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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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SOME NOTES ON THE EVALUATION OF IN-PLANT TRAINING PROGRAMMES

by

Yap Kie-Hau

Contents:

The views and opinions expressed in this paper are those of the consultants and do not necessarily reflect the views of the Secretariat of UNIDO.

1. Introduction and summary.

A number of qualitative aspects are suggested in this paper for the evaluation of in-plant training programmes. In-plant training is here to denote those training programmes, where the trainees, except for some classroom instruction, devote the major part of their time on practical assignments in industry. These assignments may concern shopfloor- or plant-operating experiences as well as laboratory, engineering or organizational types of work. The common and essential feature, however, is the undertaking of these assignments while being exposed to real-life situations in industry. Special reference is made to the aspects of interests for the training of engineers from developing countries.

In the second chapter a brief description is given of the objectives and nature of in-plant training. In particular the training is considered of younger university-graduated engineers to various functions on the middle management level, such as research and development, design and technical staff, production management, sales-engineering and other semi-technical functions. The major evaluation criteria which can be evolved for such training programmes are discussed in the subsequent chapters.

The third chapter contains an enumeration of the professional subjects which are to be incorporated and the required degree of training-intensity. Four main areas of subjects are considered: technological, socio-economic, quantitative-analytical and managerial subjects. For the degree of training-intensity and also the selection- and admission requirements a scale with five levels is suggested.

The possible contributions of in-plant training to personality development are reviewed in the fourth and last chapter. In this chapter also the effects of real-life learning situations and the tutor-trainee relationship is discussed.

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2. In-plant training; its objectives and nature.

2.1. Basic aims.

Knowledge of technology and a readiness to apply its discipline as a basis for thoughts and actions is the attitude expected from the young qualified engineer upon entering his career in industry. Yet, a further maturity of these attributes must be anticipated as well as the development of perceptiveness for opportunities of application and for new development possibilities and tendencies. The latter requirement is on the one hand related to the economic changes continuously evolving and on the other hand to the rapid strides of technological advancement, which necessitate a continuous replenishment of the engineer's technological and scientific knowledge. Career requirements further pose special demands. Two major streams may in this connection be distinguished in terms of their ultimate goals: career-development towards senior professional functions and alternatively, towards senior executive functions. [1] The former requires the cultivation of originality of mind and of analytical powers. The latter, the career-development towards executive functions, demands a broadening and integration of technological abilities with economic and social knowledge and experience, and also the development of managerial skills. In both instances, though each with a different bias, personality development is further of essential importance.

2.2. Programme structure.

In-plant training aids the above development by systematically exposing the trainees to learning situations, which are of particular benefit to them at certain stages of the

[1] Note: for a more detailed description of career-pattern and personality-requirements, see "In-plant training for engineers" by Yap Kie Han, report prepared for the United Nations, November 1963.

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described careers. In particular the in-plant training will be considered of younger university-graduated engineers, who are expected to occupy - after the training - the following types of functions at the middle management level:

- research and development functions
- design, technical staff or consultative functions
- production-management functions
- sales engineering, industrial training and other semi-technical functions.

The process of in-plant training comprises a structured series of classroom instructions as well as practical work periods in workshop, laboratory and organizational staff departments. When conducted within the context of a certain company the in-plant training programme will to a major degree be oriented on those product- and process-aspects, which are representative for the company's specific technology. However, it is also possible to conceive in-plant training on a broader, collective basis for a number of different companies within the same or from different sectors of industry.

2.3. Duration and manner of tuition.

Abovementioned in-plant training programmes may - depending on environ-mental factors and specific objectives to be achieved - vary in duration from several months upto one and a half year or even longer. This relatively long period allows a programme-structure, which is not only aimed at group-instruction of subjects of common interests, but should preferably also incorporate a substantial element of individualized tuition.

The group-instruction may cover a number of different subjects. Some common ones are the introduction of the company's or industries' productprogramme-range, of certain specific manufacturing processes and standards and the training in socio-economic and managerial subjects.

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It is desirable, and as a matter of fact a main objective of in-plant training, to expose the trainee during the practical work periods to real-life situations and to engage him in assignments with some real practical value. In this manner a high degree of personal involvement on the part of the trainee can be attained. It requires, however, also that special attention is given to the interaction between such a learning situation and the trainee concerned. This can only be attained through individualized tutorship, which may not only cover abovementioned periods of practical work, but may also concern theoretical instruction in subjects, which are of special interest either to make up a certain shortcoming in the trainee's background or to equip him in view of special requirements of a future function.

2.4. Specific functional objectives and prerequisites.

Each of the tasks for which the in-plant trainee is being prepared, poses its specific demands. The major requirements related to the abovementioned functions on the middle management level will be briefly reviewed below:

(a) Research and development functions.

Originality, creativeness and inventiveness are personality characteristics specifically required for research and development functions. Candidates must further possess a good scientific background and a perceptiveness, which in the process of in-plant training is to be developed towards an apprehension of those innovation-aspects, which are of special significance to the company or industry concerned.

(b) Design, technical staff and consultative functions.

Creativeness and analytical ability, yet with a pronounced aptitude for achieving practical solutions is a main characteristic, which candidates for design,

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technical staff and consultative functions must possess. This aspect of practical realization requires a pragmatic outlook, which must be amplified in the process of in-plant training by different situational experiences and by the development of various analytical, computational and communicative skills.

(c) Production management functions.

Organizational and executive abilities, i.e. to anticipate, plan, decide and control production-activities as well as influence and guide human actions are qualities desired in candidates for production management functions. The candidates should further possess a natural cost-consciousness. In-plant training is to sharpen these abilities and to acquaint the candidates not only with the products and processes in use, but also with the situations, which may most likely occur, and the manner in handling such situations.

(d) Sales-engineering, industrial training and other semi-technical functions.

A natural interest in associating technology with other fields of knowledge is a characteristic of candidates for semi-technical industrial functions. In the field of sales-engineering it is the aptitude for commerce and in the field of industrial training for the process of impartation of knowledge to others. In-plant training acquaints the candidates with the products, situations or other objects on which such a combination of knowledge is valuable and imparts the approach and methods applicable.

The abovementioned requirements and objectives also apply to the in-plant training in industrially advanced countries of engineers coming from developing countries. An extra dimension is, however, added. For, the trainees of developing countries are expected to abstract the knowledge and experience gained

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and subsequently judge its technological as well as socio-economic applicability in the environmental situation of their home-country. This factor also poses its specific demands on the programme structure and methods of training.

2.5. Areas of programme-evaluation.

From the above brief review of the objectives and the nature of in-plant training, two major areas may be evolved for evaluating specific in-plant training programmes:

- The first area concerns the professional subject-content, its technological scope and functional-orientation, and the degree of practical proficiency it is expected to generate.
- The second area concerns the possible contributions of the in-plant training programmes to the personality development of the candidates and their prospective career-development patterns.

These two areas of evaluation will be considered in more detail in the next two chapters, also from the point of view of applicability to engineering-trainees from developing countries.

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3. Evaluating the professional subject-contents of inplant training programmes.

3.1 Main subject-areas and desired levels of proficiency.

Four main areas of professional subjects are constituting the core of inplant training programmes for younger university graduated engineers proceeding towards the abovedescribed functions at middle management level. These subject-areas are :

- technological subjects
- socio-economic subjects
- quantitative-analytical subjects
- managerial subjects

These four areas will be described below in more detail. Also a relative assesment is made of the degree to which the various subjects should be incorporated in the inplant training programme. Five levels of ascending importance will in this respect be distinguished :

- O = zero, no specific knowledge required
- B = basic knowledge required as can be expected from the preceding scholastic education, or altenatively denoting, that only some basic understanding needs to be imparted in the course of the inplant-training.
- I = intermediate level)
- A = advanced level) levels of increasing proficiency aimed at during the process of
- M = maximum level) inplant training.

The M(aximum)-level is the highest degree of proficiency, which can be expected as a result of the inplant training programme. Obviously, this maximum-level applies only to selected subject-requirements in view of certain functional objectives. For the remainder of the subjects the A- and I-levels are to be considered, and also the B-level if only imparting of basic understanding is necessary.

The same levels, and inparticular the O-, B- and I-levels, may be applied to define the selection- and admission-requirements. In annexes I and II two examples are given

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of evaluation-profiles of inplant training programmes oriented towards design- and production-management-functions respectively.

3.2 The technological subject-contens.

The technological subjects concern product-knowhow, process-knowhow, research-and-development-abilities, design-abilities and operating abilities.

The product-knowhow is company- or industry-oriented. Only in rare instances this product-knowhow is attained during the professional education, though design-abilities may have been extensively instructed. The latter would particularly relate to principles governing the functional design of products, knowledge of materials, computational methods and procedures and other general design and drawing practices and techniques. The specific product-characteristics are, however, in general to be learned during the engineer's career in industry, after completion of his scholastic education. Product knowhow is therefore a specific element to be incorporated in inplant-training. For corporate programmes an advanced level is necessary for all trainees, whereas candidates for the design-functions should on this subject be exposed to the maximum degree.

Similarly, a maximum-level of process-knowhow is required for candidates formproduction-management functions, whereas an advanced or intermediate level may suffice in the case of candidates for other functions.

As the younger engineers are all, though to a varying degree, expected to contribute to the technological advancement, experimentation and research procedures should also be part of their inplant training programmes. In this instance a maximum degree is applicable to the candidates for research and development functions. Training in research- and development methods is also particularly valuable for engineers from developing countries obtaining training in industrially advanced countries. For, these engineers will have to acquire

a substantial insight in the influence of environmental factors on the application of various technologies (products as well as processes) in their home-countries. To aid them in experimenting with technical novelties and introducing new products and processes under different socio-economic conditions it is desirable to aim for this group of engineers at imparting an intermediate, and preferably an advanced level of proficiency in research and development practices.

The engineers are not expected to undertake themselves in their future functions productive operating activities. A certain degree of practice is however indispensable, and may vary from a basic level for research-candidates to an intermediate or even advanced level for production management-candidates. Apart from its professional training merits, these operating-experiences during their inplant training are also valuable to breakdown the white-collar-barrier, which in the present stage of technological advancement and automation becomes more and more incongruant with the nature and spirit of industry.

3.3 The socio-economic subject-contents.

The training in socio-economic subjects aims at imparting an awareness of the specific environmental conditions in which industry operates, and also at instructing in the use of certain socio-economic methods and practices. The main subjects relate to the fields of costs, instruction, communication and commercial relations.

A good insight in costs is a fundamental requirement, which should in particular be emphasized to the maximum degree for production-management candidates. The latter will also require a maximum of training in instructional and communicative abilities.

A maximum degree of training in commercial, and also in

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communicative skills, should be imparted to prospective sales-engineers, who will also require a fair amount of instructional abilities and a well-developed cost-consciousness. Exposure to these socio-economic subjects is also essential to candidates for research-and-development-functions and for design- and other technical staff functions. Apart from understanding the environmental framework within which their functions have to be executed, proficiency in these socio-economic abilities is also vital for integrating their technical-oriented work with the other aspects of the industrial enterprise and in implementing practical results.

3.4 The quantitative-analytical subject-contents.

Sharpening of the analytical abilities is an essential part of inplant training, in particular to improve the trainee's perceptiveness towards change, both changes of a technological as well as of a socio-economic nature.

Furthermore training in methods for systematic analysis and for solution-development is desirable. In this respect, each function will require its own specific techniques, such as laboratory-analysis-and-testing-methods for research-functions, or industrial engineering techniques for production-management-functions, or market-research-methods for sales-engineering-functions. Common elements in all these techniques are, however, the methods for deriviation of optimum-solutions, system-engineering (analysis as well as rationalization of procedures) and dataprocesseing (methods and devices applicable). To trainees from developing countries a study of historic replication may be of particular value. The historic replication methods aims at deriving from a study of industrial history, those experiences and elements which are valuable to an environment at a less advanced technical and economic level, and subsequently aims at developing a replica-pattern, not a duplicative one , which may facilitate an accelerated rate of advancement.

3.5 The managerial subject-contents.

A good comprehension of the planning, decision-making and control-elements characteristic for the managerial function is indispensable for all trainees. This insight must extend to the various levels of the management hierarchy and the powers and the limitations inherent to each level. A certain degree of practice in these managerial processes should also be incorporated, e.g. through role-playing. To candidates for the more operative types of functions (production-management or sales) practice under real-life situations is desirable, e.g. through seconding executives and possibly even substituting them during short periods of time. Furthermore the completion within the period of in-plant training of a full cycle of planning, executing and controlling the implementation of an industrial activity is to the trainee an invaluable experience, even if the assignments do not always lead to fully successful practical results. The above-described insight, and preferably also the practical experiences in managerial functions, is too of great value to trainees from developing countries, where managerial talents are in general very scarce.

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4. Evaluating the contribution to personality development and the training methods employed.

Besides imparting professional instruction and practical experiences, in-plant training also aims at contributing to the personality development of the young engineer.

In the first place it aims, as already previously referred to, at developing perceptiveness and interests of the young engineers. It involves the sharpening of his awareness and alertness and also the elimination, or at least the lessening of obstruent barriers from mental inhibitions and biases.

Another factor, which has also been previously touched upon, is the contribution of in-plant training towards a sharpening of the analytical abilities of the trainee. This implies that the training programmes - in spite of their practical nature - should not contain too many elements of simple routine. Preferably, the practical exercises - also on shopfloor-level - should all have some intellectual challenge built into them. It is also possible to differentiate this secondary, but essential element according to the various functional interests, such as including in a practical w rkshop assignment for prospective researchworkers a small experimentation or in tasks allotted to prospective design-engineers a product-development feature. These instances are illustrative for the great variety, which can be incorporated in the assignments in order to avoid an undesirable overdose of routine, and to cultivate those analytical abilities as desired in view of the future functional task-requirements of the trainees.

As a third factor the development of organizational abilities is to be considered. Though largely dependent upon the personal qualities of the individual, the process of in-plant training may contribute to a general improvement in the systematic approach towards solving problems within the context of a company's organizational structure.

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Character and disposition are two other elements, which may be influenced by exposure to certain learning situations and by appropriate guidance. In particular the improvement of personal qualities for teamwork and interlinked with it the improvement of emotional stability are elements to which in-plant training programmes may contribute, as a varied scala of real-life learning situations may be construed in the programme. It may also contribute to the fostering of some other personality characteristics, such as natural leadership traits, or possibly also the development of positive aggressiveness as required for sales engineering functions.

The improvement of endurance is another element of importance to in-plant training. It may be assumed, that all candidates are selected upon admission to the training programme on their physical as well as mental aptness. Yet, the in-plant training programme should cultivate this fitness further in order to prepare the trainees for the strains, which are inherent to the responsibilities of their prospective functions. When shift-work is applicable, adjustment towards working-hour requirements may also be a special point to be noted in this respect.

The potential learning effects of environmental change is in a maximum manner attained in the case of engineers from developing countries, who are for the first time receiving in-plant training in an industrially advanced country. The in-plant situation brings them into a close personal involvement with the industrial setting, and on off-training hours with the socio-economic environment. Much of this learning potential is lost when the training is restricted to the confines of special training workshops and when the trainees are housed in special dormitories both exclusively assigned to them. These latter situations filter out the possibilities for observing the continuous stream of technological developments and activities which constitute the daily life within the industrial enterprise and for noticing its direct and indirect effects on the advancement of the society. These observations are essential elements in the per-

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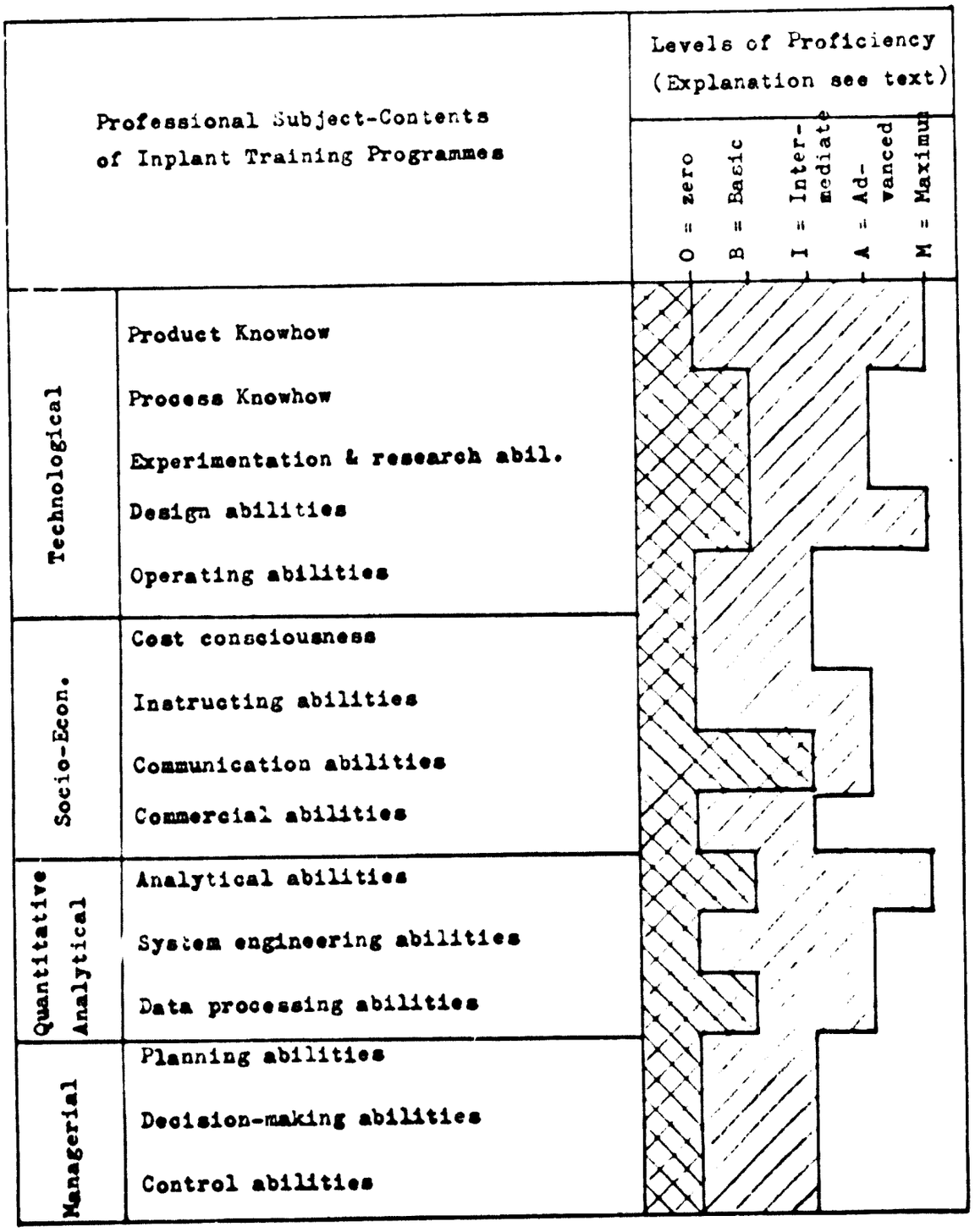
ception process of the trainee, his conceptualization of industrial advancement, its possible pitfalls and contributions, the consolidation of his personal impressions and the integration of new percepts into his pattern of thought and motivation and the evolvement of his resolution to apply the knowledge and experience gained.

To the above in-plant learning process the effective guidance from a well-qualified tutor may substantially contribute. A laisser-faire-laisser-passer attitude should be avoided, also - or rather, in particular - in the periods of practical work. The tutor should rather act as an advisor allowing the trainee to bear the largest possible degree of responsibility for the results of his assignment; yet, following him closely, correcting him on possible points of shortcomings and preventing him to make irreparable blunders, pointing out new avenues for further improvement, avoiding mediocrity and encouraging efforts to attain an even higher degree of excellence. To provide this guidance, the tutor possesses in the structuring of the trainee's inplant training programme and in formulating the specific assignments of which it is constituted, a training tool, in which a high degree of refinement can be developed and which provides an important measure to judge the quality of the in-plant training programme.



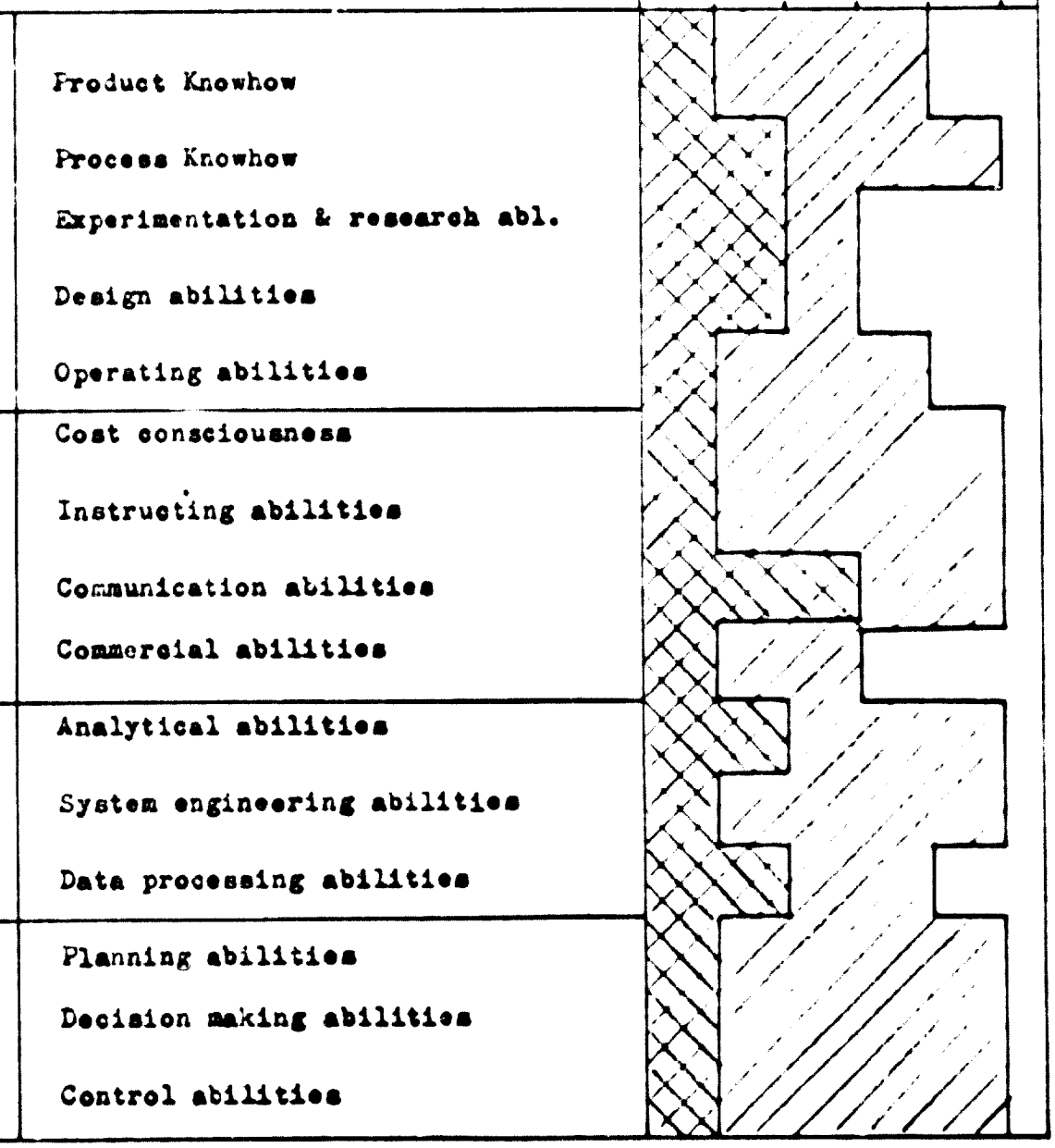
= Selection and Admission requirements

= Inplant training Objectives

Example Evaluation-Profile Professional Subject-Contents Inplant Training Programme for prospective

D E S I G N - E N G I N E E R S

	Professional Subject-contents of Inplant Training Programmes.	Levels of Proficiency (Explanation see text)
Technological	Product Knowhow Process Knowhow Experimentation & research abl. Design abilities Operating abilities	
Socio-Econ.	Cost consciousness Instructing abilities Communication abilities Commercial abilities	
Quantitative Analytical	Analytical abilities System engineering abilities Data processing abilities	
Managerial	Planning abilities Decision making abilities Control abilities	

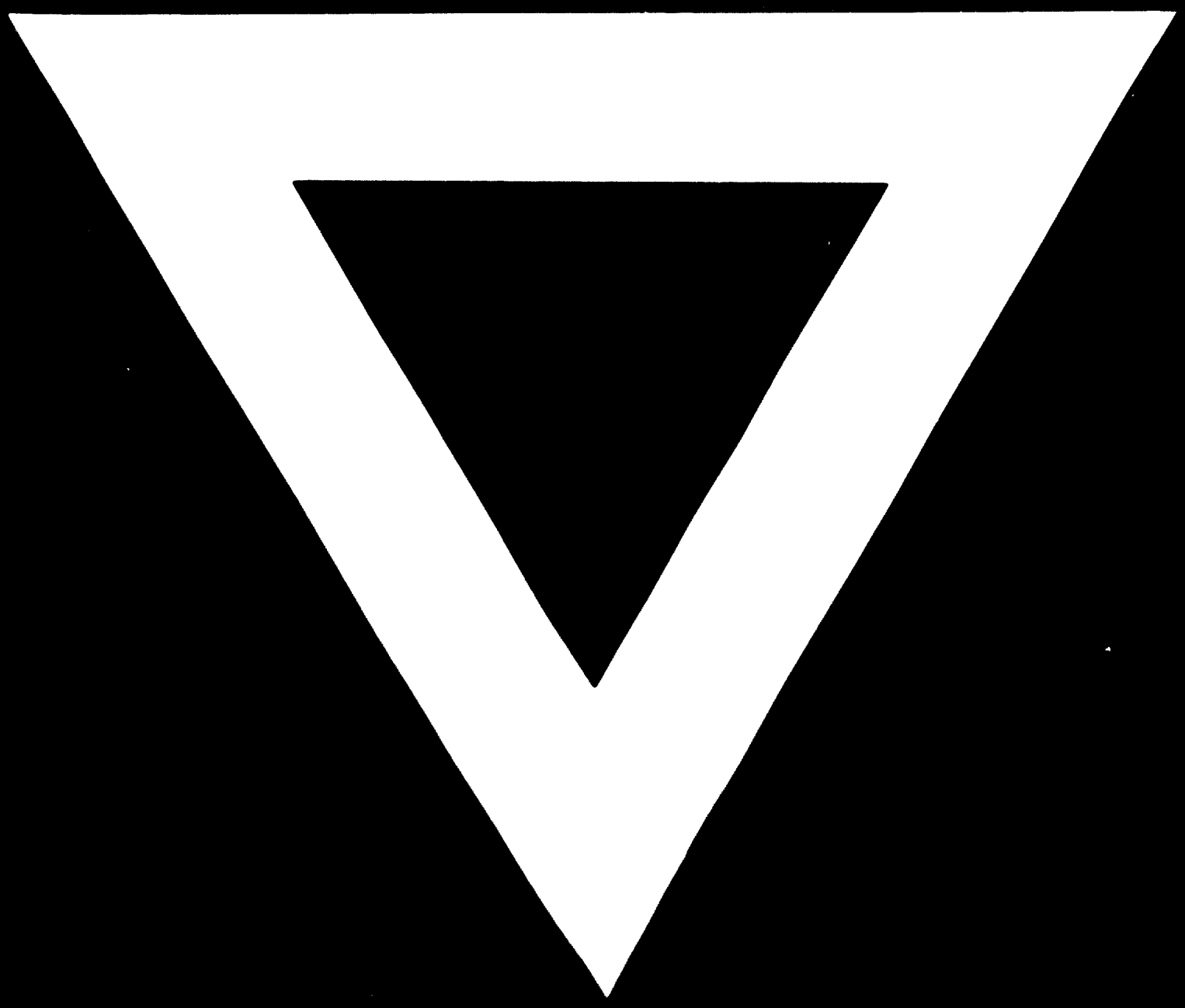


= Selection and Admission requirements

= Inplant training Objectives.

Example Evaluation Profile Professional Subject Contents
Inplant Training Programme for prospective

P R O D U C T I O N - E N G I N E E R S



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