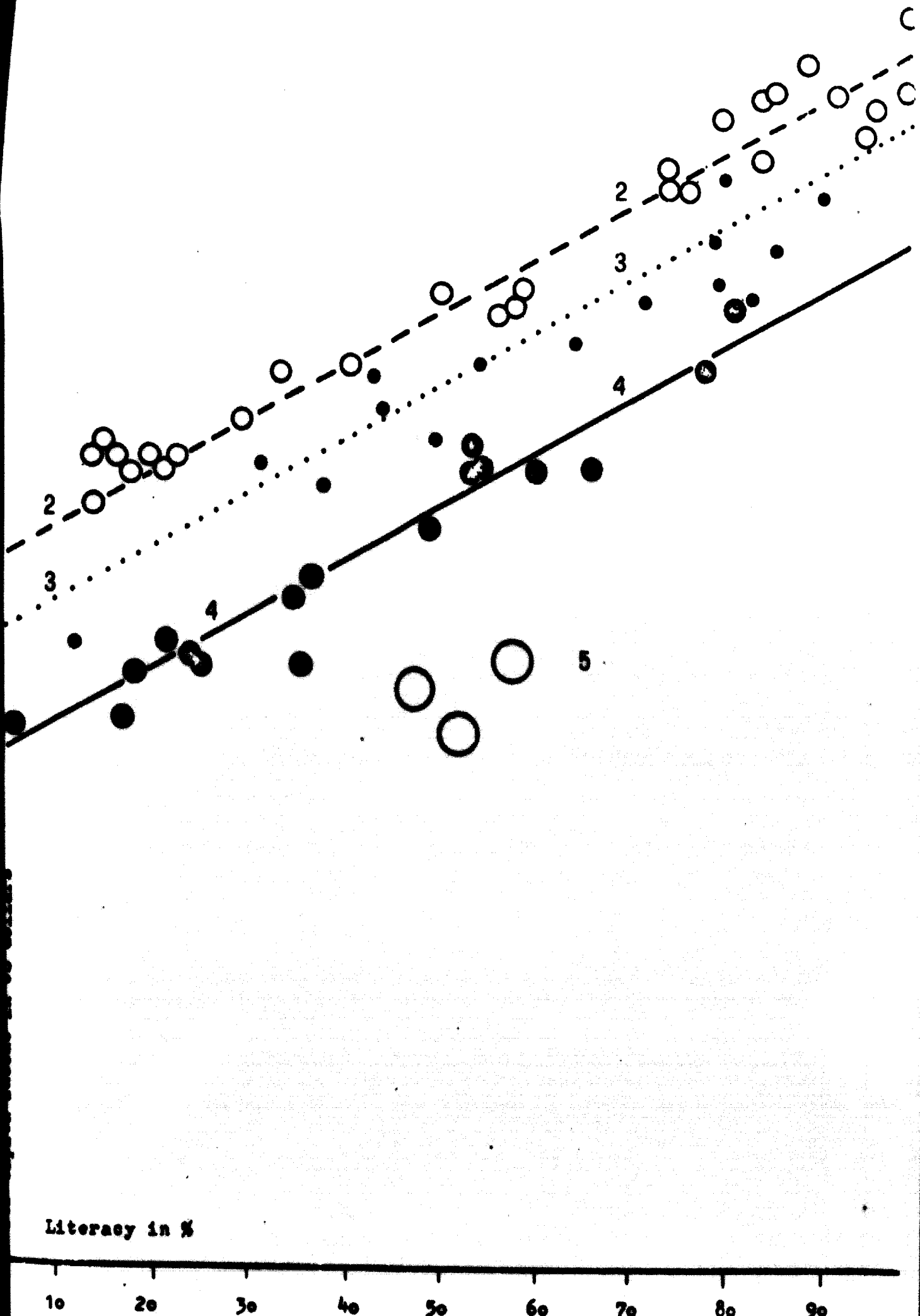


Fig. 2. Economic efficiency of education in developing countries (2)
(Courtesy H.MILLENDORFER, C.GASPARI)

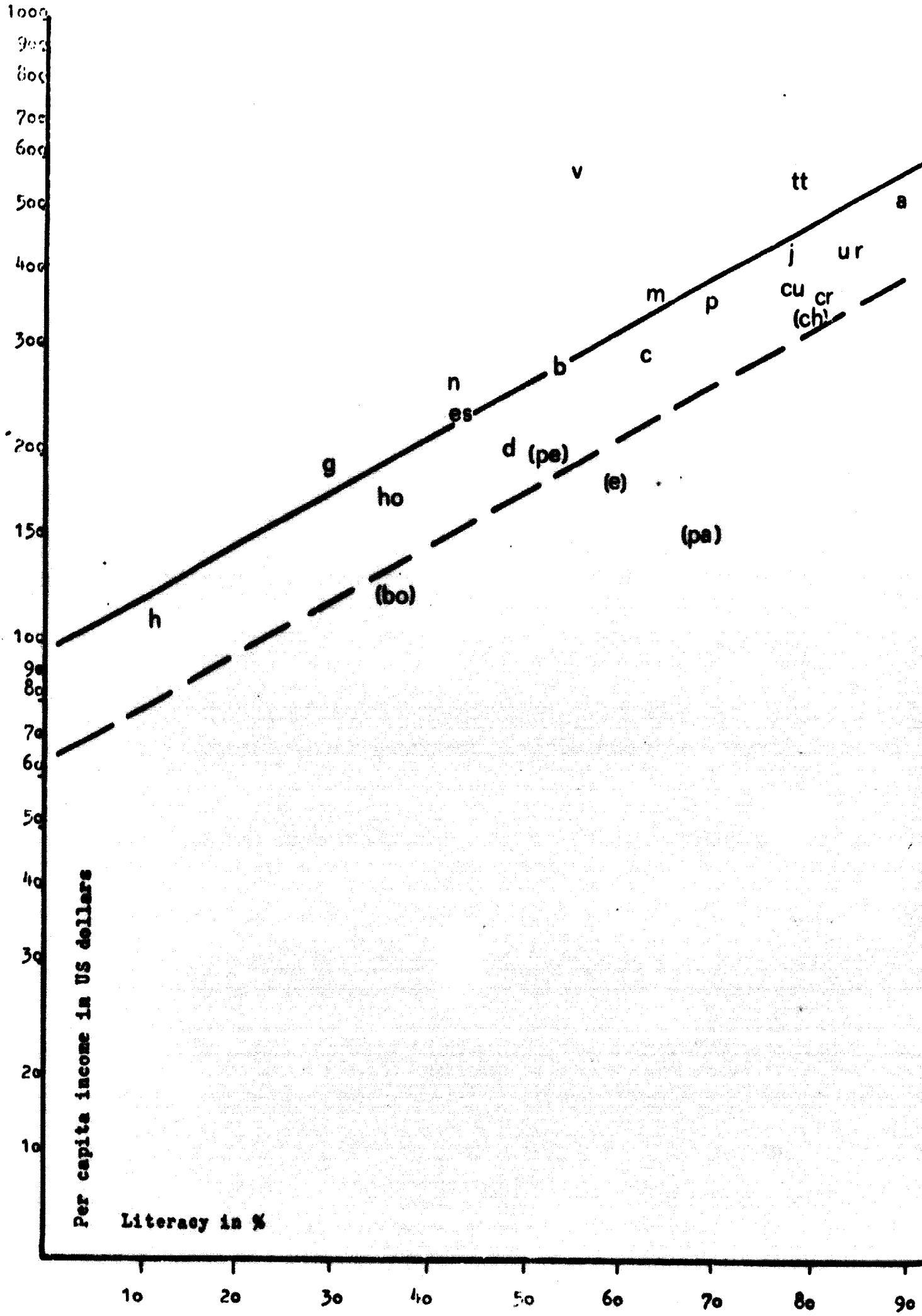


Fig. 3. Economic efficiency of education in latinamerica (2)
(Courtesy H.MILLENDORFER, C.GASPARI)

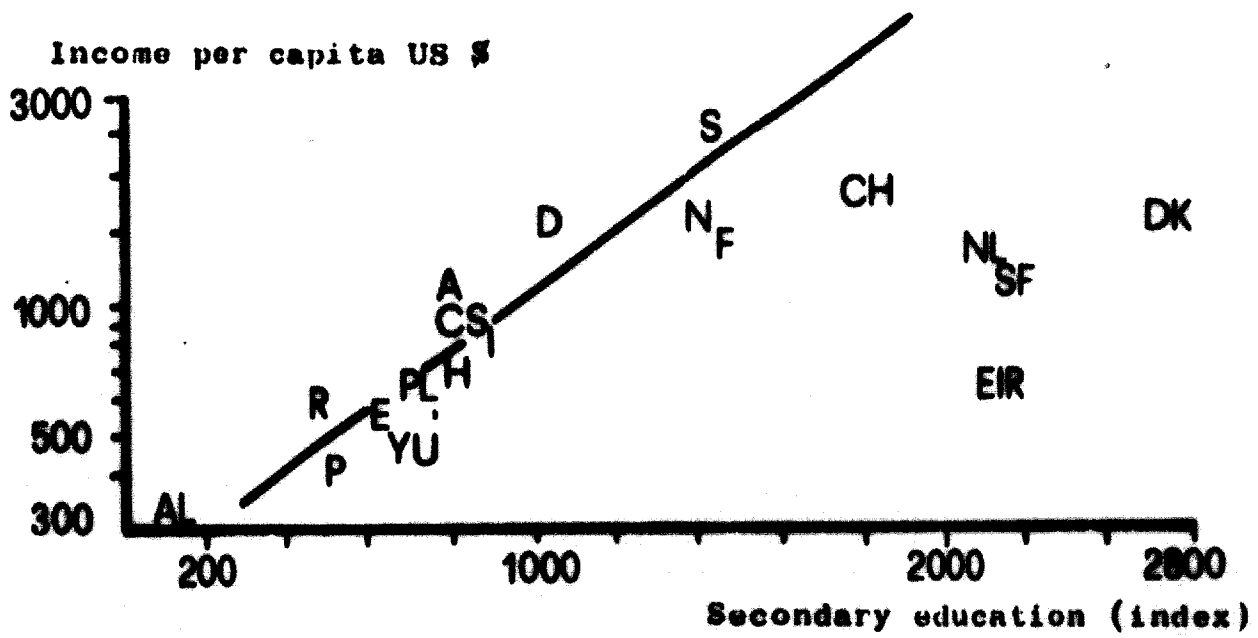


Fig. 4. Relation between per capita income and secondary education in Europe 1965 (1)
(Courtesy H.MILLENDORFER, C.GASPARI)

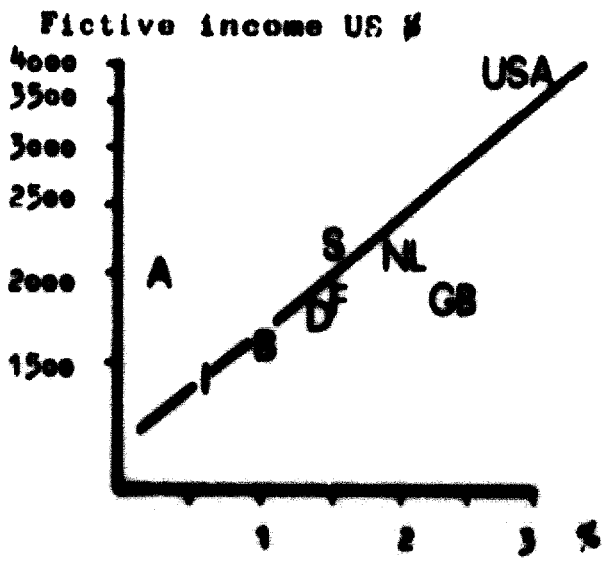
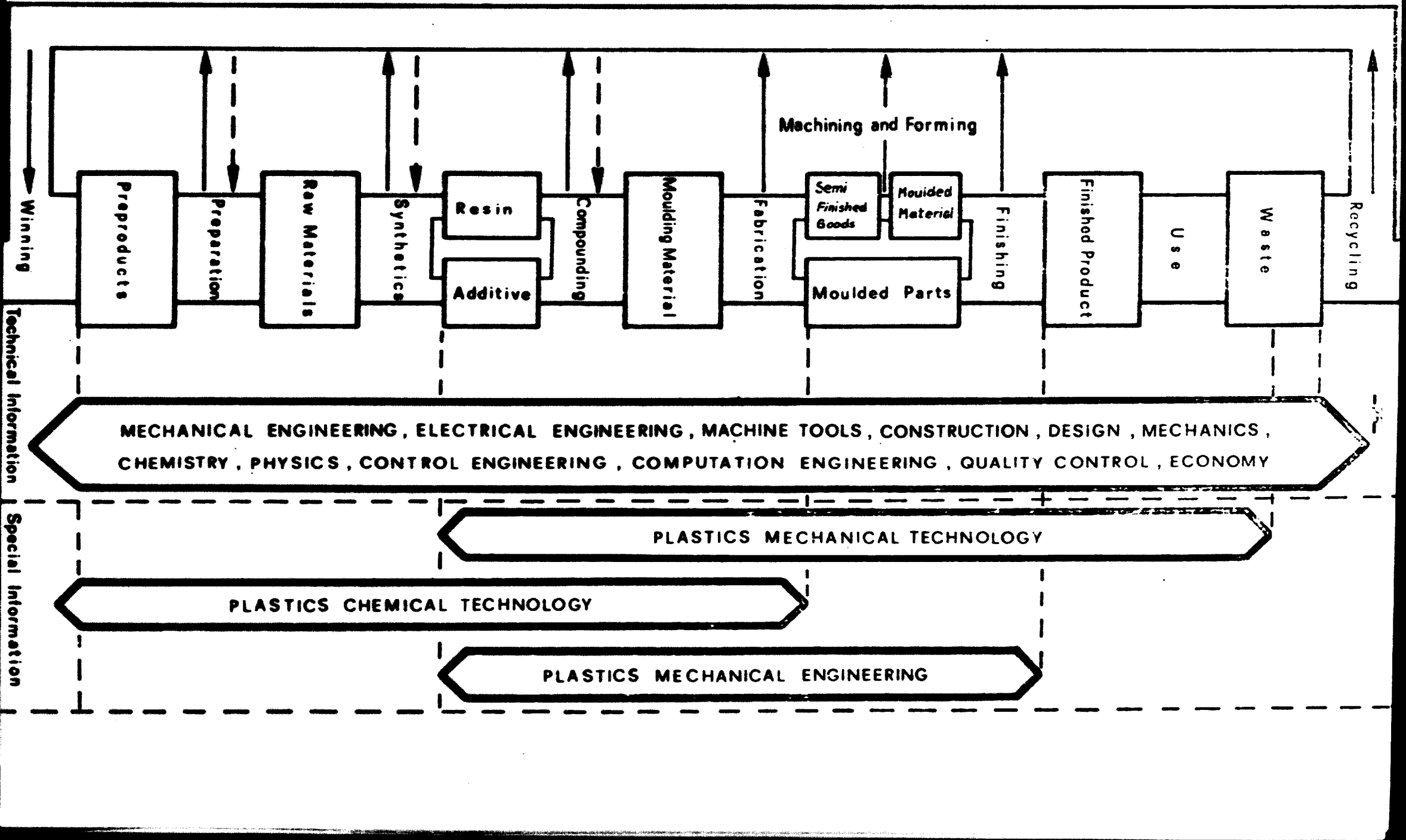


Fig. 5. Relation between capital- and education effort per capita (fictive income) and R&D effort in % of the national product (1) (H.MILLENDORFER, C.GASPARI)

Fig. 6: Subjects in plastics technology



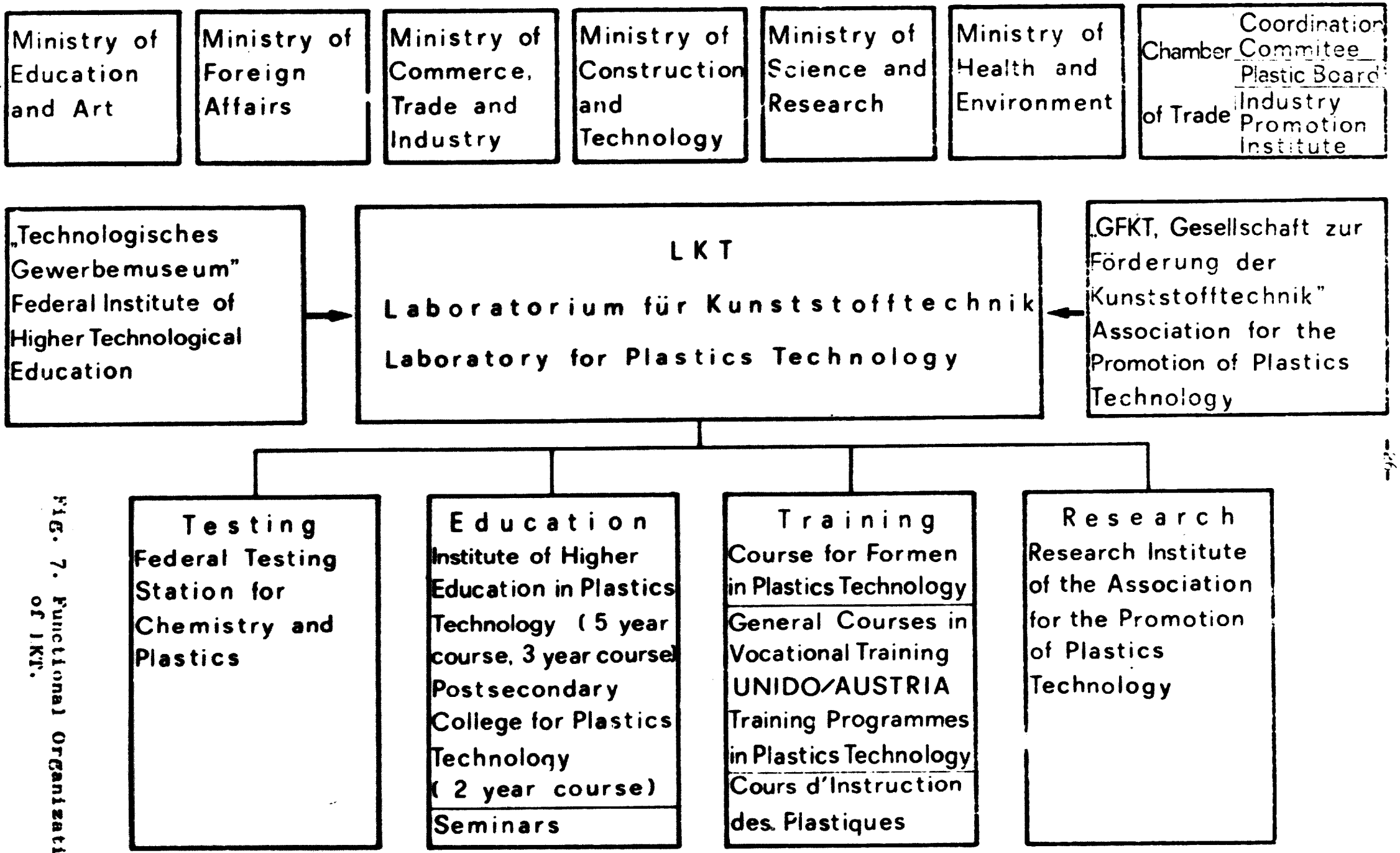


Fig. 7. Functional Organization of LKT.

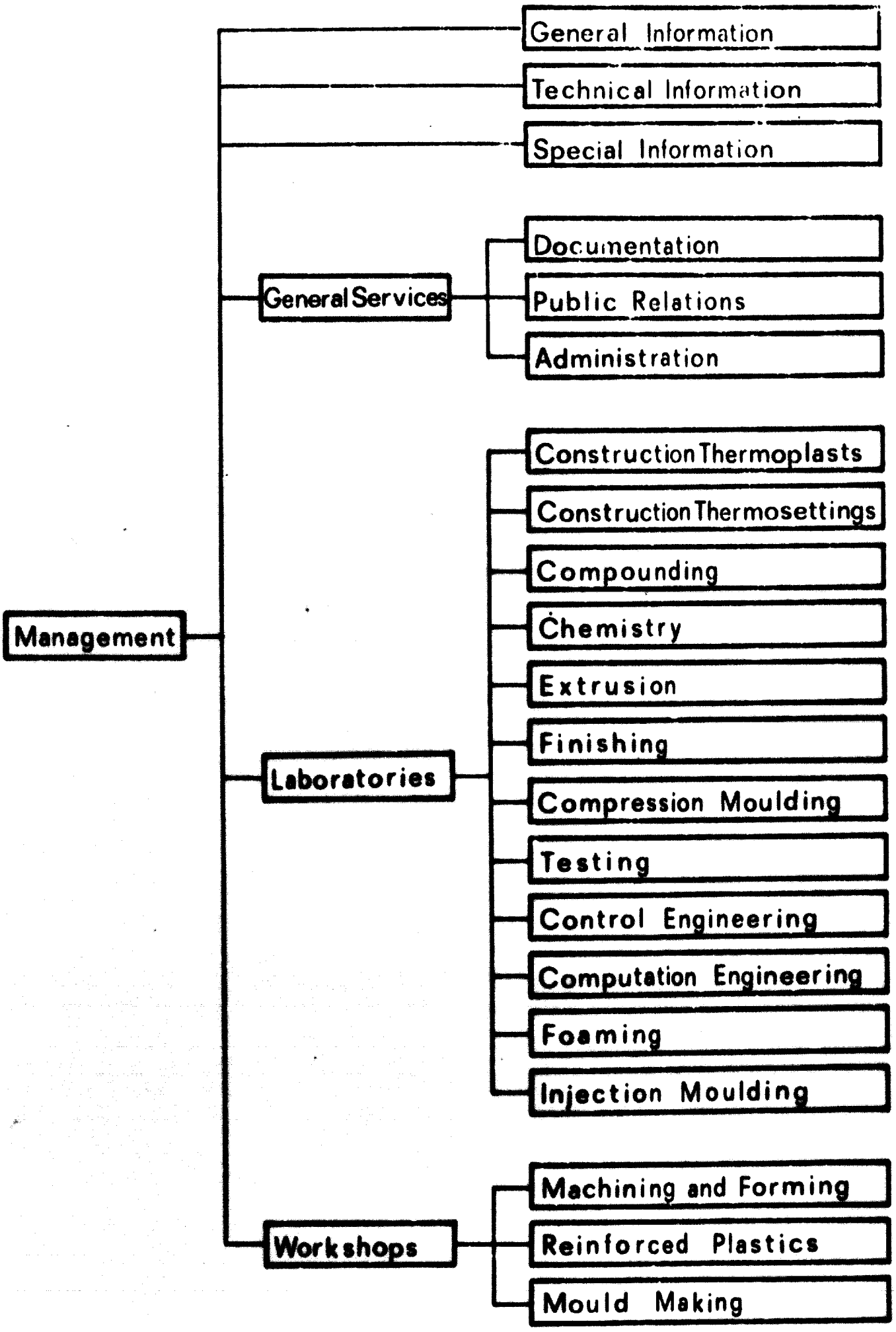


Fig. 8. Divisional Organisation of IKT

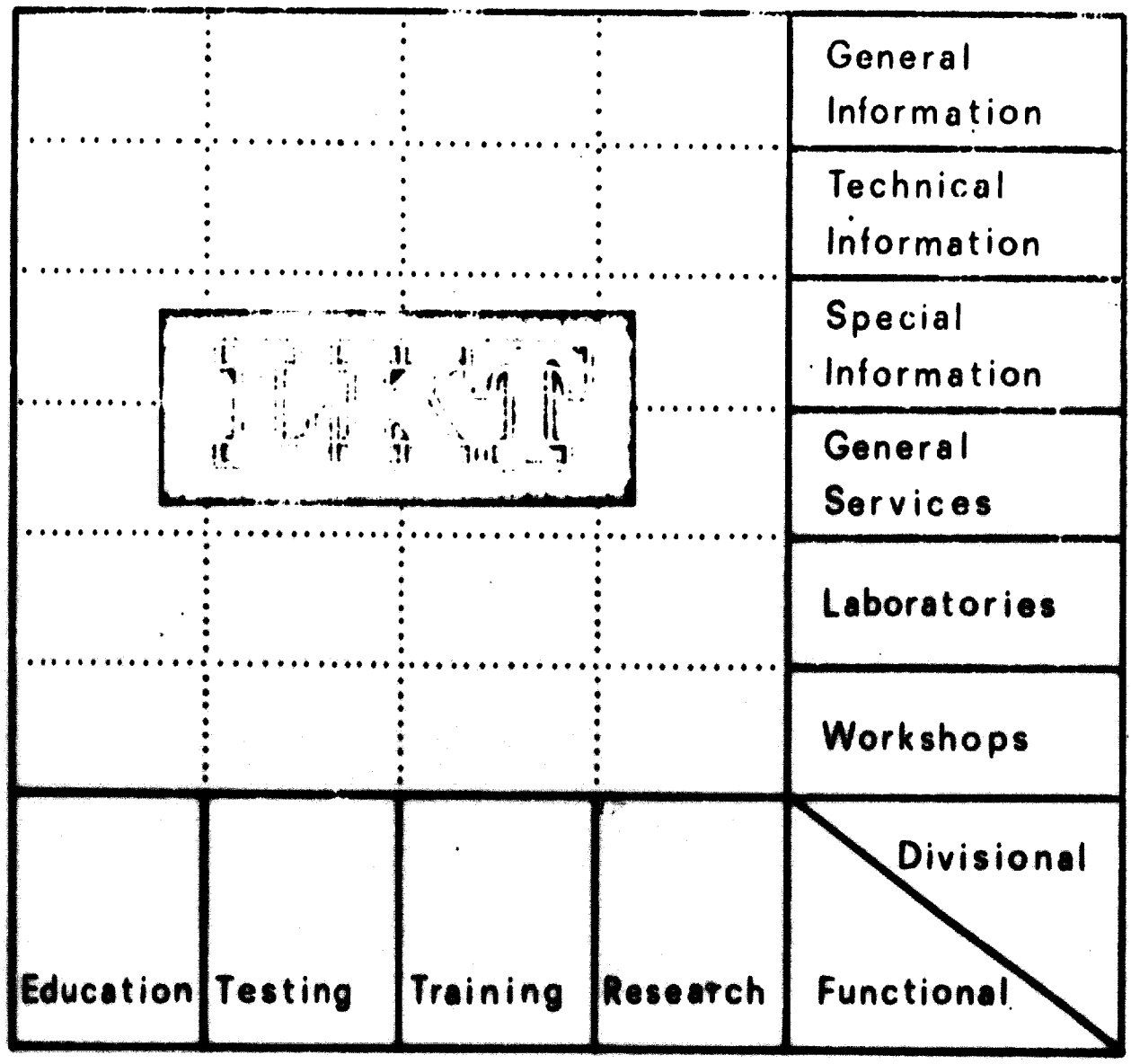
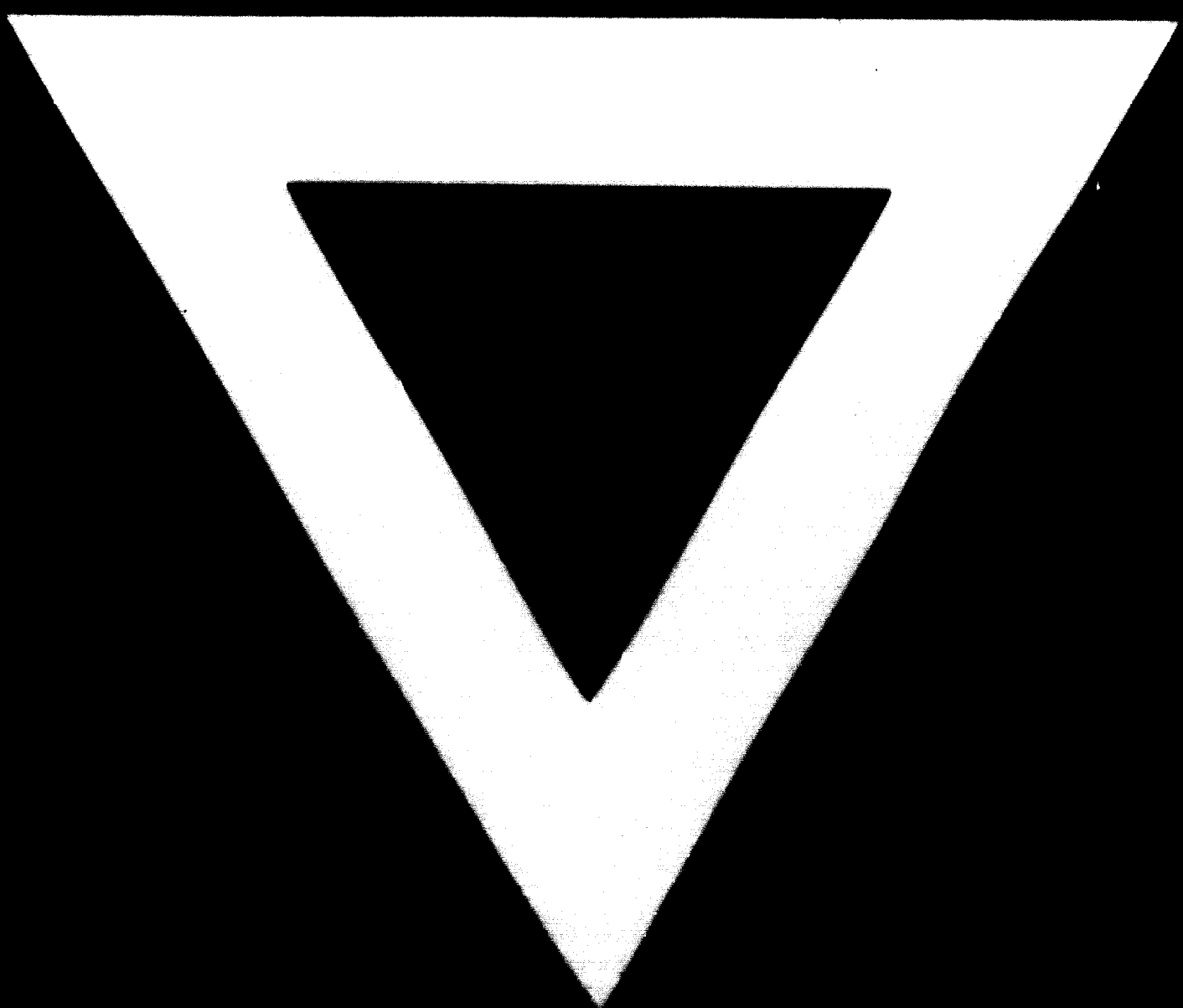


Fig. 9. Integrated Organisation of LKT



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