INFORMATION TO USERS

This was produced from a copy of a document sent to us for microfilming. While the most advanced technological means to photograph and reproduce this document have been used, the quality is heavily dependent upon the quality of the material submitted.

The following explanation of techniques is provided to help you understand markings or notations which may appear on this reproduction.

1. The sign or "target" for pages apparently lacking from the document photographed is "Missing Page(s)". If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting through an image and duplicating adjacent pages to assure you of complete continuity.

2. When an image on the film is obliterated with a round black mark it is an indication that the film inspector noticed either blurred copy because of movement during exposure, or duplicate copy. Unless we meant to delete copyrighted materials that should not have been filmed, you will find a good image of the page in the adjacent frame. If copyrighted materials were deleted you will find a target note listing the pages in the adjacent frame.

3. When a map, drawing or chart, etc., is part of the material being photographed the photographer has followed a definite method in "sectioning" the material. It is customary to begin filming at the upper left hand corner of a large sheet and to continue from left to right in equal sections with small overlaps. If necessary, sectioning is continued again—beginning below the first row and continuing on until complete.

4. For any illustrations that cannot be reproduced satisfactorily by xerography, photographic prints can be purchased at additional cost and tipped into your xerographic copy. Requests can be made to our Dissertations Customer Services Department.

5. Some pages in any document may have indistinct print. In all cases we have filmed the best available copy.
KLANGVHISAI, SUKITI

A GRADUATE INDUSTRIAL DESIGN EDUCATION FOR THAILAND: A
DESCRIPTIVE STUDY OF CURRICULUM PLANNING AND
DEVELOPMENT

The Ohio State University

Ph.D. 1981

University Microfilms International 300 N. Zeeb Road, Ann Arbor, MI 48106
A GRADUATE INDUSTRIAL DESIGN EDUCATION FOR THAILAND:
A DESCRIPTIVE STUDY OF CURRICULUM
PLANNING AND DEVELOPMENT

Dissertation

Presented in Partial Fulfilment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of the Ohio State University

By

Sukitti Klangvhisai, B.F.A., M.I.D.

* * * * * * *

The Ohio State University
1981

Reading Committee: Approved by:

Prof. Kenneth A. Marantz (Chairman)
Prof. Willis E. Ray
Prof. Haig Khachatoorian

[Signature]
Adviser
Department of Art Education
ACKNOWLEDGMENT

It is my wishful opportunity to express with sincerity my deepest appreciation and gratitude to the faculty members of The Ohio State University who throughout my years of residency have guided me with patience and understanding, and provided this study with unfailing support and valuable advice. Special recognition is due to:

Professor Kenneth Marantz, Chairman of the Department of Art Education, Chairman of the general examination and of the reading committee, my academic adviser, a competent humanistic and resourceful educator and administrator, without whom this study would not have been possible.

Professor Willis E. Ray for his inexhaustive and intelligent advice in the field of industrial technology.

Professor Haig Khachatoorian for his resourcefulness and expert comments in the field of industrial design.

Professor Arthur Efland for his marked expertise in the field of art education and evaluation.

Appreciation is duly acknowledged to Chulalongkorn University and the Faculty of Architecture for awarding me the post graduate scholarship and granting me study leave. Distinct gratitude and appreciations to Professor Khrisda Arunvongse of the Faculty of Architecture and Professor
Lert Urasyanandana of the DFA for their initial encouragement and support.

Appreciations are extended to the Department of Labor Statistics, Bangkok, with special recognition for services and information afforded for this study by Dr. Sarawut Paitoonpongse.

Dr. Suwan Choakmungmee, Dr. Sukhum Srithunratana, and Dr. Pramote Chanekarn of the Ministry of Education and Dr. Vichit Chareonpatra of the Department of Industrial Design, Chulalongkorn University, for providing this study with the research material and advice.

Special recognition is extended to the writers of the professional literature, and especially L.B. Archer and N. Potter whose writings were most beneficial. Also, appreciation and recognition are extended to publications by E.R. Towers, et al., of the IACP., R.L. Gysler, et al., of the Division of Design, and A. Gomez of the Department of Design Research, Royal College of Art, England. The structure and format of their curriculum project development were invaluable assets in providing guidance for this study.

Finally, my deepest gratitude and appreciation are expressed to my parents, my wife, and all in the family. It is almost a sinful act in our culture, and certainly a defeat of purpose, to submit this acknowledgment without
recognizing a very special group of people, filled to their hearts with love, care, support, encouragement, and blessing, who may be invisible in this study, but who are not only very much a part of it, but very much a part of my being.

S.K.
VITA

May 31, 1941 ........ Born - Bangkok, Thailand
1974 ................. M.I.D., Industrial Design, Pratt Institute, Brooklyn, New York (USA)
1981 ................. Ph.D., The Ohio State University, Columbus, Ohio (USA)

Experience:

Ten and One Half Years Varied Experience in Teaching and Research and Development for the Institutional and Industrial Applications in the Field of Industrial Design with the Following Firms:

197 -Present ........ Teaching Staff, Department of Industrial Design, Faculty of Architecture, Chulalongkorn University, Bangkok (Thailand)

Fields of Study:

Major Field: Industrial Design Education
Minor Fields: Landscape Architecture
Environmental Design
Product Design
Computer Science

Studies in Industrial Technology. Professor Willis E. Ray
Studies in Art Education. Professor Kenneth A. Marantz
Studies in Design Research. Professor Haig Khachatoorian
TABLE OF CONTENTS

ACKNOWLEDGMENT ii
VITA v
LIST OF TABLES x
LIST OF FIGURES xi

CHAPTER

I. THE PROBLEM 1

Background 1
Introduction to the Problem 4
Statement of the Problem 7
Objectives of the Study 7
Significance of the Study 8
Limitations of the Study 11
Assumptions of the Study 12
Definition of Terms 13
Research Methodology 14
Presentation Format 16

II. PROGRAM FORMULATION 17

Rationale 18
Needs: The Term Requiring Further Clarifications 20

PART I. THE RELEVANCE OF NATIONAL ECONOMIC DEVELOPMENT NEED 23

Identification of Priority Development Objective 23
The Needs of the Economy 28
The Demand for Manpower 33
The Kind of Needs 34
The Degree of Needs 38

PART II. IMPLICATIONS FOR THE PROPOSED EDUCATION: INSTITUTIONAL CONSIDERATIONS 41
<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>III. FIXING EDUCATIONAL OBJECTIVES</td>
<td>45</td>
</tr>
<tr>
<td>Rationale</td>
<td>46</td>
</tr>
<tr>
<td>The Functions of the Industrial Designers</td>
<td>48</td>
</tr>
<tr>
<td>Design Function</td>
<td>49</td>
</tr>
<tr>
<td>Research Function</td>
<td>49</td>
</tr>
<tr>
<td>Technical Design Production Functions</td>
<td>50</td>
</tr>
<tr>
<td>Commercial Functions</td>
<td>50</td>
</tr>
<tr>
<td>Managerial and Administrative Function</td>
<td>51</td>
</tr>
<tr>
<td>Other Functions</td>
<td>52</td>
</tr>
<tr>
<td>The Structure of the Economy</td>
<td>53</td>
</tr>
<tr>
<td>Effects of Technological Change</td>
<td>54</td>
</tr>
<tr>
<td>Educational Objectives: A Desired Model of Graduating Industrial Designers</td>
<td>55</td>
</tr>
<tr>
<td>IV. EDUCATIONAL CONSIDERATIONS</td>
<td>57</td>
</tr>
<tr>
<td>PART I. THE KNOWLEDGE-BASES OF INDUSTRIAL DESIGN EDUCATION</td>
<td>57</td>
</tr>
<tr>
<td>Structure and Organization of Knowledge</td>
<td>60</td>
</tr>
<tr>
<td>Technology (Praxiology), A Term Needing Further Clarification</td>
<td>65</td>
</tr>
<tr>
<td>Elements of Design in the Structure of Industrial Technology</td>
<td>67</td>
</tr>
<tr>
<td>The Equations of Industrial Design Practice and Industrial Technology</td>
<td>72</td>
</tr>
<tr>
<td>PART II. DELINEATION OF THE FIELD OF DESIGN TO ESTABLISH THE DISCIPLINE AND FIELD OF INDUSTRIAL DESIGN</td>
<td>77</td>
</tr>
<tr>
<td>Identifying the Sub-categories in the Design Field of Study</td>
<td>78</td>
</tr>
<tr>
<td>Delineation of the Field of Industrial Design</td>
<td>80</td>
</tr>
<tr>
<td>Conclusion</td>
<td>86</td>
</tr>
<tr>
<td>PART III. SOME PHILOSOPHICAL-THEORETICAL BASES OF TEACHING AND LEARNING PRINCIPLES</td>
<td>89</td>
</tr>
<tr>
<td>Basic Guidelines Formulation</td>
<td>89</td>
</tr>
<tr>
<td>Specific Guidelines Formulation</td>
<td>92</td>
</tr>
<tr>
<td>An Analysis of the Subject Matter Domain</td>
<td>93</td>
</tr>
<tr>
<td>Learner Characteristics</td>
<td>95</td>
</tr>
</tbody>
</table>
CHAPTER IV (Cont.)

V. PROGRAM DEVELOPMENT

PART I: THE PROGRAM STRUCTURE

Program Objectives
- Objective at Philosophical Level
- Objectives at Behavioral Level
- Objectives at Operational Level

Structural Organization

Description of the Program Areas of Emphasis
- Design Administration
- Design Planning and Development
- Design Education

Organization of Studies

Tentative Course Work and Time Allocation
- Graduate Design Course Work
- Graduate Specialization Course Work
- Graduate Application Course Work

PART II: IMPLEMENTATION

Considerations at Policy Level
- Admission Policy
- Enrollment Policy

Considerations of the Physical Facilities
- Budget

Consideration of Instruction Materials
- Teaching Methods
- Supervision of Students' Work

VI. CONCLUSION AND GUIDELINES FOR FUTURE RESEARCH

On the History of Design Education
On the Broad Objectives of Design Education
On the Impact of Technological Innovations
On the Curriculum Development
### CHAPTER VI.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guidelines for Future Research</td>
<td>129</td>
</tr>
<tr>
<td>Empirical Research on Design Education</td>
<td>129</td>
</tr>
<tr>
<td>Evaluation of Design Needs Through Design Manpower Surveys</td>
<td>130</td>
</tr>
<tr>
<td>Redefinition of Educational Policy</td>
<td>130</td>
</tr>
<tr>
<td>Evaluation of Curriculum</td>
<td>130</td>
</tr>
</tbody>
</table>

### BIBLIOGRAPHY

- Page 132

### APPENDIXES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>LITERATURE SEARCH</td>
<td>141</td>
</tr>
<tr>
<td>B.</td>
<td>SOME DEFINITIONS OF INDUSTRIAL DESIGN</td>
<td>161</td>
</tr>
<tr>
<td>C.</td>
<td>THE STRUCTURAL ELEMENTS OF THE DISCIPLINE OF INDUSTRIAL DESIGN</td>
<td>165</td>
</tr>
<tr>
<td>D.</td>
<td>AN UNDERGRADUATE INDUSTRIAL DESIGN PROGRAM AT CHULALONKORN UNIVERSITY</td>
<td>181</td>
</tr>
<tr>
<td>E.</td>
<td>WORLD DIRECTORY OF SCHOOLS OF INDUSTRIAL DESIGN</td>
<td>190</td>
</tr>
<tr>
<td>TABLE</td>
<td>Description</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>1.</td>
<td>Thailand National Domestic Product by Origin at 1972 Price</td>
<td>29</td>
</tr>
<tr>
<td>2.</td>
<td>Thailand's 1976-1977 Imports by Economic Classification</td>
<td>32</td>
</tr>
<tr>
<td>3.</td>
<td>Employed Person 11 Years of Age and Older, 1971</td>
<td>36</td>
</tr>
<tr>
<td>4.</td>
<td>Functions of Areas of Knowledge</td>
<td>64</td>
</tr>
<tr>
<td>5.</td>
<td>Comparison of Concepts Taught in Construction and Manufacturing Technology to Bruce Archer's System</td>
<td>74</td>
</tr>
<tr>
<td>6.</td>
<td>A Proposed Graduate Program Event Plan</td>
<td>115</td>
</tr>
<tr>
<td>7.</td>
<td>The Undergraduate Program</td>
<td>184-186</td>
</tr>
<tr>
<td>8.</td>
<td>World Directory of Schools of Industrial Design</td>
<td>191-196</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

FIGURE                                                                 Page

1. Phenix's Realms of Meaning                                           62

2. Relationship Between the Domains of Man's Knowledge and the Discipline of Design 65

3. Economic Institution                                                 67

4. Major Elements in Industrial Technology                              69

5. First, Second, and Third Order of Selected Elements of Manufacturing Technology 70

6. Archer's Model for Product Design                                    73

7. Model of Systematic Product Design                                   76

8. Sub-Categories in the Design Field of Study                          79

9. The Field of Industrial Design                                       83

10. Structure Elements of the Discipline of Industrial Design           84

11. Relationship Between Major Structural Elements of the Discipline of Industrial Design 86

12. Summary Model Depicting Industrial Design Curriculum Development     88

13. Tyler's Model for Curriculum Construction                           91

14. Relationship Between the Field and Profession of Industrial Design 108

15. Instructional System Model for the Industrial Design Educational Program 124

16. Industrial Design Curriculum Development Evaluation Model          131
CHAPTER I
THE PROBLEM

Background

When Thailand launched its National Scheme of Education on October 20, 1960, it was a major attempt by the country to clarify educational objectives and formulate an educational philosophy. Among the objectives were plans to promote an intellectual and practical education, which involved the expansion and improvement of specialized programs at the technical and professional levels. The increased emphasis was aimed at mobilizing skilled manpower for high priority development projects, particularly in the agricultural and industrial sectors. The government conceded that:

If Thailand is to develop rapidly, it is absolutely essential that large numbers of people are given new vocational and technical skills, for without skilled agricultural manpower, the agricultural sector will not be able to develop as fast as is needed, and without craftsmen, artisans, and technicians, new industries will not be able to operate as effectively as could be expected.

(Ministry of Education, 1966:37)

As a central role in the national economic development process, the vocational training education programs, dealing with product development (i.e., allied design, industrial arts, fine and applied arts, etc.), and those involving technological innovations (i.e., science and technology) had been given high development priority. Although the proposed recommendation
was not a mandate at the college level, it nevertheless affected and influenced a specialized education for designers to a certain extent.

In 1962, two years after the National Education Council announced its educational scheme, the Faculty of Architecture at Chulalongkorn University initiated a contingency "Fine and Applied Arts" design program, which was offered as an option to the fourth and fifth year students in architecture. In the following years, Silpakorn University in Bangkok, and King Mongkul's Institute of Technology at Lart Krabang, introduced similar training in the Faculty of Architecture. King Mongkul's, in 1970, became the first degree-granting institution to offer a five-year curriculum in industrial design.

It was not until 1975, however, that the Ministry of Education implemented the Fine and Applied Arts program at the Institute of Technology and Vocational Education (ITVED). From this has evolved one of the most comprehensive arts, crafts, applied arts, and industrial design curriculum programs in the country. Significant contributions from this initiative are the inclusion of design courses in both the higher certificate's and secondary schools' arts programs. Since 1975, the subject of industrial design has become a required elective for all students in the vocational stream.

In an effort to further contribute to the cause of national development, Chulalongkorn University (CU) in 1979
replaced its two-year option study with a new five-year industrial design curriculum. This change is characterized by the increased applications of scientific and technological knowledge to the traditional "fine and applied arts" program of work. Such initiative was preceded by a unique conceptual approach to an overall program formulation. The Department of Industrial Design believes that under the present stage of Thailand's economy, the need to teach broader bases of knowledge in design is more important than the need to produce the potentially career-limited specialists (Pramote, 1980:2). Consequently, the new program is offered without conferring upon graduates the specialized degree. However, a more conventional arrangement has been proposed for graduate training which is scheduled to be opened in 1982.

Throughout the brief and rather abrupt history of industrial design education development, Thailand has seen an upsurge of both quantitative expansion and qualitative improvement in the allied design programs. The Institute of Technology and Vocational Education is expanding its art-based industrial design study to four other regional campuses. Several other teacher-training institutions also plan to add more "design" courses to their existing curriculum. But presently, only CU offers advanced education at the graduate level. The proposed program is now pending development.
Introduction to the Problem

During the last two decades, Thailand has been orienting its educational system toward national development goals. The initial perception of the needs of design education, which led to the establishment of the industrial design curriculum in the various institutions, is based almost exclusively on national social and economic needs, after they had been "translated" into the overall educational policies and objectives by the Education Council. But a formal assessment of educational need and the resulting demand for this specialization has never really been conducted.

Since 1963, three studies were made: 1) A joint Thai-USOM Task Force, the Preliminary Assessment of Education and Manpower in Thailand, in 1963; 2) the Ministry of Education's The Current and Projected Secondary Education Program for Thailand, in 1966; and 3) Report of Educational Development, Academic Year 2519, in 1976. None of these studies, however, made specific forecasts or references concerning design education other than in terms of overall objectives, even though it is a vitally important curriculum area. (See Chapter II). As a result, many design schools, without a full knowledge of educational needs, included what they believed to be the essential subjects in their design curricula. The majority of subjects offered were based on occupational activities, which reflected only the kind of educational need, while the important question concerning the degree of
educational need for each subject was often left unattended. This problem was further complicated by the fact that in most cases, there was no adequate statement of educational objectives. The program objectives, instructional objectives, and student's behavioral objectives are condensed in a paragraph-long statement, which rarely reflects the real educational purpose. (See Chapter II, p.27). There was serious concern that wherever the educational programs exist, most of them do not propose specific approaches, procedures, instructional materials, or methods of education. (State University Bureau, 1975: 11). It is necessary, then, to supplement these objectives with more specific, identifiable educational goals that truly represent national and educational needs.

Another fundamental problem in industrial design education development -- although such an issue is not necessarily restricted to the particular situation at CU--is the fragmented approach in determining the curriculum content. The problem is largely due to the crucial lack of the aforementioned research which would enable the field to establish on that basis, the scope, role, and function of its education, as well as its professional practice. On the other hand, these confusions are the results of both the infancy of the discipline, coupled with the interdisciplinary nature of the program itself. With limited material resources available, research of this type must rely heavily on the ad-hoc
committee or on the individual's perception and experience on the "what?-when?-why?-how?" of educational development. Unfortunately, these conventional procedures have provided neither correct nor productive answers to design curriculum development. Dr. Nida of the Institute for the Promotion of Teaching Science and Technology in Thailand said:

"The inadequacies of this 'ad-hoc committee' procedure is the tendency to case the curriculum in a rigid and compartmentalized mold; they leave little room for systematic tryouts and for incorporating new insights derived from research or the experiences of teachers; and they dislink the formulation of curriculum, on the one hand, from the materials and methods in which any curriculum must find its concrete expression and, on the other hand, from the evaluation procedures by which the outcomes are adjudged."

(Dr. Nida, UNESCO, 1977)

In the final analysis, the education for the practice of industrial design in Thailand has not been conceived formally as an independent study or as a unique field. The programs that have been developed since 1962 were the products of adaptations and refinements of allied knowledge derived from other fields such as architecture, arts, and science. It was not until 1979, when the Congress established an Industrial Designers Society of Thailand through the passage of the Patent Act, that the education for industrial design was fully recognized. But, because of the initial lack of research on design needs, most institutions have failed to support the role and function of designers with a "sound" disciplinary
knowledge that would allow this education and its practice to grow and develop more successfully.

Statement of the Problem

Industrial design educators have yet to identify an organized body of knowledge, and a system of concepts and unifying themes relating to aspects of national development needs, that can be applied to the planning, development, and implementation of a graduate industrial design program in Thailand. This study assumes that if any institution is to be successful in this operation, it must establish a cohesive and unified framework of education concepts and objectives that would clearly indicate the need and the direction of the program to be developed.

It was the purpose of this study to identify these pertinent issues of needs and their relative impacts on industrial design curriculum formulation. The ultimate goal of the study was to develop a suitable model for such instruction at graduate level. It was also of particular interest to develop the proposed program toward greater articulation and integration with the existing educational and social environment.

Objectives of the Study

The specific objective of this study was to identify, organize, and structure a body of knowledge that gives a
positive identification to the comprehensive process, involving the planning, development, and implementation of a graduate program in industrial design at the Department of Industrial Design, Chulalongkorn University, Thailand.

To accomplish the foregoing proposal, this study has been developed with the following objectives:

1) To establish, on a national scale, the basis of need for an advanced industrial design program;

2) To identify the designer's role (a desired model) in relation to the established requirements and the matters relevant to it;

3) To conceptualize the body of knowledge of the discipline of industrial design; and

4) To develop a curriculum model for graduate instruction in industrial design, based on the preceding researches and findings.

Significance of the Study

As with many newly formed fields of study, confusion existed, and presently exists, as to the scope, role, and function of the different design curriculums within the total design education context. For example, precise differences among such programs, fields, and functions as industrial design and engineering design were never fully described or substantiated. With a limited amount of resources and information about the areas and aspects of design practices,
the tendency of the involved parties (both industry and education) to avoid making a specific or a committed statement about their fields or their practices, has become all too obvious. Consequently, there is virtually no authoritative organization -- not even the newly established "Industrial Designer's Society of Thailand" -- which is able to make a real attempt in defining the different terms for the proper context. The basic questions concerning the definition, role, aims, and objectives, as well as the way in which those objectives can be achieved, have never really been challenged.

Nevertheless, the total field of design has become recognized both nationally and internationally as an important aspect of material goods and services production. This recognition has become the central focus for the development of highly effective educational programs, which both fulfill the need for human resource development and advance the growth of knowledge in the profession.

Of major importance to this study is the area of education at the graduate level. Since the mid-1970's, significant numbers of new industrial design programs have been established. But now arises the difficult problem of finding qualified teachers, particularly those who hold a specialized degree. Usually, when such demand occurs, the University Development Project will provide sponsorship for prospective university instructors for further education
in the needed area. Although the importance of industrial design education is well recognized, reservations are also voiced regarding the deflection from urgent priorities, such as medical science and agricultural engineering. It is therefore becoming necessary for the design universities to seek alternate means of acquiring the needed resources themselves. Employing graduates from foreign countries is perhaps the alternate solution, but there is not enough personnel available to fill even the narrowest gaps of the present shortages. The problem becomes more acute as the country has no local facility to train its own specialists. Even though there are numbers of graduate schools around the country, and three of them -- the Asian Institute of Technology (AIT), Krasetsart University (KU), and Chulalongkorn University (CU) -- presently have design programs, their scopes are somewhat restricted to the production and research of scientific and agricultural equipment.

While it does not have a graduate industrial design program, Chulalongkorn University does have the potential and capability to initiate one because of its already available facility, manpower, legal supports, and learning environment. Recognizing these potentials, the University assumed the responsibility of educational leadership to provide knowledge towards greater comprehension and development in this field.

In contributing to this development, this study aims to establish a solid position of knowledge in the field and
profession of industrial design. However, it should be noted that the position presented in this study is by no means considered to be final, or without need for further modification and refinement. Instead, this study attempts to logically locate, order, and structure those pertinent knowledges upon which to base further development of the proposed graduate program at CU.

In view of the aforementioned situation, this study feels that the problems in planning and developing a proposed project at CU, or at any institution in the country, cannot be resolved satisfactorily without first having a clear concept of the discipline's knowledge and being able to apply such knowledge within the constraints and considerations imposed by the school and the society that the education has to serve. This study aims to show the need to work toward this end.

Limitations of the Study

One disadvantage of a descriptive study is that regardless of how carefully one tries to describe the objectives of the program, or to what level of detail, the result is always defective and incomplete. On the other hand, if the interest is in scientific research and not merely on metaphysical speculation, one has to accept analysis as a valid and indispensable tool for his work. W.J. Rittel in "Some Principles for the Design of an Education System for Design"
explained:

Solving the problems which originated from a recognized discrepancy between what "is" and what "ought" to be is a matter of self-confidence and judgement.

(W.J. Rittel, 1971)

He pointed out that if one tries to be rational, there is no beginning and no end to reasoning. On the other hand, a non-rational, spontaneous action on a large scale is irresponsible, so both extremes have little survival value. For all of these reasons, he believes there cannot exist anything like "the answer," which smoothly and automatically resolves the problems, and that one must rely on his own "instinct" and the availability of techniques, methods, and "tool chest" to master or solve the problems of his work. (Rittel, 1971)

In this study, analysis has not explained the entire body of educational theory. However, some practical results have been achieved, and light has been thrown on some of the fundamental issues. In any case, analysis is a prerequisite for approaching education on a rational basis and, more importantly, for fulfilling the intended goal of this study.

Assumptions of the Study

The study was conducted and developed with the following assumptions:
1) In the process of shaping its contemporary cultural identity, Thailand, with the rapid growth of its industrial technology, will inevitably need high-level, specialized manpower, including "industrial designers;"

2) There is a need for advanced education in the fields of "industrial design" in Thailand.

Definition of Terms

The following definitions will clarify the terms used in this study:

. Design - Education  An integration of scientific principle, technology, and imagination to define new structures with pre-specified function. (Yearbook of World Problems and Human Potential, 1976).

. Design - Practice To conceive the idea for some artifact or system and/or to express the idea in an embodiable form. (Archer, 1971).

. Design - Activity A problem-solving process that involves the following steps:
   . Programming
   . Data Collection
   . Analysis
   . Synthesis
   . Development
   . Communication
Design - Industrial
A professional service of creating concepts and specifications that maximize the appearance, function, and economic value of products and systems for the mutual benefit of the end user and the manufacturer. (IDSA, 1979).

Industrial Arts
Those occupations by which changes are made in the forms of materials to increase their values for human usage. As a subject for educative purposes, industrial arts is a study of the changes made by man in the forms of materials to increase their values, and of the problems of life related to those changes (Bonser and Mossman, 1925:5).

Industrial Technology
Knowledge of practice; the totality of technical means employed by people to provide itself with the objects of material culture; a science of applying knowledge to practical purposes.

Industry
A subcategory of economic institution which substantially changes the form of materials in response to man's wants for goods.

Research Methodology
This study was based primarily on a literature search. There are approximately three main headings under which this search has been conducted:

1) Design (Industrial Design);
2) Education;
3) Other disciplines relevant for the development of the practice of industrial design and relevant for design education (e.g., management developmental economics, etc.).
In these areas of research, the following sources were consulted:

1) Articles in specialized magazines, mainly "Industrial Design," "Design," and series of articles by the "Design Methods Group" and "Connection."

2) Lectures and conferences sponsored by the Department of Industrial Design, and seminars arranged and conducted by the Industrial Designer's Society of America (IDSA).

3) Papers from universities engaged in research and development of programs relevant to this study.

4) Reports and documents pertaining to the subject of study from Thailand.

5) Constant feedback and evaluation of the proposed study from industrialists and educators from Thailand.

6) Library at The Ohio State University under the following headings:

   6.1 Architecture
       History
       Theory

   6.2 Anthropology
       Cultural/Social

   6.3 Art
       History
       Theory
       Art and Science

   6.4 Design
       History
       Theory
       Education

   6.5 Education
       Industrial Arts
       Art Education
6.6 Industry 
   History 
   Professional Practice 

6.7 Industrial Design 
   Design 
   History 
   Theory 
   Education 

6.8 Socio-Economics 

6.9 Technology (industrial) 

The study was assessed in meetings, correspondence with Thai government officials, and discussions with members of the Reading Committee.

Presentation Format

For the purpose of maintaining the flow of information and to keep the topic consistent throughout, other supplementary research of historical relevance which is essential to the understanding of the subject but too lengthy for inclusion in the text is all presented in Appendix A. It is advisable to read through this section so that once it is referred to by the text, it is better understood.
CHAPTER II
PROGRAM FORMULATION

It is generally agreed that the degree of success in developing the so-called "Industrial Design" educational program in developing countries is significantly dependent upon: 1) how well the program has been conceived and structured; 2) whether it has taken into consideration all the facets of the discipline's knowledge; and, most importantly, 3) how it has been conditioned to more fully serve the needs of that particular society.

Intuitively, then, one could think that developing such a program in Thailand is like developing a program in any other developing country, and that it must represent a different sort of program from one in a developed nation. But is this really so? If it is, what are the unique characteristics that the program should have that would represent a suitable model worthy of development considerations?

In discussing this issue, it should be recognized that the pattern of a design educational development in Thailand, since 1962, has consistently been geared towards the National Economic and Social Development (NESD) needs. The demand by the country for certain types of industrial products and
services, and the implication that this has for the industry are, therefore, the determining factors for the roles and training of industrial designers.

In dealing with the specific issues of NESD needs and its relative contributions to the role and the education of industrial designers, this chapter is divided into two parts, representing the following studies:

1) An examination of national development needs;
2) An examination of the demand for education in relation to the national development needs;
3) An establishment of educational frameworks in relating to both 1) and 2).

Rationale

The major social institutions in a modern society are believed to include the family, government and politics, church or religion, and the economic system. In a transitional social order, such as Thailand today, one cannot fully comprehend any one of these social institutions without taking into consideration the related structures, which continually and sometimes drastically modify each other. For example, the family system is affected by the political institution whenever legislation is passed. Similarly, economic behavior is also unintelligible without noting its interaction with political institutions. Therefore,
educational policies are deeply implicated in social status, politics, and productivity (Riggs, 1964:9).

From a simple agrarian economy, Thailand has yielded somewhat to an economic system based upon industrialism, capitalism, and international trade. With new and increasing transportation and communication facilities, Thais are moving about as never before. In the process of changing from a simple diversification to a world market and industry, Thailand is now confronted with many economic problems and dilemmas; a change from a subsistence economy to a commercial economy calls for a knowledge and understanding of certain fields of education little known to the Thai people years ago. The Ministry of Education refers to these fields as:

"...the principles of marketing, banking, and sophistication in the international trading... Management of the natural resources of the country is imperative for the survival of the national economy..."


Using this analysis as a basis, the following study identifies educational goals that are in keeping with both broad and specific objectives of national development in Thailand.

An immediate concern of this study was to identify the general characteristics of the Thai economy, which might help clarify the meaning and function of design education, and to show how such characteristics have a direct bearing
on education for designers. However, in order that such inquiries can be conducted effectively, they have been preceded by a brief discussion of implied needs.

Needs: The Term Requiring Further Clarifications

It has been generally accepted that all individuals have certain minimum biological or physical needs such as food, clothing, shelter, and medical care. But, as a member of organized societal groups, the individual has many other needs such as those relating to his own family, his religious aspirations, his political systems, and his professional work. Additionally, he has needs growing out of his psychological and emotional make-up which, in turn, are very much influenced by his social environment. It has been claimed that there are few, if any, "pure" individual needs (Ministry of Education, 1966: 55).

From the "designers" viewpoint, both biological or physical, and the psychological needs have been referred to as the "user's needs." There are two levels of user needs, distinguished by Gomez (1976:165) as:

1) a primary level, which he terms as the "level of subsistence," and
2) a more profound and subtle level (also much more difficult to describe) which has to do with "the fulfillment of life," to which was referred to as "level of existence."
Gomez explains that man, in his struggle for subsistence, has evolved through a dual process of adapting to his environment on one hand, and adapting his environment to his necessities on the other hand. In contrast with the slow pace of man's adaptation to his environment, we have been able to witness through the records of a few operations the rapidity with which the process of environmental modifications has been taking place. In this process, it is found that the production of goods, against circumscribed subsistence levels, and resources is becoming increasingly critical (Gomez, 1976).

On the other hand, the "level of existence," sometimes called "the second element of design awareness," is defined as the most advanced element of design. It is concerned with "man's capacity to impose qualitative considerations to impose aesthetic, spiritual, and ethical elements upon physical, economic, and national elements" (L.B. Archer in Gomez, 1976:7).

Archer further points out that the shift in society's values is likely to occur as a result of the crisis of the attitude, which regards constant change. For instance, what we perceive as necessary commodities today will in time become obsolete and inferior. Archer identifies the main reasons for this crisis as a dilemma we have in controlling the problems of population, pollution, and the depletion of resources: the more restrictions we put on personal freedom,
personal participation, and diversity of values, the more bureaucratic society becomes.

An added breadth of information is presented by the Thai government in the *Current and Projected Secondary Education Program for Thailand*, which states:

Broadly speaking, the needs that any effective schools system must meet can be grouped under two categories: societal and individual. This is not to imply that the distinction between these categories is always sharp and identifiable. A well-educated individual is a social asset: a viable social and economic order contributes to the well-being of the individual. But this distinction in categories of needs is still useful. For example, it permits us to identify certain social and economic imperatives that in effect become mandates for the schools to follow. It also permits us to focus on certain personal attributes and aptitudes that the schools can develop in the youth of the land. These needs become the basis for the educational goals...

(Ministry of Education, 1966: 165)

Based on the aforementioned considerations, this has constituted the fundamental line of inquiry for design education that must be conducted mainly at the level of existence. This will hopefully enhance the relationship between "users" and "designers."
PART I: THE RELEVANCE OF NATIONAL ECONOMIC DEVELOPMENT NEED

Identification of Priority Development Objective

Thailand launched its first six-year National Economic Development Plan in 1961. The plan spelled out the national development targets and economic policies aimed to encourage private industrial investment through incentives (Board of Investment, 1976). The First and Second Plans (the latter for 1967-1971) were somewhat similar in scope and addressed themselves mainly to the public development projects. They did not make a serious attempt to establish industrial targets in terms of productive capacities, nor did they recommend specific programs or measures to accelerate industrialization beyond those which already existed.

For the remainder of the Second Plan period, and for the Third Plan (1971-1976), the government had several major objectives. Those most concerned with economic development are:

1) To pursue a vigorous export promotion program;
2) To implement fiscal and monetary policies that will preserve stability and keep foreign exchange reserves at a prudent level;
3) To maintain a satisfactory pace of social and economic development; and,
4) To expand government revenues rapidly, and to the maximum feasible extent, rely upon resources generated within the economy.
The highest priority objective concerning the increased export of goods and services during the Third Plan are:

1) Traditional Products.
2) New Agricultural Products.
3) Service Exports.
4) Industrial Exports.

By concentrating on domestic resources in the production of merchandise exports, the Thai government believed that the country's economy could be helped along a pattern of long-term stable growth, provided that a reasonable rate of growth of production output is maintained. The government also admitted that because it will take several years to complete the shift, it will seek foreign assistance in the evaluation of the potential effectiveness of different policies, and in the identification of the related projects. These are the major objectives of technical assistance that will be required in the immediate future (BOI, 1976:4).

The thrust behind vigorous export promotion was due in part to the government's concern over the $1.2 billion trade deficit during the planned period 1971-1976. In 1978, the balance of payment problems resulted in steps to reduce excessive imports. This gave rise to an increase of import substitution industries.

To further help the balance of payment, the government increased taxes on certain commodities, including petroleum,
and tightened credit in early 1978. In addition, in March of 1978, duties were raised on over 100 items. The government hoped to reduce the current account deficit, limit price increase to 7%, and achieve an economic growth rate of at least 7% (Burns, USDC, 1979).

Under the preceding programs, economic growth improved in 1978 to 8.7%, largely due to a bumper crop year and a boom in commercial and industrial construction. Non-agricultural output increased by approximately 12% over the previous year, and was led by the construction industry with a 23% increase, which was due in part to the recovery of private investment, mainly domestic. Real net capital formation increased by 32%, with a distribution ratio of 70:30, split between private and public sectors, respectively. During 1978, total approved investment was $1.3 billion, as compared to $185 million in 1977. According to the U.S. Department of Commerce, applications for promotional privilege before the Board of Investment in Thailand in 1978 totaled 342, the highest number since 1973. The official rate of inflation in 1978 was 8.4%, although the actual rate may have been closer to 12% (Barns, USDC, 1979).

One of the major reasons for this industrial growth in Thailand is the active response of local and foreign investors to the Investment Incentive Program which was first launched by the government in 1959. As the country
entered the new development decade, and especially in the 1970's, the combined investment of the local and foreign investors resulted in extensive merchandise exports, which were valued in 1978 at $4.1 billion, a 15% increase over 1977. This allowed a net international reserve to drop from $1.3 billion in December, 1978, to $1.2 billion in April, 1979. They are still equal to about four months' imports. (USDC, 1979).

Although capital participation from external sources has accounted for only one-third of the total equity investment in the promotion programs, its relative contribution is much greater in terms of labor skill improvement, managerial know-how, industrial technology, and "industrial design" technology. (See Part III.)

Among other promotional programs to accelerate the economic growth were plans to increase the development of manpower, education, science, and technology. Special emphasis was placed by the government on the following areas:

1) Programs to mobilize skilled manpower for high priority development projects and to fill the requirements of the private sector;

2) Greater development of educational and research programs on science and technology, the results of which will enhance economic productivity;

3) Expansion of the educational system, particularly the secondary and vocational-technical training.  
   (Ministry of Education, 1971)
In response to the planned program development, several institutions have extended their specialized education to those areas directly involved in the economic development projects. The areas of design for specialized goods and service production, for instance, are covered by the specialized field called "industrial design" (Gysler et al., 1976). The relative contribution from such education to the developmental needs is best described in terms of Chulalongkorn University's industrial design program objectives:*

1) To produce industrial design graduates who are conceptually and creatively able [to design the products] in meeting the country's industrial expansions (Article 4.1);

2) To increase the number of knowledgeable industrial design graduates who are capable of producing and improving the various products for industrial and handicraft production (Article 4.2);

3) To encourage and promote new and innovative product development. Such products should be produced with maximum utilization of the available resources [man-power, materials, technology, etc.], representing both

---

*These objectives have been literally translated into English from the original content for the purpose of presenting the rather ambitious and optimistic goals as they are expressed and written in Thai. Nevertheless, I feel in certain places that more information is needed to clarify these concepts. Such information is supplied in the parentheses.
aesthetically and functionally, a high standard of quality products (Article 4.3);

4) To increase industrial productivity through which the balance of national trade deposit can be feasibly achieved (Article 4.4);

5) To cause graduates to become responsible designers for their society (Article 4.5).

Source: Department of Industrial Design, 1979.

In the following sections, this study creates "backward links" between the enumerated objectives and the details of the needs of the society. The compositions of those needs, which might be relevant for determining the subject matter for the proposed curriculum development, will be identified.

The Needs of the Economy

The economic development programs in Thailand since the beginning of the Third Plan have been aimed at building up an infrastructure of communications, transportation, irrigation, and other agricultural products and supporting facilities. From 1965-1968, "invisible" exports and private investment grew very rapidly. This rapid increase in "invisible" exports was due partly to the demand generated
by direct and indirect U.S. military expenditures. It is a fact that growth of private investment was largely due to the opportunities created by the rapid expansion of aggregated demand. The pattern of such expenditure created a considerable impact in shifting domestic factors of production away from other activities particularly in agriculture, and towards production of goods and services to satisfy the new types of demands. Table 1 reflects Thailand's Gross Domestic Product and its relative percentage figures representing changes of the economic factor and labor force reallocations.

**TABLE 1**

Thailand Gross National Domestic Product
By Origin at 1972 Prices

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>(Millions of Baht)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>56,961</td>
<td>61,864</td>
<td>64,377</td>
<td>63,742</td>
</tr>
<tr>
<td></td>
<td>(30.11)</td>
<td>(30.36)</td>
<td>(29.20)</td>
<td>(27.23)</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>33,566</td>
<td>36,162</td>
<td>41,425</td>
<td>47,082</td>
</tr>
<tr>
<td></td>
<td>(17.74)</td>
<td>(17.75)</td>
<td>(18.71)</td>
<td>(20.11)</td>
</tr>
</tbody>
</table>

Source: Office of the National Economic and Social Development Board

Domestic factors were then drawn into production created by these new investments, and the labor force had been shifted into a non-agricultural activity.
As a result of these domestic factor reallocations, a demand for new types of industrial products was created. The following is a partial list of the new product demands at a subsistence level that require special attention. Based on the commodity number system prescribed by the Department of Industrial Promotion, the number of need-areas illustrates some significant correlation between the needs of the economy and of the potential demands for a specialized (design) manpower:

1.) **Tools and Instruments**: Agricultural hand-tools and light equipment, basic machine tools, craft tools;

2.) **Handicraft Products and Systems**: Marketing research, management, production and quality control through better design.

3.) **Shelter**: Building components, building materials, sanitary ware, lighting fixtures, etc.

4.) **Products and Systems**: Kitchen appliances, furniture, play and leisure equipment.

5.) **Packaging Systems**: Containers for food and products.

6.) **Visual Communication**: Books, signage, graphics, printed forms, business forms, tickets, identity cards, diplomas, direct mail, stationery, newsletters, promotional campaigns, symbols, trademarks, emblems, awards, visual identity programs, tourism, architectural graphics, television graphics.
7.) **Transportation:** Machine and/or human-powered vehicle, ship, boat, aircraft interiors; bus, air, rail, and ship terminals.

8.) **Interiors:** Public buildings, post offices, city halls, courts, libraries, schools, government offices, housing, hospital and health buildings.

9.) **Human Survival:** Facilities for the aged, for the physically and mentally handicapped.

10.) **Disaster Relief:** Earthquakes, famine, disease, flood, war, etc.

In meeting these demands, the Board of Investment (BOI) admits that technical assistance of significant magnitude is most urgently needed, especially in the areas of design, marketing, production, and quality control (BOI, 1970). Meanwhile, the country has spent almost $4.8 billion on the imports. Table 2 lists Thailand's 1976-1977 imports by economic classification.

With an increased emphasis on the export-oriented industries during the Fifth Development Plan period (1981-85), the need for technical assistance in the design-related areas of manufacturing will undoubtedly become more acute. However, to prove whether or not such assistance is specifically implied, the "industrial design" service is to define the term itself--a matter which is quite beyond the present scope of study. In order to maintain the current
**TABLE 2**  
Thailand's 1976-1977 Imports by Economic Classification

<table>
<thead>
<tr>
<th></th>
<th>1976</th>
<th>1977</th>
<th>% Change 76-77</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consument Goods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nondurables</td>
<td>279</td>
<td>319</td>
<td>+14</td>
</tr>
<tr>
<td>Food &amp; beverages</td>
<td>119</td>
<td>134</td>
<td>+13</td>
</tr>
<tr>
<td>Clothing, clothes &amp; footwear</td>
<td>74</td>
<td>83</td>
<td>+12</td>
</tr>
<tr>
<td>Medical &amp; pharmaceutical products</td>
<td>64</td>
<td>75</td>
<td>+17</td>
</tr>
<tr>
<td>Other nondurables</td>
<td>22</td>
<td>27</td>
<td>+23</td>
</tr>
<tr>
<td>Durable</td>
<td>192</td>
<td>238</td>
<td>+24</td>
</tr>
<tr>
<td>Household goods</td>
<td>56</td>
<td>67</td>
<td>+20</td>
</tr>
<tr>
<td>Electrical appliances</td>
<td>66</td>
<td>83</td>
<td>+26</td>
</tr>
<tr>
<td>Other durables</td>
<td>70</td>
<td>88</td>
<td>+26</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>471</td>
<td>557</td>
<td>+18</td>
</tr>
<tr>
<td><strong>Intermediate Products &amp; Raw Materials</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chiefly for consumer goods</td>
<td>626</td>
<td>803</td>
<td>+28</td>
</tr>
<tr>
<td>Textile, fiber, yarn, thread</td>
<td>147</td>
<td>175</td>
<td>+19</td>
</tr>
<tr>
<td>Chemicals</td>
<td>340</td>
<td>419</td>
<td>+23</td>
</tr>
<tr>
<td>Other</td>
<td>139</td>
<td>209</td>
<td>+50</td>
</tr>
<tr>
<td>Chiefly for capital goods</td>
<td>384</td>
<td>538</td>
<td>+40</td>
</tr>
<tr>
<td>Iron &amp; steel</td>
<td>233</td>
<td>317</td>
<td>+36</td>
</tr>
<tr>
<td>Other</td>
<td>151</td>
<td>221</td>
<td>+46</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1010</td>
<td>1341</td>
<td>+33</td>
</tr>
<tr>
<td><strong>Capital Goods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilizers and pesticides</td>
<td>93</td>
<td>136</td>
<td>+46</td>
</tr>
<tr>
<td>Metal manufactures</td>
<td>72</td>
<td>98</td>
<td>+36</td>
</tr>
<tr>
<td>Nonelectrical machinery &amp; parts</td>
<td>493</td>
<td>633</td>
<td>+28</td>
</tr>
<tr>
<td>Electrical machinery &amp; parts</td>
<td>154</td>
<td>178</td>
<td>+15</td>
</tr>
<tr>
<td>Scientific &amp; optical instruments</td>
<td>42</td>
<td>53</td>
<td>+26</td>
</tr>
<tr>
<td>Aircraft &amp; ships</td>
<td>53</td>
<td>53</td>
<td>---</td>
</tr>
<tr>
<td>Other</td>
<td>63</td>
<td>75</td>
<td>+19</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>970</td>
<td>1226</td>
<td>+26</td>
</tr>
<tr>
<td><strong>Other Imports</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land vehicles &amp; parts</td>
<td>259</td>
<td>397</td>
<td>+53</td>
</tr>
<tr>
<td>Crude oil</td>
<td>693</td>
<td>822</td>
<td>+19</td>
</tr>
<tr>
<td>Other fuel &amp; lubricants</td>
<td>142</td>
<td>217</td>
<td>+53</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>98</td>
<td>142</td>
<td>+45</td>
</tr>
<tr>
<td>Gold bullion</td>
<td>--</td>
<td>3</td>
<td>+100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1192</td>
<td>1581</td>
<td>+33</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>3643</td>
<td>4705</td>
<td>+29</td>
</tr>
</tbody>
</table>

1Preliminary  
Source: Department of Customs
topic of discussion, it is necessary to assume that if Thailand were to improve its economic productivity in the specific areas (see list on pages 30, 31) technical assistance in industrial design is viewed as imperative. The significance of such needs is reflected by an educator who said, "A society which does not design is a dependent society" (Gomez, 1976: 115).

The Demand for Manpower

The recent rapid expansion of the Thai economy, particularly in the industrial sector, has made the government aware of the need for a considerable increase in the number of the technologically-minded design graduates. It is also generally recognized that the level of development attained by a country is directly dependent on the number of designers at its disposal. But this rapid increase demand has caused an acute shortage of manpower, which has become a critical factor in the progress of the nation's economy (Sarawut, 1980). "Forecasts" made in connection with this demand indicate that the country "needs a substantial number of industrial designers in the 80's" (Department of Labor Statistics, 1980). This raises several pertinent questions: Where does the demand lie? How many are needed? What implications does this have for the educational undertaking? This chapter discusses several possible solutions.
In assessing the approximate manpower resource demand at the industrial level, an overall view of the design-related employment of different occupational groups is presented. The established figure is then compared against the supply side of the student output. In view of this supply and demand imbalance, the estimated number of manpower needs are established. Since the original proposal has been geared toward a development of a graduate program, the pursuant study concentrated on the numbers of particular groups, which demand the highest level of educational attainment (i.e., teachers, government officials, etc.).

The final target of the study was to project the ratio between the number of teachers required for the teaching and training of needed designers. This calculation is based on the maximum allowable number of student-per-teacher ratio set by Chulalongkorn University in the equivalent areas of education. The educational budget, the admission policy, and the justification for the program undertaking were then determined utilizing this figure.

The Kind of Needs. According to the 1976 Census, the total number of employed persons in Thailand (age 11 and over) was 19,402,100, compared to 16,618,650 in 1971. The average annual increase is approximately 500,000 persons. The sectorial composition of the 1970 Census indicated that 82.4% of the employed labor force was engaged in agriculture, forestry, hunting, and fishing. While it is common to find
most of the labor force in developing countries employed in some phase of the agricultural (primary) sector, this is a particularly high percentage in Thailand, considering its level of development. Other types of employment distribution within the non-agriculture sectors were 3.1% for construction, 21.5% for manufacturing, 7.6% for transportation and communication, 30% in services, and 35% in commerce.

The occupational composition of the 1971 census is divided into nine categories. Details of the distribution is shown in Table 3:

The projected labor force towards the year 1990 is expected to be 30.3 million, while the population will increase to 67 million. The actual increase of the labor force and population over the year 1960 are 16.5 and 27.2 million, respectively.

An analysis of the percentage of employed persons within the major occupations and industry reveals that there are small numbers of people in professional, technical, and administrative sectors in relation to the total number of persons employed under the manufacturing and construction sectors. The problem is further complicated by the fact that while the shortages are critical, there is a very small percentage of employed persons in professional, technical, and administrative positions which have obtained university degrees. This represents a rather acute shortage of high-
Employed Persons 11 Years of Age and Over, By Major Occupation and Industry, 1971

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Manufacturing</th>
<th>Construction</th>
<th>Transportation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional/Technical</td>
<td>3,880</td>
<td>420</td>
<td>900</td>
<td>262,370</td>
</tr>
<tr>
<td>Administrative/Executive</td>
<td>14,780</td>
<td>10,100</td>
<td>4,980</td>
<td>63,980</td>
</tr>
<tr>
<td>Clerical Workers</td>
<td>25,580</td>
<td>4,180</td>
<td>12,730</td>
<td>180,230</td>
</tr>
<tr>
<td>Sales Workers</td>
<td>2,560</td>
<td>---</td>
<td>54,400</td>
<td>1,234,040</td>
</tr>
<tr>
<td>Farmers, Fishery</td>
<td>2,560</td>
<td>---</td>
<td>60</td>
<td>9,590</td>
</tr>
<tr>
<td>Transportation &amp; Commerce</td>
<td>6,670</td>
<td>4,600</td>
<td>176,250</td>
<td>31,800</td>
</tr>
<tr>
<td>Craftsmen, Products</td>
<td>598,590</td>
<td>169,100</td>
<td>16,290</td>
<td>283,240</td>
</tr>
<tr>
<td>Other Craftsmen</td>
<td>399,740</td>
<td>75,010</td>
<td>15,210</td>
<td>278,690</td>
</tr>
<tr>
<td>Svc. &amp; Recreation Workers</td>
<td>5,800</td>
<td>450</td>
<td>2,040</td>
<td>261,930</td>
</tr>
<tr>
<td>Others</td>
<td>---</td>
<td>60</td>
<td>---</td>
<td>60</td>
</tr>
<tr>
<td>All Occupations</td>
<td>659,090</td>
<td>188,910</td>
<td>213,340</td>
<td>1,171,980</td>
</tr>
</tbody>
</table>


Note: Distribution figures in Agriculture, Mining, Electricity, and Commerce Industries are omitted. Figures shown are for the immediate study only.

level or university-trained manpower in the economy.

The government acknowledged its need for such manpower:

Only 62,800 out of 471,000 persons (13.5%) employed in the professional, technical, and related jobs in 1976 had completed a university-degree program. About 25% of the persons working in administrative, executive, and managerial jobs had attained university degrees. This suggests the need for
more university-trained people to fill the ever-increasing high-level manpower shortage in Thailand, particularly in professional, technical, and administrative positions.


A detailed listing of shortages among the high-level manpower, that are now (and probably will continue to be) most urgently needed in Thailand, is described by the Ministry of Education (Ministry of Education, 1966:23):

- **Economists**: Development Economists who are familiar with the methodology of econometrics and also some rural sociology and anthropology;
- **Accountants**: Cost Accountants with training in inventory control and operation research;
- **Agricultural Economists and Agricultural Researchers**: Persons with training in agricultural economics and biology who can do the research urgently needed in such fields as agricultural marketing; also, feasibility studies of new food processing techniques, agri-business potential, and studies of agricultural yields and means for raising productivity.
- **Engineers**: Construction engineers for highway and feeder road-building; industrial engineers with knowledge of production and processes.
- **Teachers of Technical Institute Teachers**: Persons
with university training who can teach the future teachers in the increasing number of two-year, post-secondary, and agricultural technical institutes.

University Professors: All universities in Thailand need more teaching faculty members, but the need is especially acute in the newly established universities in areas outside of Bangkok.

Agricultural and Industrial Extension Agents: These persons are badly needed to work in the rural areas with small shop producers and owners to improve design of products, production techniques, quality control and marketing.

Administrators and Executives: There is a general need for administrators and executives throughout Thailand's economy. The need is most urgent for educational administration, public administration, in the Thai government agencies and particularly in the government-owner industries, and business management of the medium-sized private establishments.

Statisticians: Statisticians, particularly those trained in demography and sample survey techniques, and computer programmers.

The Degree of Needs. As Thailand continues to develop into a more complex socio-economy, the demand for high-level, university-educated graduates in industrial design will
undoubtedly increase. This will in turn place greater responsibilities on the secondary education to provide more and better-prepared graduates for the universities.

The universities, on the other hand, must be readied for the influx of newly-graduated secondary school students. There are currently only 10,000 vacant seats available in the freshman class, hardly enough to accommodate the approximately 60,000 high school and vocational school graduates each year.

So far, the educational design programs have yet to provide adequate numbers of human resources needed by the country. According to data provided for this study by the Department of Labor Statistics, there is an upward trend of design-related manpower demand, and this demand will increase in the coming decades. Past statistics show that manpower demand had increased from 830 persons in 1960 to 2,774 persons in 1970. Of the 284,104 persons engaged in design-related fields, the increased number had amounted to only .98% of the total labor force. From the same survey, the total output of industrial design graduates from five institutions in Thailand in 1970 -- 110 persons -- hardly accommodated the 2,774 persons needed. It would require a substantial increase to meet the demand in the coming decade. (Department of Labor Statistics, 1980).

If the level of activity in the design field should maintain the same upward trend with the rate of economic
growth at 8.7% (according to the previous discussion), the relative increase in design resource demands in the 1980's would be double that of the 1970's. Since most design schools are currently operating at their maximum capacity, filling the gaps of the shortages would have to be accomplished elsewhere, in either the secondary schools or in other design-related institutions.

The current need of the country as perceived by this study is an education at the highest possible level. There is a definite need to train people who could train other people and assume the role of educational and professional leaders in this area. The role of the government has already been fulfilled, to some extent, in its setting-up the educational policy, speeding the passage of the long-overdue Patent Act, approving the Industrial Design professional affiliation (IDST), and establishing the Institute of Technology and Vocational Education (ITVED). These incentives are not only perceived as a national recognition of the newly-formed field of study, but as a provision for future growth of the practice of the profession.

In the final analysis of Thai economy, it is relevant to stress some of the statistics pertinent to future programs in design. First, it is important to note that the educational level of the Thai labor force, while rising, is still quite low for a country at Thailand's stage of
development. Secondly, there appears to be a high correlation between the lowly educated of the labor force and low productivity, particularly in the agricultural and service sectors, and in some segments of industry. A key manpower problem is the present rather low level of education of the administrative and managerial personnel, and also craftsmen and production workers in the industry. In the professional category, the study had cited several important manpower shortages, and among them, industrial designers.

PART II: IMPLICATIONS FOR THE PROPOSED EDUCATION: INSTITUTIONAL CONSIDERATIONS

Chulalongkorn University, being the first "true university" in Thailand, has enjoyed considerable prestige, due no doubt to the purpose for which it was originally founded. Around 1952, when Thailand began to emerge as a progressive nation, the government realized the need for technically trained "designers" to carry out these necessary services. This gave rise to the corps of designers such as architects and engineers, who, because they occupied positions of great responsibility in the economic world, enjoyed considerable social status. Today, although most designers are employed in the industry, they continue to enjoy the same prestige, and CU continues to attract the brightest
students.

The growth of the national income has made it possible for an increasing number of young men to continue their studies at university level; those interested in taking industrial design are therefore led to apply to CU, rather than to other art-based institutions. The demand for admission to CU will be even greater, since it will be the first program of its kind in the country. Here, perhaps, more than anywhere else, CU graduates are guaranteed employment security and an assured future. The Department will most likely experience considerable difficulty in keeping the enrollment down to a reasonable level, but this is precisely what this study believes will have to be done, if the university is to remain a pilot establishment, and if the education standard is to be maintained or even improved.

But again, Chulalongkorn University, like the other institutions offering design programs, will probably be unable to meet the increase in demand for admission in accordance with the previous forecast. Admittedly, the economy requires an increasing number of industrial designers; but at the same time, there will never be more than a limited number of openings for designers with top qualifications. What the economy actually needs is a complete spectrum of people, trained at various levels and in different specialties. As people are beginning to realize that the
number of functions of the type attributed to present designers is not going to grow as fast as the number of designers themselves, a certain disparity is beginning to make itself felt between the status of designers "managing" small firms and that of their colleagues employed by bigger concerns in positions involving more technical responsibility. It is therefore predictable that most of the young men now entering CU will, upon graduation, assume functions more similar to those performed by their counterparts in other industrialized nations. The increased emphasis on the technical aspect of the design function, leading to an increase in the productivity of firms and a more rational organization of the industrial sector, will prove highly favorable to the development of the economy, provided that designers are adequately trained.

It is therefore safe to conclude that the needs of the economy do not solely justify sacrificing the quality of the proposed training to an increase in enrollment. On the contrary, the trend in the functions assumed by the designers depends on the quality of their education.

The foregoing considerations clearly show that the Department should not allow quantitative policy considerations to have an adverse affect on the quality of the teaching or to yield to the pressure for admission, especially when a pilot establishment at CU is concerned.
As this study shall explain in greater detail later, the objective of the education arising from the needs of the economy is not so much one of imparting knowledge, as of providing training. In other words, the study believes that the preparing of individuals to assume their functions (roles) in the economic world is more effectively accomplished by giving them a constructive and practical turn of mind, working methods and a sense of professional discipline, than by requiring them to absorb an enormous amount of knowledge which they rarely have the occasion to use. This trait is "peculiar" to most design studies and sets them apart from the "traditional" university education. This distinction is apparent in the way in which the student's work is "organized". While students in other fields are for the most part free to work on their own along individual lines, the work of design students must be organized and closely supervised.

This objective "unique" to design studies requires that teaching be organized efficiently in order to make such supervision possible. This condition also determines the size of the Department. On the basis of this consideration, efficient teaching should be the essential "characteristic" of the Department of Industrial Design and the principal concern of the Department's officials to see that all students are given adequate training.
CHAPTER III
FIXING EDUCATIONAL OBJECTIVES

Usually, when referring to the needs of the Thai economy, one thinks of quantitative requirements, of the forecasts made by the Planning Commission, of a firm's demand for qualified personnel, or of the number of individuals interested in a graduate design education. In the preceding chapter, the study analyzed the effect of some of these needs on the number of students to be accepted at the Department. This analysis is by no means considered to be conclusive, since it is greatly dependent on the available data. Nevertheless, the needs of the economy may also be expressed qualitatively, and the designers graduating from CU should correspond to the specific character of the Thai industry. This becomes a matter of defining the educational objectives, as it is always necessary for planning a new program. For this reason, this study pays special attention to defining the educational purpose, which represents, the vital links between the needs of the economy and the demands for education. The method outlined in the following sections signify the frameworks of the program's objectives. The content of such undertaking will be described at the end of the chapter.
Rationale

The various types of instruction, making up an educational system, are commonly fixed by their objectives, whether their purpose is to stimulate certain aptitudes, to impart specific knowledge, or to develop manual dexterity. In other words, education is always a purposeful activity; how much of these purposes are actually handled or at least expressed by educators and students is, however, quite another problem. The idea of developing a discipline of "Curriculum Development" is in fact mostly based on the necessity to express explicitly the educational objectives, as well as, the strategies used in attaining such objectives. In this way, the problem of building a curriculum can very well be centered on the subject of educational objectives.

For the sake of simplicity, and to keep this study at a reasonable length, the educational objectives may be grouped under the heading of two main goals; to provide students with an overall culture, designed to help them take their place in an organized society, or to train them for a specific form of professional activity.

Whereas, the objectives of education for cultural purposes are essentially the result of policy considerations, those of professionally-oriented education result from a study of economic needs. This study has already emphasized the fact that the economy calls for a whole spectrum of qualifications, and that the various categories of qualified
personnel should be complementary to one another. In general, the study finds any attempt to define the objectives of the professionally-oriented education involves the analysis of the functions to be assumed by the various types of graduates and an evaluation of the output of the other types of education. In the case with which this study is concerned, this analysis is simplified considerably by the fact that the existence of National Social and Economic Development Plan makes it possible to form a fairly (good) idea as to the future structure of the Thai economy. The task of the Department will be to train its students for the part they are to play in it. The objective of the proposed program, then, is not to produce designers of the type trained, during the former years by the Department, but rather to determine the functions and responsibilities the designers will have to assume through the course of their career, so as to give them the appropriate training and to develop in them the qualities they will most need.

Clearly, in any country, the nature of the tasks performed by an "industrial designer" changes in the course of his/her career. Recent graduates are usually assigned functions of a typical nature; as time goes by, they assume increasing responsibilities and devote more and more time to management, organization and administration problems. The first objective of the program is to give students training that makes them adaptable. This study believes that students
cannot be expected to assimilate in a short two years all the "know-how" they may need later on. Upon leaving school to go to work in a firm, or a private practice, they will have to familiarize themselves with the specific areas of "technology" in which they will be working. Later on, they will be expected to acquire a knowledge of the organization or marketing techniques required (BOI, 1972:54). Therefore, the Department must do more than give its students a training that will make them adaptable; it must also impart a mentality, compatible with the state of industry and the general level of development in the country. This can be achieved, for instance, by providing them with the means and install in them the desire to play an effective role in the economy and contribute to its progress.

The Functions of the Industrial Designers

The study finds it extremely difficult to list the functions of the industrial designers and to describe all aptitudes of the design profession. In the Appendix A, the study made an historic overview to surface the role and function of industrial designers through past practices. It was even more difficult to try to sort out the functions usually entrusted to designers in the present topic. This is because the choice of a graduate industrial designer for a given position depends on a variety of factors: the availability of a sufficient number of engineers on the market; confidence in the quality of their technical design training;
their ability to cope with practical problems; the size of the firm; the complexity of the design problems; availability within the firm of experienced designers and their level of competence. This means that the utilization of designers, and accordingly the objectives of the Department, depends on many factors; the degree of industrialization of the country, and the structure and average level of qualification of manpower force, all play an important part (Shapira, 1974:5-12). All of these considerations were taken into account in the following attempts to classify the functions usually performed by industrial designers.

**Design Function.** The nature of design functions performed by the industrial designer varies considerably according to the scope of work and the size of the firm in which he is employed. In the design office of a large firm, teamwork on highly specialized studies, often of a fairly theoretical nature, is the rule. In small and medium-size firms, design work is to a much greater extent based on the designer's intuition and creativity (Potter, 1969:14-22); such work, therefore, is much less specialized and is entrusted to people who often also have other tasks to perform. Designers in consultant firms, on the other hand, must be highly versatile and well-equipped in widely differing branches of designing and the technological know-how applicable to the existing environmental problems.

**Research Function.** Nowadays, major industrial firms in
Thailand, including the government sector, have their own research programs involving practical applications of the most up-to-date scientific developments, or even some basic ones. While research (mostly marketing research) of this type requires a very special set of aptitudes and methods, past training in the related form of design research enable most designers to adapt themselves quite well to such work.

*Technical Design Production Functions.* Industrial design work involves both the end-user and the manufacturer (IDSA). The manufacturing production comprises three aspects, which may respond to distinctly different functions. These are: 1) the planning aspect, which involves elaborating a manufacturing process, formulating the concepts, researching, and making a prototype; 2) the organization procedure including determining worker function and setting work conditions; and, 3) the controlling phase of the production. (See appendix C for further details). While these functions are distinct in large corporations, they cannot be separated in small and medium-size firms, and designers in the latter must demonstrate not only technical know-how and practical intuition, but also their ability to act in a managerial capacity.

*Commercial Functions.* It is a common misconception that commercial functions should be left to the graduates of a specialized school or that one does not have a diploma to know how to sell. In a contemporary design situation, making
a product to sell (distribution) is an increasingly complex function. Market research nowadays requires interdisciplinary insights to spot what the public needs, find ways to meet this potential demand, determine the characteristics of the market, launch the product and ensure after-sales service. The use of raw materials and the employment of appropriate technology also require a good, all-around "technical" training. It becomes quite obvious that designers in Thailand employed in "smaller than average" (less than 15 staff) firms cannot afford to be ignorant of these fundamental aspects of designing or running a business, even if they are not fully responsible for them.

Managerial and Administrative Function. Although the present stage of the professional development in design field is still in its infancy, some of the early graduates have been appointed in managerial and administrative functions; in the government service they act as heads of a section or division, and also in top-level posts in private enterprises. To carry out these functions the designer will find his/her overall background, the ability to tackle and analyze problems, more useful than the technical training. Nonetheless, one must acquire specific qualifications for each of the functions one performs. While these functions are distinct in large organizations, they cannot be separated in small firms. Industrial designers, must therefore, be highly versatile in carrying out a variety of tasks without
necessarily specializing in any.

**Other Functions.** Graduate industrial designers may themselves be heads of enterprises, and called on to perform a wide range of functions often having little or no technical content, but their training is nevertheless a vital element of their success. They may also become entrepeneurs or developers of projects.

At the level of higher and specialized education, it is almost out of the question for special instruction to be offered, corresponding to each of these functions. An analysis of the structure of Thai industry previously performed gives this study the opportunity to determine which functions are the most frequently encountered and the most vital. In Thailand, as in most developing countries, the principal task of industrial designers is to create concepts and organize production. Emphasis should therefore be placed on encouraging an "enterprise" attitude, a taste for practical achievement, a resource and productivity consciousness. The Department, in light of these considerations, should choose the direction most favourable to the development of the economy. This does not mean that the graduates will be unable to adapt themselves to other types of work such as other related design fields. In fact, the designers educated by the Department of Industrial Design will be very high qualified, and their training should enable them to succeed in all branches of industrial design.
The Structure of the Economy

To determine the type of functions that graduates of the program undertaking will carry out, the study, in Chapter II, assessed the kind and degree of the economic development needs. It showed that Thai industry, in 1976, represented 21.5% on the gross national product, is characterized by its many small and medium-sized firms. The vast majority of the manpower is to be found in the private enterprises employing fewer than 25 people, with a relatively limited managerial staff and very low productivity (BOI, 1976). For this reason, the Thai government committed itself to a gradual lifting of restrictions on trade with foreign countries. The launching of the Investment Incentive Program, which features a credit policy, favoring mergers and associations of small firm and foreign cooperations, thus enables private industry to meet foreign competition.

An idea of the effects of this policy and of competition on the utilization of industrial designers in the future years reflects certain economic trends. It is presented briefly for the purpose of refreshing what has already been discussed in the previous chapter, and to show the direction that the designer's work will have to take in determining which aptitude the program should be designed to develop. However, not only the needs of the Thai industrial structure should be taken into account, there is also the rapid change in technology, the constant progress in science, and the
increased complexity of world problems, which may affect this educational objective formulation.

Effects of Technological Change

Perhaps, there is no single force more influential on design functions than technological progress. This change and continuous economic (industrial) development have brought about a tremendous technical expansion with an increasingly rapid pace. At the beginning of the industrial revolution, the techniques employed in industry were relatively simple, and all the designer needed was creative thinking and practical, common sense (more detailed discussion in Appendix A). Since then, industrial design has become increasingly complex and the number of specialized branches has grown considerably. The task of design schools has therefore changed, and the education they provide has been adapted to this dynamic situation.

In examining the various design schools today (see Appendix E), their roles are considered to be one of training. The term "training" is used to emphasize the fact that an advanced program should influence the mentality of its students and their reactions to the situations in which they will find themselves, rather than simply provide them with a certain amount of knowledge. This does not mean that the Department will provide students with a set of answers to all the problems they will have to cope with after graduation, rather, that their attitudes and their conceptions of the roles they have to play, will lead them to adopt that
pattern of behavior, which has been found most rational and most effective in industry (R.L. Gysler et al., 1972:58-72).

It becomes evident that any training, any pattern of behaviour must be based on a certain amount of knowledge. Such knowledge should be considered as a pretext for the task undertaking. This matter is vitally important for the pilot program to give students a solid foundation of the knowledge discipline, and the practical "experiments" sufficient to constitute an effective means of training. The aspects of such "knowledge" will be discussed in detail in the following chapter.

Educational Criteria: A Desired Model of Graduating Industrial Designers

On the basis of the foregoing considerations, the objectives of the Industrial Design Graduate Program at CU may be formulated as follows:

1. Most of the industrial designers graduating from Department of Industrial Design will be assigned functions very closely concerned with production for which they will be both technically and administratively responsible. They must therefore be able to apply the knowledge they have acquired, and act as enlightened catalysts among the various professions managing the change of the economic needs. They must, at the same time, be sensitive to technological progress, in order to make use of the new possibilities
it affords and derive applications within the constraints therefrom.

2. The graduates from the Department of Industrial Design will have to adapt themselves to the specialized design problems characteristic of both modern and existing industry. They must therefore have an adequate disciplined knowledge supported by technological and scientific background, with the managerial and an administrative know-how of the industry.

3. Most of the graduates will have the responsibility of running workshops or firms. Accordingly, they must have the spirit of ownership or directorship, and be familiar with the wide range of design knowledge and the basic techniques of management and organization. In addition, to make the most of a variety of personal interests, the education provided should enable those having a special need for advanced subjects to study them in greater depth without neglecting the technical side of running a firm, which must still be the main purpose of the Department's training.
CHAPTER IV
EDUCATIONAL CONSIDERATIONS

The three objectives described in the previous chapter, having been determined on the basis of the Thai economy, necessitate certain teaching principles. However, the quality of training to be provided for students on that basis will be effective only to the extent that learners are taught how to make use of knowledge they have acquired. And, because of this, both the knowledge and the teaching methods constitute the vital parts of the program's achievement. In this chapter, the main discipline's body of knowledge (industrial design), and some philosophical-theoretical considerations of the teaching principles have been identified.

PART I: THE KNOWLEDGE-BASES OF INDUSTRIAL DESIGN EDUCATION

There was a point in time in design history where "technological innovation" (ICSID) had outlasted the ingenuity of the handicraft tradition, and the budding of the machine inventions had drastically revolutionized the complexities of man's way of designing. At almost the same instant that this happened, industrial design was evolutionized and became a hidden dimension within the many facets of that revolution. Thailand has now reached that stage, from which industrialized countries once attempted to depart.
Perhaps one might think this is a rather negative assessment about the country's development progress. What this study suggests is that Thailand has come to the point where the need for further involvement in constraints and possibilities derived from technology (technological discovery) and the need for "self-preservation" (technological recovery) have become the critical factors in its national development. And the education and practice of industrial design, which are believed to have been involved in this process of transformation, must then establish their identities.

Today, industrial design has expanded its involvement to many other disciplines, and the field itself is no longer easy to identify. Throughout this study, attempts have been made to surface the role and function of the designer. Although the three functions of designers which have been described in the previous chapter are greatly dependent on the contemporary need of the Thai society, the history of design education shows an unmistakable trend in design practices from a heavy weighting on the applied arts, towards programs in which systematic and scientific thought becomes more and more applicable.

While this scientific and technological innovation is an essential requirement of highly industrialized countries, the elements of this necessity are also recognized by industry.
In Thailand, this study finds the situation a paradoxical event. Here, "design for need" is required more than anywhere else, and yet, design has played a very minor role, for various reasons among which economic, technological and cultural dependence seems to be the most important. This study found the situation in which:

1.) Industry (especially small-scale industry) does not express a need for the designer;

2.) Society in general does not know what role the designer plays; and

3.) The designer has not yet the means nor the opportunity for developing and expressing identity.

It is within the view of this study that this situation can be changed, and that it must be changed. Although this change does not depend entirely on the designer's abilities, his professional competence has a vital role to play in the emergence of a more desirable state of things.

Pending the suspended state of technological change as previously mentioned, this "time-lapse" gives the country a second opportunity to reconstruct its own "design history" to fit the exact profile of need. By dealing with the issue of design directly, the source of change (technological innovations) can be used, rather than the equation of practice in contrast to other related design activities. The roles and practices of design and their placement in the established corpus of knowledge (body of knowledge) has caused these to change, and because of this, they can be identified, codified, and established.
To further support this contention, this chapter prepared an argument for designating "technology" as one of the principal categories (or domains) of Mankind's accumulated knowledge, and that "designing" is a major component of "technology". The role of technology in the education and practice of industrial design, with specific interests developed between the three main agencies or institutions; designers, producers and users are also discussed.

Structure and Organization of Knowledge

"Knowledge refers to "cognitive or intellective mental components acquired and retained through study and experience ....knowledge includes both empirical material and that derived by inference or interpretation" (Webster, 1978:725).

In the Yearbook of World Problems and Human Potential, (1976; H0146), "cognition" refers to:

"...the processes by which an individual obtains knowledge of an object or of its environment. It includes: perception, discovery, recognition, imagining, judging, memorizing, learning, thinking, and frequently speech. These processes develop through a series of stages from birth onwards giving rise to a progressive increase in the ability to construct and express fundamental physical concepts (such as object and space) and logical concepts (such as coherence and classification)..."

"Mental growth may therefore be defined as the progressive expansion of the individual's ability to deal effectively with encountered environmental situations. As such it is to be clearly distinguished from brain growth and neurological maturation, although a close relationship exists between them."
Through the history of Mankind, the assumption that knowledge can have an effect on being is not only to be found in religion and moral philosophies, but in humanism. Aristotle, the first great systematizer, categorized Man-kind's accumulated knowledge into three classes: (1) the theoretical disciplines, (2) the practical disciplines, and (3) the productive disciplines. The theoretical disciplines were mathematics, natural sciences and metaphysics. The practical disciplines encompassed ethics, politics, and human conduct. The productive disciplines included the fine arts, the applied arts, and engineering (McKeon, 1947).

Later in the nineteenth century, Augustine Comte proposed a new scheme of classification derived from Aristotle's earlier concepts. His positive hierarchy of the sciences started with mathematics. After mathematics came, in order: physics, chemistry, biology, and the social sciences (Cassirer, 1950).

Contemporary educators like Hanna, Phenix, Tykociner and Steiner point out similar views of knowledge to those of Aristotle. Hanna points out the remarkable correlation between the Western and the Chinese system of knowledge in which they spoke of man-to-thing, man-to-man, and man-to-spirit. Phenix, on the other hand, suggests that knowledge may be considered on a continuum where at one end of the realm is symbolics, which include language, mathematics and non-
FIGURE 1

Phenix's Realms of Meaning
discursive symbolic forms. Within **empirics** are the physical sciences, the life sciences, psychology, and the social sciences. The **esthetics** cover music, visual arts, arts of movement, and literature. The **synnoetics** encompass philosophy, psychology, literature, and religion in their existential aspects. **Ethics** is considered those varied special areas of ethical and moral concern. The last realm, **synoptics**, includes history, religion and philosophy. (See Figure I).

Phenix, too, is Aristotelian in his classification, but there is a notable omission of the applied arts and engineering (Hanna, Phenix, in E.R. Towers, et al., 1966:3-8).

Tykociner proposes a systematic scheme which operates as "...a guide to find gaps in systematized knowledge" (Tykociner, 1964:133). The following, Table 4, summarizes the scheme:

In recognition of praxiology, Steiner speculates four types of systematics knowledge about formal events, values, and practices. This formation was further developed and emerged as formal theory, event theory, valuational theory, and praxiological theory. The four classes of theory were finally conceptualized and ordered into four areas or domains of knowledge: (1) descriptive knowledge (e.g., sciences); (2) prescriptive knowledge (e.g., fine arts and humanities); (3) formal knowledge (e.g., mathematics, logic, and linguistics); and (4) praxiological knowledge (E.S. Maccia, 1965).

Tower, Lux, and Ray further described the fourth knowledge as knowledge of practice, asserting that:
### TABLE 4

#### Functions of Areas of Knowledge

<table>
<thead>
<tr>
<th>Series</th>
<th>Areas of Knowledge</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>1. Arts</td>
<td>To develop systems of symbolic representation of perceptual and cognitive activity for purposes of communication.</td>
</tr>
<tr>
<td></td>
<td>2. Symbolics of Information</td>
<td></td>
</tr>
<tr>
<td>II.</td>
<td>3. Hylenergetics</td>
<td>To systematize knowledge of basic facts and their relations.</td>
</tr>
<tr>
<td></td>
<td>4. Biological Scs.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Psychological Scs.</td>
<td></td>
</tr>
<tr>
<td>III.</td>
<td>7. Exelingmology</td>
<td>To systematize knowledge of the past, project future needs, and regulate activities.</td>
</tr>
<tr>
<td></td>
<td>8. Promoetics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10. Disseminative Scs.</td>
<td></td>
</tr>
<tr>
<td>IV.</td>
<td>11. Zetetic Sciences</td>
<td>To promote the growth of all the arts and sciences.</td>
</tr>
<tr>
<td>V.</td>
<td>12. Integrative Sciences</td>
<td>To create an all-embracing synthesis.</td>
</tr>
</tbody>
</table>


"...This domain is represented in higher education by the various professional schools and departments. Among them would be medicine, journalism, law, engineering, marketing, education, dentistry, dairy, technology, pharmacy, and many others... These disciplines demand a clinical or professional body of subject matter. This body of knowledge is termed knowledge of practice (principles of practice) or praxiology -- man's way of doing which is valued (or ought to be).

(Towers, Lux and Ray, 1966)

It is within the area or domain of praxiological knowledge the science of efficient action (Kotarbinski, 1962), from which industrial technology (Kuwik, 1970), and industrial design (Division of Design Research, O.S.U., 1972) were
Technology (Praxiology). A Term Needing Further Clarification

Technology (Praxiology), the product of the organized and disciplines study of the practice of man, has often been equated with industry, both in industrial arts and in the literature of technology. But the term itself for more than half a century has been loosely used as a means to "communicate" and used to denote the wide range of its applications (E.R. Towers, 1966:30). The loose usage of the terms "technology" and "industry" thus remains at the root of the terminological problem. Walker states:

"Since it would be impossible in less than a dozen volumes to look at the way technology influences all organizations, the emphasis (of this book) will be on industrial ones."
(Walker, 1962:1)

He then suggests that technology is apparently more inclusive than industry, but nevertheless proceeds to equate technology with industry as follows:
Technology includes both physical objects and the techniques associated with them. For instance, the technology of pottery-making includes (1) the clay or other materials; (2) the potter's wheel or other machinery; and (3) all the skills and procedures that enter into making the product. Similarly, when (speaking) of the technology of an automobile assembly line, there is signified not only the moving part and all other "hardware", but also the mass production methods devised by management and practiced by workers to assemble an automobile. In such a definition, scientific management and other kinds of engineering rules which impinge on people are included under the term "technology." (Walker, 1962:2).

From consideration of the foregoing, technology can be held to include a finished "object" and also materials, tools and machinery, skills, procedures, methods and rules used in their production. However, there are other views of this terminology. Webster, in 1961, defined "technology" as, "the totality of means employed by a people to provide itself with objects of material culture" (Webster's, 1961:2438.) It is this definition which Dewhurst, Walker, and others used implicitly. Commonly, the focus of technology is on "material culture" with only secondary concern for "the totality of means employed." Thus, practices with humans often are overlooked even when they directly affect material production. That is, some fail to note that this definition provides for the inclusion within technology ("the totality of the means") of ways of motivating or safeguarding workers, for example, as a means "to provide objects of material culture."
Technology means too many things to too many people. To further elaborate its meaning is quite beyond the scope and immediate concern of this study. However, it is recognized that "technology" has made a significant contribution to the evolution of industrial design, and it should be noted for further study.

Elements of Design in the Structure of Industrial Technology

The history of man indicates that man has developed his civilization only to the degree that he has developed his knowledge and transmitted his knowledge through some educational process. At the same time, as he has developed, his life has been formalized into five basic institutions: religion, family, education, politics, and an economic system. The institution which encompasses the industrial dimension of praxiology, as prescribed by the Industrial Arts Curriculum Project (IACP), is the economic institution (Towers, Lux, and Ray, 1966:64-71). (See Figure 3):

(Towers, Lux, and Ray, 1966:73)

FIGURE 3

Economic Institution
While organized religion, government, and the economic systems each have a dominant function to fulfill, they interrelate with each other and other societal institutions. In developing an Industrial Arts Curriculum Project (IACP), Tower, Lux, and Ray relate the functions of the economic institution and the industry this way: "The industry's primary role is that of organizing resources and of substantially changing their form so that they yield the industrial material goods required to satisfy man's wants" (E.R. Towers, et al., 1966). Such process of transformation is called "construction" if the process is on site, or "manufacturing" if the production is carried out in plant. Although construction technology and manufacturing technology are functioned on a separate basis, they have common concepts of industry in those affecting people (management, technology, and personnel technology), and in those affecting things (Production technology). The reason for this is that most production workers, for instance, are managers to some extent, and vice versa; the carpenter on a construction job when he measures and checks his work against the plan is thereby performing a control function listed under management. Likewise, the product designer produces from utility as he develops the prototype of a new product. Thus, the distinction between production of time each performs a particular function, and both are affected by personnel practices which affect the economic, physical, and social conditions related
FIGURE 4
Major Elements in Industrial Technology

(Towers, Lux, and Ray, 1966:16)
First Order  Second Order  Third Order

FIGURE 5

First, Second, and Third Order Selected Element of Manufacturing Technology

(Adapted from Towers, Lux, and Ray, 1966)
to their work environments. Since industrial management technology does affect both materials (production) and humans (personnel), it is often viewed as a body of knowledge which plans, organizes, and controls humans in a material production system (Towers, Lux, and Ray, 1966:172). The notion does imply the management's function is to plan, to organize the "input" to the system (to implement the plan), and to control the plan and organization to produce products. In classifying these practices, the IACP Staff selected the term "production technology," "management technology," and personnel technology."

Figure 4 illustrates the relationships of production technology, management technology, and personnel technology to the larger concept of industrial technology. It also illustrates that each of these three concepts of industry is common in both construction technology and manufacturing technology.

In developing the IACP program, the IACP staff identified from this basic structure of the major elements in industrial technology the sub-elements (more finite concepts) from which subject matter could be based for course content. Figure 5 illustrates a first, second, and third ordering of elements of technological concepts identified for manufacturing technology. Within this manufacturing/management technology, design functioned as an integral part of the planning process.
The sub-element of the planning process is described by IACP Staff as follows:

1. Formulating
   1.1 Determining goals
   1.2 Establishing specific objectives
   1.3 Setting policies
   1.4 Forecasting
   1.5 Programming

2. Researching
   2.1 Retrieving
   2.2 Describing
   2.3 Experimenting

3. Designing
   3.1 Determining function
   3.2 Preparing performance specification
   3.3 Postulating a solution-in-practice
   3.4 Making simple models
   3.5 Postulating alternate solutions
   3.6 Making working or scale models
   3.7 Selecting solution
   3.8 Communicating design solution
   3.9 Making prototype

4. Engineering
   4.1 Detailing design communication
   4.2 Detailing specifications and standards
   4.3 Work design (methods, standards, processes)
   4.4 Estimating
   4.5 Scheduling

(E.R. Towers et al., 1966:174)

The Equations of Industrial Design Practice

In comparing the "designing" process here against the IACP's units on design of construction technology and manufacturing technology, it reveals a common procedure in all phases of designing. It was apparent that although both units compared were structured to represent different
FIGURE 6

L. Bruce Archer's Model for Product Design
<table>
<thead>
<tr>
<th>Construction Technology</th>
<th>Archer's Systematic Process of Design</th>
<th>Manufacturing Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying the Problem</td>
<td>Analytical Phase</td>
<td>Identifying the Design</td>
</tr>
<tr>
<td>Developing Preliminary Ideas</td>
<td>a. Programming</td>
<td>Creating Alternative Design Solution</td>
</tr>
<tr>
<td></td>
<td>b. Data Collecting</td>
<td></td>
</tr>
<tr>
<td>Refining Ideas</td>
<td>Creative Phase</td>
<td>Making Three Dimensional Models</td>
</tr>
<tr>
<td>Engineering the Design</td>
<td>a. Analysis</td>
<td>Refining the Design Solution</td>
</tr>
<tr>
<td>Selecting the Design</td>
<td>b. Synthesis</td>
<td>Obtaining Approval of Management</td>
</tr>
<tr>
<td></td>
<td>c. Development</td>
<td>Designing Power Elements Building the Production Prototype</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering the Product</td>
</tr>
<tr>
<td>Making Working Drawings</td>
<td>Executive Phase</td>
<td>Making Working Drawing</td>
</tr>
<tr>
<td>Writing Specification</td>
<td>Communication</td>
<td>Technical Writing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and Illustrating</td>
</tr>
</tbody>
</table>

Reference: Paul D. Kuwik, 1970
approaches of design unique to the construction and manufacturing industries, certain principles of design underlying technological concepts were also common to both units. L. Bruce Archer (1963) reinforces this observation when he claims that the process of designing includes elements or steps, which are relevant to the design of any product. Archer explains the process of design as a systematic routine composed of three phases: an analytical phase, a creative phase, and an executive phase. In these three phases, the design process follows a continuum similar to the scientific method. The analytical phase of designing is a phase of programming and data collection which uses direct observation, measurement, and inductive reasoning. The creative phase of designing includes analysis, synthesis, and development of design data and uses evaluation, judgment, and deductive reasoning. The executive phase of designing (the last phase of the series) communicates the design using description, translation, and transmission (Archer, 1963:1-6).

In developing an achievement test to measure "The Technological Principles of Design," Kuwik (1970:55) equates Archer's systematic process of designing (Figure 6) to the concepts taught within IACP units of design in construction technology and manufacturing technology. The illustrated comparison (Figure 7) proves an existence of systematic design procedures which are common to the design of any
product, technically and scientifically.

The results of Kuwik's test instrument were then evaluated and compared for further assurance of its validity against other notable design models such as Christopher Jones (1963), Horst Rittel (1971) and the updated version of Archer (1976). It reveals that there are no significant differences among the models reviewed, although the terms have been substantially changed to fit the "style" of the individual. Nevertheless, this study noted that the built-in evaluation procedures which are commonly exercised during the creative process have been isolated and become an independent unit to serve as a monitoring device in the systematic design process (Figure 7).

![Diagram](image)

**FIGURE 7**

Model for Systematic Product Design

(Adapted from A. Gomez, 1976)
PART II: DELINEATION OF THE FIELD OF DESIGN TO ESTABLISH THE DISCIPLINE AND FIELD OF INDUSTRIAL DESIGN

In reviewing the related literature pertaining to the subject of design and its disciplines, the study has found a pool of information, but nevertheless written by only a few notable names such as Read, Carrington, Teague, and Morris. Contemporary writers such as Archer, Jones, Rittel, and Gysler, whose works have been the most influential factor for the development and progress of the field and profession of industrial design, were also the subjects of this study.

The study also reviewed the "practical" contributions of these listed names and found Bruce Archer's to have an edge over the others in terms of past background experiences in architecture, mechanical engineering, education, and industrial design. He is currently the chairman of the Department of Design Research at the Royal College of Art, England. His most distinguished work is the systematic model of design which this study has earlier utilized in equating technology to design.

Another notable name is Horst Rittel, who was the director of the Hochschule für Gesaltung at Ulm before coming to Berkeley in 1964. His work has centered on the development of information systems for various government agencies.

Ironically, both Rittel and Archer hold partial
responsibilities in the development of "A Rationale and Structure for the Discipline of Industrial Design" used by the Department of Industrial Design at The Ohio State University.

On the basis of their competencies, and their past involvements with the Department, whose programs have been among the few accredited by an Industrial Designer's Society of America (IDSA), the use of their model for this study has been justified. Therefore, in delineating the field of design to establish the discipline of industrial design, the study will deal exclusively with the synthesis of the "body of knowledge" therein contained. This will give the study a knowledge-base for the educational framework necessary in the proposed curriculum development.

Identifying the Sub-categories in the Design Field of Study

In developing a rationale and structure for the discipline of industrial design, R.L. Gysler et al. first employed the structure and format developed by IACP to guide the second phase of the delineation process. By the use of two sub-categories ("material products and services," and "other economic activity") industrial design, architectural design, and engineering design have been isolated from the other forms of general design activity. This was accomplished by an expansion of the industrial, material goods sub-category of the material products and services field.
Through this expansion process the more highly specialized fields within the overall fields of design were established. The specialized fields of study within the "material goods and services" category are concerned with the solution of design problems through the development of material products and product systems (services). The "other economic activity" category is composed of the fields of study wherein problem solutions are obtained through the use of conceptual end-products. In this way, the designing process (drawn from the discipline's structural elements) could be applied to the planning, development, and administrative functions of a management of research project. The sub-categories in the design fields of study are shown in Figure 8.

![Diagram of Design Fields of Study]

**FIGURE 8**

Sub-categories in the Design Fields of Study
Delineation of the Field of Industrial Design.

In a more recent interpretation of the industrial design field has span its scope beyond the creative process to include many aspects of manufacturing, communication, and human environment factors. These definitions (Also see Appendix B) described the designer's function as that of a creative and systematic planner who resolves problems (affecting humans and things) through the development of material products and services. Gysler, in an attempt to show the widespread philosophical differences within the broadly conceived interpretation of the field, selects two of the more common forms of definitions:

- Industrial design is a creative activity whose aim is to determine the formal qualities of objects produced by industry. These formal qualities are not only the external features but principally those structural and functional relationships which convert a system to a coherent unity both from the point of view of the producer and the user.

- Industrial design extends to embrace all the aspects of human environment which are conditioned by industrial production.

  (Thomas Maldonado)

Across the continent, Rino Petrini of the Association of Quebec Industrial Designers expressed:

- Industrial design is a process which embraces both the establishment and definition of the problem, and the manner of its solution...It is an activity undertaken at a specific instance within a specific social environment and is infringed upon by all the physical forces operative in our habitat. As such it is subject to a host of influences and pressures, both
tangible and intangible, and the forms that it assumes are mental environment, spiritual environment, material and natural environments.  
(Rino Petrini, Association of Quebec Industrial Designers)

From the definitions presented, Gysler concluded that the industrial design field is concerned with the practice of analyzing, creating, and developing products (material products and services) through systematic planning for manufacture (R.L. Gysler et al., 1972:18). Further interpretations reveals that the field has not been limited to a single or multiple grouping of industries but, on the contrary, has applied itself to all forms of material production and services. In this respect, the goal of the field seems to be to produce products (in response to particular defined problems) which are assured of acceptance by the prospective user(s) before an extensive capital investment has been made. These products must also be produced at a price permitting wide distribution and reasonable profits. Gysler also suggested that in order to obtain such a goal, the field must focus upon the material manufacturing and the human environment to develop problem solutions which fulfill the needs of humans (client, group, society) and things (a material product, systems, establishment).

R.L. Gysler et al. titled these areas, as shown in Figure 9, as "Product Design," "Visual Communication," and "Space and Enclosure Design" and defined them as follows:
"The product design area of industrial design is concerned with the planning and development of design solutions for manufactured products and product systems. Its functions are based upon the practical application of manufacturing, engineering, and the physical and behavioral science knowledges."

"The visual communication design area of industrial design is concerned with the planning and development of design solutions for non-verbal, pictorial, or linguistic communication products for manufactured products and product systems." Its functions are based upon the practical applications of visual language systems to the broadest range of visual information products. This range may encompass a variety of media such as photography, handgraphics, typography, film, and television.

"The space and enclosure design area of industrial design is concerned with the planning and development of design solutions for manufactured enclosure products and systems. Its functions are based upon the practical application of the interrelationship of human activities and the environmental aspects of constructed, volume-defining systems."

(R.L. Gysler et al., 1972:19)

In establishing the structural elements of industrial design Gysler, et al., in their preliminary study of the structural elements of industrial design discipline, categorized the field of design into eight areas of praxiologial knowledge. These areas are presented in Figure 10, and are described as follows:

1) Systematic planning practices;
2) Research and development practices;
3) Communication practices;
4) Visualization practices;
5) Marketing practices;
6) Manufacturing practices;
7) Material processing practices;
8) Human relation practices.

Close examination of these areas of practice indicate the existence of various degrees of duplication and overlap within and between categories. Therefore, Gysler et al., proposed further detailing and delineation, which involved four restructuring procedures.

First, the individual structural elements were described by the formation of general content outlines. Reference sources from both the professional design literature and literature of each respective area were employed to provide that information.

Second, the individual content outlines were detailed and ordered. They were then examined and adjusted to provide an internal consistency, devoid (within practical

![Diagram of the Field of Industrial Design](source: Division of Design, The Ohio State University, 1972:21.)
FIGURE 10

Structural Elements of the Discipline of Industrial Design

Source: Division of Design, The Ohio State University, (1972:22).
limits) of discrepancy and redundancy. This was accomplished by detailing the content outlines, coding individual items, and the cancellation or incorporation of minor and non-essential items.

Third, the items (practices) within the completed content outlines were then compared, contrasted, and correlated for the purpose of selection and placement. At this point in the process, a particular type of practice (i.e., technique, process, procedure, etc.) was established within only one of the structural element categories. In some cases, reference to a particular practice was made in several outlines, but received major emphasis only once.

Fourth, the newly formed structural elements were then evaluated in relationship to each other and received their final detailing.

Through the procedures listed above, the "research and development practices" were incorporated into the "systematic planning practices" to produce the new structural element titled "Industrial Design Systematic Planning Practices." The visualization practices" were incorporated into the "Communication Practices," and the "marketing-management-material production-human relation practices" were consolidated to form the "Industrial Design Manufacturing Practices." The models in Figures 10 and 11 were then formulated to
present the relationship between the major structural elements of the discipline of industrial design and its component areas of product, visual communication, and space and enclosure design.

![Diagram of Industrial Design Components]

**FIGURE 11**
The Relationship Between the Major Structural Elements Of the Discipline of Industrial Design

Source: Division of Design, The Ohio State University, (1972:24).

Figure 12 briefly portrays and summarizes the procedures aforementioned.

**Conclusion**

The curriculum development processes began with the establishment of the "discipline of design" in relationship to the "four domains of man's knowledge." With the
establishment of the "praxiological domain" as the basis for the discipline of design, guided and monitored by the "knowledge base" in design, the derivation of the discipline's "structural element" was accomplished. The discipline of design was then delineated to categorize its major "fields of study," with special emphasis on the "field of industrial design." As a result of becoming more specific with the completion of each stage of development, the "discipline of industrial design" was drawn out from the larger body. The "major bodies of knowledge" within the industrial design discipline were isolated, further detailed, and ordered to form major "structural elements" of (1) Industrial Design Systematic Planning Practices; (2) Industrial Design Communication Practices; and (3) Industrial Design Manufacturing Practices. Finally, the structural elements were conceptualized to produce the "major concepts" of the Industrial Design curriculum.
The Four Domains of Man's Knowledge

- Formal Knowledge
- Descriptive Knowledge
- Prescriptive Knowledge
- Praxiological Knowledge

The Discipline of Design

- Logic Theory & Practices
- Decision Making Theory & Practices
- Systematic Planning Theory & Practices
- Communication Theory & Practices

The Discipline of Industrial Design

- Systematic Planning Practices
- Research and Development Practices
- Communication Practices
- Visualization Practices
- Marketing Practices
- Management Practices
- Human Relations Practices
- Material Production Practices

(Major Bodies of Knowledge)

CONCEPTS OF THE INDUSTRIAL DESIGN CURRICULUM

FIGURE 12
Summary Model Depicting Industrial Design Curriculum Development

Source: Division of Design, The Ohio State University, 1972:47
PART III: SOME PHILOSOPHICAL-THEORETICAL BASES OF TEACHING AND LEARNING PRINCIPLES

Basic Guidelines Formulation

     Education in Thailand, as in all countries in the world, plays a central role in the economic and social development process: the maintainance of national and cultural identity, and the transmittal of new ideas and attitudes to the mass of population. In so doing, it must provide for the full development of individuality to social ends and purposes. The development of productive individuals and the fostering of a democratic social orientation are, therefore, the two fundamental guiding principles of the country's educational reconstruction as viewed by the nation's leaders. These principles permeate all education from the elementary to the university level.

     In reviewing the various theoretical approaches to curriculum development from such sources as Kotarbinski (1965), Gyler (1971), Maccia (1965), and Tucker (1967), there is clear evidence that "general" studies and "vocational" studies were conceived as separate tracks leading to separate life goals: the former preparation for liberal or professional/higher education, and the latter for those who lack either the means or skills for the former. The philosophical-theoretical position taken in this study and one that is consistent with the theoreticians just mentioned is that curriculum should be an "integrated system" where an educational experience helps a person to discover, define
and refine his talents and use them in working towards a career.

An educational program like any other activity, is directed by the expectations of certain outcomes. The chief activity of education is to change individuals in some way to fit into a social structure by adding the knowledge they possess, and to enable them to perform skills, which otherwise they would not perform, also to help develop certain understanding, awareness, insights and appreciations. It is generally agreed that these aims are related to certain wants and needs of the society, as created by the activities of life, which can be satisfied only if individuals acquire knowledge, skills, techniques and attitudes that fulfill these larger purposes.

Educational aims, on the other hand, have a variety of functions. The most important one is that of guiding decisions about the selection of content and outcome of learning experiences. Ralph Tyler questions the criteria for curriculum development this way:

1. What educational purposes should the school seek to attain?
2. What educational experiences can be provided that are likely to attain these purposes?
3. How can these educational experiences be effectively organized?
4. How can we determine whether the purposes are being
Objectives, therefore, are the important value statements of what the learner is trying to accomplish or what the educational program is trying to achieve. These objectives are derived from the needs of the individual as well as the society. The nature of knowledge also comes into focus during this complex relationship between the individual and the needs of society.

A clear statement of objectives helps to select from vast areas of knowledge in various disciplines, that which is realistically necessary for valid outcomes. Furthermore, these objectives serve as a guide for evaluation of the achievement whether it has been fulfilled in view as "process" or "product". The relationship between different components can better be illustrated with the following diagrams:

<table>
<thead>
<tr>
<th>Step 1 Needs</th>
<th>formulation of educational objectives</th>
<th>Desired Outcome (end-product) Society/Individual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Society/Individual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 2 School Program</td>
<td>select learner characteristics</td>
<td>Psychology of Learning</td>
</tr>
<tr>
<td>Step 3 Activities</td>
<td>organizing learner characteristics</td>
<td>Disciplines (concepts, skills, values)</td>
</tr>
<tr>
<td>Step 4 Revision</td>
<td>evaluation of learner performance vs. established objectives</td>
<td>Outcome</td>
</tr>
</tbody>
</table>

FIGURE 13

Tyler's Model for Curriculum Construction
Based on the foregoings, the general function of "curriculum foundations" is to give perspective and a sense of relationship among all the elements and factors involved in the development of an educational program. It is reasonable for a foundation in curriculum to identify the critical issues or points in curriculum development and their underlying generalizations. One of these is to bring out the relationships, which exist between the critical points and their supporting structure. The other is to suggest and forecast the future approaches which may possibly be explored to resolve these issues. Tyler's rationale provides a significant way to approach this large and complex problem. By the same token, his proposal is found compatible with other major writings reviewed.

Specific Guidelines Formulation

In Tyler's four major tasks in curriculum development, the primary function of his organization is to relate the various learning experiences which together comprise the curriculum in producing the maximum cumulative effect in attaining the objectives of the educational program. Gysler, in his development of the rationale for industrial design curriculum has related Tyler's concepts to several other proposals which resulted in deliberating four major considerations for sound curriculum development decision-making:

1. An analysis of the subject matter domain
2. A study of learner characteristics
3. The construction of instructional procedures and materials, and
4. The evaluation of learner performance as compared against established criteria.

(R.L. Gysler et al., 1972:53)

An analysis of the subject matter domain emerged in the methods of constructing the conceptual bases for the organization and presentation of instructional content which Gysler terms as: a) the subject-centered approach, b) the problem-centered approach, and c) the discipline-centered approach. The discipline-centered approach was singled-out as an "ideal model" because it directly relates the students to the discovery of the principal concepts of the discipline, and the inter-relationship of those concepts. Gysler advocates that in the process of examining the discipline's domain, the students can employ the methods or tools of the discipline, and also can apply these methods when confronting new aspects of the discipline. Students, according to Gysler's, thus become "active learners", (Foshay, 1962:66). In this manner, emphasis is placed upon both a concern with major concepts of education, and the methods of acquisition of these concepts.

One notable indication of Gysler's methods is the interactive sensitivity between the "facts" and "principles". For example, if concern is not shown, a major emphasis on fact could return the curriculum approach to a subject-matter schema. On the other hand, a major emphasis on the "methods
of acquisition" could bring about the problem-centered approach. Therefore, the relationship between the topic, problem, or the question being used to direct and involve the student with the concepts and methods to be acquired must be specified with utmost care.

Concerned with the manner in which the subject matter domain relates to other fields or disciplines, Gysler established five guidelines to direct the selection of learning experiences and activities from the industrial design structured body of knowledge (also see Appendix C for further details):

1. Emphasis should be placed upon the major concepts and principles of industrial design, rather than upon facts.

2. Emphasis should be placed upon the methods employed within the discipline of industrial design to treat data in its domain of knowledge.

3. Emphasis must be placed upon the balance and interaction between facts and principles.

4. The scope of "learning activities" should be largely restricted to the praxiological domain of industrial design knowledge; i.e., the application of theory, principles, etc., rather than a conceptual study.

5. The degree of emphasis on "learning experiences" upon the data and interrelationships of allied fields within the same domain of knowledge should be determined by their (students') ability to clarify
and reinforce the discipline of industrial design.

(R.L. Gysler et al., 1972:58)

Learner Characteristics.

Gysler, in referring to the writings of Simpson (1966); Krathwohl, Bloom and Masia, (1964); Bloom, (1956); and Mager (1962), draws several implications regarding the physical (psychomotor), cognitive, affective and social development characteristics pertinent to the development of the industrial design collegiate level curriculum as following:

Psychomotor Development:

1. Physical development within young adults is fairly complete and generally stabilized between individuals. However, differences in ability to perform motor skills must be realized and care must be taken to adjust psychomotor learning activities to these differences.

2. Complex manipulative activities should be preceded by a cumulative sequence of less complicated skill building acts. When this is not possible, the task at hand should be "illuminated" by a thorough explanation, demonstration, and/or trial of the required component performances.

3. Manipulative activities should be selected, planned, presented, and evaluated through the use of student
behavioral objectives; i.e., specification of psychomotor (and cognitive, affective) learning or performance.

**Cognitive Development:**

1. The learning activities and experiences within the instructional program should be varied to encourage the continuous development of many cognitive dimensions.

2. The level of learning activities and experiences should be varied in difficulty to insure that the lower fourth of the class will not be lost, nor the highest fourth of the class will be bored by lack of challenge.

3. Learning activities and experiences cannot be entirely pre-planned for the needs of all individuals, therefore flexibility through options or alternatives is mandatory. The general instructional program plan should establish the overall plan of activities, but must allow for adaptations for individual differences within the realm of practicality and feasibility.

**Affective and Social Development**

1. The interrelationship between social and intellectual development must not be disregarded.

2. The instructional activities should promote the use of peer leadership and the normal social patterns of
young adults.

3. The instructional activities and experiences should provide healthy and congenial contact with many peers (and faculty), through a variety of roles.

4. In terms of the managed-design process, considerable use of role playing through activities would seem appropriate. Also, the use of socially and professionally successful individuals as examples may be helpful for the purpose of guiding self-realization.

5. In relationship to the previous discussion the following group activity may be useful to reinforce individual study; laboratory work; group projects; role playing and simulation; field trips to design offices, manufacturing plants, construction sites, etc.

Learner Variables. A great deal of literature has evolved on the subjects of the "nature of the learner," learning theory," "instructional theory," and so on. As examples, the outlines below have been selected from those writings which are commonly found to be germane to the educational literature.

1. Phases of the teaching-learning process
   1.1 Learner readiness
   1.2 Pacing and individualizing
   1.3 Goal-setting and goal-seeking
   1.4 Affectivity and learner aspiration
   1.5 Transfer
   1.6 Evaluation
2. Factors of learning
2.1 Rate of learning
2.2 Amount to be learned
2.3 Mode of learning
2.4 Interpersonal relationships to learning
2.5 Motivation to learn

3. Categories of learning
3.1 Stimulus-response connections
3.2 Discriminations
3.3 Motor chains
3.4 Verbal chains
3.5 Concepts
3.6 Principles
3.7 Strategies

4. Variables of Learning
4.1 External variables of:
   4.1.1 Disinterest
   4.1.2 Daydreaming
   4.1.3 Physical discomfort

4.2 Internal variables of:
   4.2.1 Referent confusion
   4.2.2 Imperception
   4.2.3 Verbalism

4.3 Interviewing variables of:
   4.3.1 Prejudice
   4.3.2 Experience
   4.3.3 Cognitive knowledge

R.L. Gysler et al. *in A Rationale and Structure for the Discipline of Industrial Design, 1972, had reduced the above variables to four general contributions which concern: 1) meaningfulness, 2) interference, 3) reinforcement, and 4) readiness. They also provided brief explanations of the "learner variables" as follows:

Meaningfulness was described, for example, as the distinction between nonsense and meaningful materials. In order for subject matter to be meaningful, it must be organized and presented in a manner which promotes learning as a continuous and cumulative process. Material that does not relate to previous materials, or does not build readiness for further learning through continuity becomes non-meaningful (nonsense) and breeds inefficiency and learner frustration. In this manner, the organization of materials as they are presented to the most significant variables in learning.

(R.L. Gysler et al., 1972)

Therefore, the instructional program should use any applicable and necessary device to make activities and experiences more meaningful.

Interference was described as a block to the completion of the learning process. It is brought about through a competitive situation where in stimulus; i.e., predisposition mental or physical distraction, etc., attracts the concern of the individual and becomes more influential than the materials to be learned. In the case of learning new materials it would seem that the individual learns or forgets in relationship to a competitive situation within himself regarding that new material. Therefore, unless new materials are related in some meaningful way to previous materials (e.g., old ideas, knowledge, skills), the previous may be more competitive and may reduce the effectiveness of learning activity. Further-
more, it is then assumed that it is most satisfactory to move from general (broad) ideas to more specific ideas through a process where the logical "whole" is first presented. In addition, the new material should be presented in relationship to past and/or pre-requisite materials.

Reinforcement was described as anything that positively or negatively influences the outcome of the learning activity. It may be reward or punishment. The knowledge of results itself may be satisfactory reinforcement in one case, while an additional form of reward may be needed in another. "In most educational writings it has been agreed that immediate positive reinforcement is more desirable in terms of promoting learning activity then the use of negative reinforcement. However occasional negative reinforcement may produce some desirable results when the learner has the opportunity to learn regarding corrective behavior". (R.L. Gysler, et al., 1972).

Readiness (transfer and readiness) was described by R.L. Gysler, et al. as a condition of physical and/or psychological set. The optimum point of readiness evolves as the learner inquires a positive expectancy toward a desired goal and is able to perceive relationship by a variety of available learning techniques. They felt that preparation (readiness) for the transfer of learning is a vital component of the teaching-learning activity process. They said, "The learning experience and activities should direct the learner through

Conclusion.

In trying to reveal from several other sources what is actually applicable from modern psychology to design education programs, this study has met not only the difficulties of specialized language but has found difficulty sorting out the controversies among psychologists themselves. This, besides being a factor of confusion seems to provide us with a basis for supporting almost any educational practice by quoting the appropriate source. For this reason, the task of finding a set of fairly firm conclusions which can be accepted regardless of the framework provided by each psychological theory was seen as something which ought to be made by psychologists rather than emerge solely from considerations of this study. It would appear that, however, the only totally safe statement that can be made is that human variability does exist and it becomes a monumental task to attempt to describe a "typical learner". Nevertheless, the study recognizes the nature of the learner is an important factor affecting the selection of learning experiences and activities.
CHAPTER V
PROGRAM DEVELOPMENT

This chapter presents a model for translating the theoretical bases, generated thus far in this study, into a practical program within an institutional setting. It thereby provides a link between theory and practice.

Program Development Criteria. To guide the concept formulation and generation process, the following objectives were established:

1) In developing the knowledge-based program of work, the structured body of knowledge within the industrial design curriculum should contain and relate to:
   a) Information from the formal, descriptive, prescriptive, and praxiological domains of knowledge;
   b) Information about the natural and man-made world;
   c) Information concerning the inter-relationships that exist between man, industry, society, and the total environmental setting.

2) In providing students with socio-economic training, the program should not be intended simply to impart knowledge but, more importantly, should train students to use it. Therefore, the structured body of
knowledge within the industrial design curriculum should demonstrate: a) the concepts and principles of industrial design; b) the utilization of its subject matter in "real life" applications of occupational, recreational, economic, and social-cultural needs; c) the application of such universal processes as the systematic approach to problem solution, the processes of research and development, the process of communication, and the dynamics of individual and group (human) interaction.

3) In maintaining the effectiveness and efficiency in the employment of the knowledges and practices listed above, the structured body of knowledge within the industrial design curriculum should emphasize an understanding and appreciation for: a) how man systematically, intuitively, and creatively designs; and b) the practice employed by man to plan, communicate, and manufacture.

PART I: THE PROGRAM STRUCTURE

Program Objectives

The graduate industrial design program objectives, proposed for the Department of Industrial Design at Chulalongkorn University, are presented here in practical terms and stated at three levels.
Objectives at the Philosophical Level: The program's philosophy is to produce the cadre of design professionals who, upon completing the program, will be sensitized to their overall role and responsibility with the socio-economic picture specific to the Thai culture. At the same time, the training will have afforded them the integrative background knowledge, and the practical skills competitive with international standards of performance.

Objectives at the Behavioral Level: The Department's basic philosophy can be further expressed in the specific objective of the training of men who are capable of:

a) Functioning in the fields of industrial design and production, for which they will be both technically and administratively responsible;

b) Joining the groups whose tasks are to help prepare governmental policies concerning the cultural products and their design;

c) Sharing in the task of industrialized product planning, development, and research;

d) Imparting knowledge in industrial design as members of multi-disciplinary task forces in the government service, and the large corporations, as well as practicing industrial designers of the traditional type.

Objectives at the Operational Level: In order to produce the cadre of professional aforementioned, the Department will
have to develop a design program which reflects the higher goals and aspirations of a society which wants to emerge successfully in the world economic development arena.

This can be accomplished by efficient training through teaching methods that emphasize inter-departmental cooperation, integration of artistic, scientific, technical and practical courses, intensive multi-level communication and interdisciplinary team studies. This conciliation of theoretical knowledge and the development of practical training necessitates the attitudinal and structural changes in the existing design education program. These changes can be described in terms of specific program objectives, which are as follows:

1) To accept, apply, and develop all artistic, scientific, and technological knowledges and new endeavors that will serve to transform the once-intuitive/creative/integrative ability of the fine and applied arts designers into an ability that is closely akin to the praxiological knowledge of the areas of scientific and technology; and to achieve this goal, while furthering the industrial designers' traditional and profoundly humanist outlook upon the purpose of cultural environment;

2) To provide the educational training in which social goals and technological know-how and innovation are fused in a question and problem-solving oriented process
toward the practical goal and well-being of the Thai industry.

In the following discussion, the study attempts to describe the program structure from which will derive specific recommendations concerning the organization of program content (subject matter), and the supervision of student's work (teaching methods). The obtainment of design practices and skills in the respective areas of industrial design, which include "visual communication," "space and enclosure," and "product design," are the emphases of program development.

Structural Organization

The graduate program proposes three specialized studies in the areas of Design Administration, Design Planning and Development, and Design Education. The rationale behind this selection is based upon examination of professional practices (functions) in the field which are related to and relevant for the specific national economic and social development needs (see Chapter III). It is recognized that additional divisions may be possible; however, those which have been selected are considered pertinent, and are within the capabilities of implementation in the existing educational setting.

As stated in the behavioral objectives, the proposed functions of graduates in relationship to design activities
may be ordered into the areas of managing, designing, and teaching. All three areas may be viewed through their related components of planning, developing, researching, and managing. The end products of each area may be somewhat different, i.e., project administration, product or process development, or subject-matter instruction. However, in specific cases the end products should be similar in nature dependent upon the problem to be solved. On the basis of this premise, an instructional program model has been developed and is presented in Figure 14. In specific reference to the model, the Design Administration and Design Education areas of application represent specific job titles or positions within the field and profession; i.e., those jobs or positions relating to management and teaching. The Design Planning and Development area of application may be thought of as the overall classification for a variety (and the majority) of jobs or positions in the field and profession. From an instructional standpoint, the planning and development area may be a concentrated form of formal study to extend and refine the designer's level of knowledge and skill.

The Design Planning and Development content may be organized to reflect equal amounts of, or to place specific emphasis on, any one of three structural elements. When separated, these elements -- even though overlapping in function -- may be classified as that of planning, development, and research. It is conceivable for a student to
The Field And Profession Of Industrial Design

Product Design

Visual Communication Design

Space and Enclosure Design

Design Administration

Design Planning and Development

Design Education

Planning
Methods and Techniques
Strategies, etc.

Development
Materials and Processes,
Practices and Procedures, etc.

Research
Obtaining, Providing, and
delineating info. and data;
Testing and Evaluation, etc.

FIGURE 14
The Relationship Between the Field and Profession of Industrial Design and the Proposed Program Structural Elements.
enter the graduate program and place his entire amount of emphasis on gaining a suitable background in the overall planning and development area. If the student is intent on specializing in this area, he may overview, then place emphasis on obtaining more depth in one aspect, such as design research. If he wishes to becoming more specialized, the student may overview the entire area, and then emphasize one aspect such as design research in visual communication.

Description of the Program Areas of Emphasis (Sub-Programs)

The following pages describe information illustrating each of the three areas of program emphasis.

Design Administration: The design administration emphasis area within the proposed program in Design is concerned with the investigation and interpretation of management functions and principles; that is, planning and organizing, staffing, directing, and controlling in relation and application to the industrial design field.

The graduate program in Design Administration will conduct seminars in the overview of the industrial design profession and management. These areas of study will include an introduction to research techniques, philosophical issues in relation to corporate and managerial positions, managing creative people, selling design concepts to businesses, and considering how one might manage socio-technical problems in an industrial society. Decision-making
theory, network techniques, management accounting, corporate finance, manpower and industrial relations, psychology of individual effectiveness, consumer behavior, retailing and human factors, will be enforced by supporting coursework outside the Department.

**Design Planning and Development:** The design planning and development undertaking in industrial design is concerned with three categories: Planning, Development, and Research. Each of these categories is interrelated to the others. The students entering the graduate program could engage in a general program placing equal emphasis on all three categories, although it is more likely that they would specialize in only one of these categories.

The Planning category places emphasis on the development and application of the methods, techniques, and strategies found both within and outside the industrial design profession. Also included within this category are the activities associated with the preparation of the preliminary brief and the conceptualization of the problem solution.

The Development category places emphasis on the translation of the design concepts, the approved schematic design studies, and the complex resource data into a final solution. Included within this category are the activities associated with the documentation of the project in all its essential details.
The research category places emphasis on the development of expertise in investigatory methods including testing and evaluation techniques appropriate to industrial design. The scope of the methodologies could relate to applications in such areas as human engineering and ergonomics, perception and communication, information theory, computer science, and decision theory and systems analysis.

The design planning and development phases of the professional practice are the heart of the industrial design process, the points at which the actual form and character of the final product are planned, developed, and tested. Collaboration of all persons concerned with the project is vital during these phases. The industrial designer should therefore have a comprehensive background in the planning and development area, thereby providing him with the knowledges necessary in the integration of the requirements posed by all project collaborators.

Design Education: The design education emphasis area within the proposed program in design is concerned with the acquisition of knowledge and the development of skills which are necessary to design (plan and develop), administer (teach and supervise), and evaluate (test and revise) collegiate-(or equivalent) level instruction. The purpose of the program is two-fold. It first strives to provide the opportunity to extend and refine previous design-related
knowledges. The resultant end product is the development of expertise in special areas, and an overall breadth in professional and related areas.

The second purpose of the program is to provide the opportunity for obtaining knowledge and skill in educational practices, then adapt these practices to the design teaching situation. This is accomplished by the study of educational information and its actual application through structured teaching experiences.

Organization of Studies

Tentative Course Work and Time Allocation. The program content structure is based on a required 70 semester hours set by the University. This includes a Master's project and a comprehensive examination. The normal duration of the whole program is four semesters (2 years). Students are expected to attend to subject matter for about 18 credit hours per semester. However, the University's regulations governing required course work mandate new program an inclusion of a minimum of 3 credit hours of subject from the host Faculty (Architecture). This leaves the Department approximately 67 credit hours to be divided among the proposed three blocks of study.

Graduate Design Course Work. Approximately 17% of total courses will be devoted to study in graduate design courses. All incoming students are required to take a total
of 12 hours of the courses contained in this block. These courses serve as orientation to the program, and establish a framework for multi-disciplinary study. The content of the three core courses focuses primarily on design methods, problem solving theories, philosophy, histories, aesthetics, research and inquiry procedures. The remaining hours may be occupied by the required architectural subjects. The following are the proposed subjects for the Graduate Design Course Work:

<table>
<thead>
<tr>
<th>Design Core Courses</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>2-4</td>
</tr>
<tr>
<td>Design Theory</td>
<td>4</td>
</tr>
<tr>
<td>Fine (Traditional) Arts</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>10-12</td>
</tr>
</tbody>
</table>

Elective Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Technology</td>
<td>2</td>
</tr>
<tr>
<td>Architectural Design</td>
<td>3</td>
</tr>
<tr>
<td>Research Methodology &amp; Report Writing</td>
<td>2</td>
</tr>
<tr>
<td>Technical Drawing</td>
<td>2</td>
</tr>
<tr>
<td>Communication (Graphics)</td>
<td>3</td>
</tr>
<tr>
<td>Textile</td>
<td>4</td>
</tr>
<tr>
<td>Ceramics</td>
<td>3</td>
</tr>
<tr>
<td>Space &amp; Enclosure (Interior)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>23 (Select 12-15)</td>
</tr>
</tbody>
</table>

Graduate Specialization Course Work. Approximately 50% of the total course work will be selected from disciplinary areas outside of design. The framework of this block of related study will provide the necessary background knowledge for specialization in one of the program's three major areas of emphasis. A recommended structure and selection of courses for each area is established below and will be used as
a guide for the development of each individual student's program:

**Recommended Core Courses**

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Planning &amp; Development</td>
<td>3-5</td>
</tr>
<tr>
<td>Design Administration</td>
<td>3-5</td>
</tr>
<tr>
<td>Design Education</td>
<td>3-5</td>
</tr>
<tr>
<td>Design Research</td>
<td>3-5</td>
</tr>
<tr>
<td>Design for Development</td>
<td>3-5</td>
</tr>
<tr>
<td></td>
<td><strong>15-25</strong></td>
</tr>
</tbody>
</table>

**Elective Courses**

- Technological Innovations: 2
- Statistics: 2
- Marketing: 2
- Public Administration: 2
- Psychology: 2
- Industrial Economics: 4
- Material and Process: 2
- Prototype: 2
- Human Engineering: 2
- Computer Science: 3

23 (select 15)

**Graduate Application Course.** The remaining 33% of the total course work will be used to synthesize, integrate, and support both studies in design and studies in the "area of emphasis." These courses will also be within the Department and other disciplines, and will be chosen through consultation with a faculty advisor. The purpose of this block of study, then, is to interrelate overall and specific design-related knowledge, functions, and practices in a manner which produces competent designers, design administrators, and design educators. Independent study, projects and thesis work will contribute to the program's stated end goals. The
### TABLE 6

**A Proposed Graduate Program Event Plan**

<table>
<thead>
<tr>
<th></th>
<th>Semester 1 1</th>
<th></th>
<th>Semester 1 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours/week</td>
<td>Cr</td>
<td>L</td>
<td>S</td>
</tr>
<tr>
<td>Subject</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Design Theory</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Design III</td>
<td>4</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>History of Architecture</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Fine Arts</td>
<td>2</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>English (Advanced)</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>Electives</td>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Semester 1 3</th>
<th></th>
<th>Semester 1 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours/week</td>
<td>Cr</td>
<td>L</td>
<td>S</td>
</tr>
<tr>
<td>Subject</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Design Planning &amp; Dev II</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Public Administration</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Individual Study</td>
<td>3</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Seminar</td>
<td>3</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Electives</td>
<td>7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: CR = Credit; L = Lecture; S = Studio; OT = Outside of school work*
graduate application course work includes:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional Practice (Internship)</td>
<td>6</td>
</tr>
<tr>
<td>Thesis</td>
<td>12</td>
</tr>
<tr>
<td>Seminar</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>21</strong></td>
</tr>
</tbody>
</table>

The proposed course outlines rely on two main factors for achieving integration between "learning" and "knowing" how to use the knowledge acquired:

1) The design course will be based on the analysis of real life cases rather than on speculative design exercise;

2) Great importance will be assigned to learning through making.

The rationale and structure behind the organization and content of the foregoing may be best summarized through its objectives described at the beginning of this section. The end-product, representing the entire program event plan, is illustrated in Table 6.

PART II: IMPLEMENTATION

To facilitate the proposed education in the Department of Industrial Design, Faculty of Architecture, Chulalongkorn University, the following considerations are essential for the planned implementation.
Considerations at Policy Level

Admission Policy. In 1976, the Department of Industrial Design, which was then the Department of Fine and Applied Arts, proposed to the Faculty of Architecture an opening of an industrial design graduate program capable of admitting 15 students annually. (See Table 7.) However, the program projected only a 50% graduate efficiency which resulted in a fluctuation of student intake. These admission and enrollment policies are conflicting with the "characteristic" of the proposed program, where efficient training is considered to be the principal concern. This led to the recommendation that students should obtain their Master's Degree two years later. Only a minimum percentage of students should be eliminated, and such eliminations should be done prior to the end of the second semester, so that those students who are unable to adapt to the work of the department may consider other alternatives.

TABLE 7
Projected Student Enrollment, 1979-1981

<table>
<thead>
<tr>
<th>Master's Degree</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1979</td>
</tr>
<tr>
<td>New Student</td>
<td>15</td>
</tr>
<tr>
<td>1st Year</td>
<td>15</td>
</tr>
<tr>
<td>2nd Year</td>
<td>--</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
</tr>
<tr>
<td>No. of Graduates*</td>
<td>--</td>
</tr>
</tbody>
</table>

*Note: Based on a 50% graduate efficiency
The number of the proposed "drop-outs" can be alleviated on the one hand by adopting more demanding admission requirements while, on the other hand, making training by the Department more efficient. It is also recommended that while the Department's admission policy should be quantitatively limited and qualitatively selective, it should also be flexible enough to make an allowance for "in-service" trainees to be not only eligible for the program, but also part of the recruitment.

**Enrollment Policy.** It has been established earlier in this study that the Department should not allow quantitative policy considerations to override the necessity of providing a limited number of students with quality training, while not yielding to the pressure of admission. It was concluded that since the Department will not be able to accommodate the aggregate enrollment demand at the present time, a recommendation for efficient teaching is seen as a viable alternative.

In implementing these recommendations, CU and the people in charge of the program will have to convince the public, and particularly the students, that the number of applicants accepted for entrance should be so strictly limited because of considerable pressure created by demand. Two arguments may, however, be advanced: 1) material factors do make it impossible to accept a large number of students in a newly established programs; and 2) the Department will not be just
another department designed along the lines of existing programs to train general designers for "industry;" rather, this will be a pilot curriculum for experimenting with new teaching and organizing methods for the betterment of the industry itself.

In any event, CU will have to recognize that in making admission to the Department open to all qualified students and "trainess," the capacity of the facility must be sufficient to meet demand. Since this condition is not met at present, the matter must be put into effect immediately.

Considerations of the Physical Facilities

To implement the proposed curriculum in the existing facility would have to be worked out in detail in collaboration with the Faculty of Architecture and the Department of Industrial Design. The following are itemized tasks necessary for implementation.

**Budget.** Educational budget usually depends on the number of student intake and the quality of teaching to be provided. The fixed expenditures for each student in the graduate programs are:

- Teaching Facility: 2,000 B\(^*\) per \(\text{lm}^2\)
- Equipment: 2,000 B per student
- Supplies: 1,250 B per student
- Miscellaneous Expenditures: 625 B per student

\(*20B = \$1.00.\)**

**Source:** Department of Fine and Applied Arts, Bangkok, 1976.
Based on the proposed number of students enrolled, it requires:

1. Studio 5 @ 80m²
2. Lecture Room 3 @ 40m²
3. Library 1 @ 100m²
4. Supply Room 1 @ 50m²
5. Office 7 @ 10m² (Instructor)
   1 @ 30m² (Administrator)

Implementing the program must take this set of figures into consideration in order to be most effective.

Considerations of Instruction Materials

The problem of curriculum implementation in a newly formed field is the lack of text and materials for research. Vigorous promotional campaigns are needed to encourage the production, translation, and distribution of instructional materials.

Meanwhile, the Department has in its library a total of 300 books on the related industrial design subjects. Students may take advantage of other organizational facilities such as UNESO library, British Council's library, the AUA's library, and the library of the Asian Institute for additional research. Unfortunately, the number of highly specialized technical books are available in English, and thus, much of the instruction and the required reading in the post-graduate program has to take place in English. For
this reason, the proposed program mandates two full 
semesters of advanced language study. Should this not be 
enough, there is a local post-graduate English Language 
Center which provides intensive language study for 
university instructors, post-graduate students, and 
selected English teachers and civil servants.

Teaching Methods. It has been emphasized throughout 
the study that the proposed program should not only be 
intended simply to impart knowledge, but also train students 
to use it productively. However, such an undertaking will 
require the active participation of the student, which is 
quite difficult under the existing system of formal lectures. 
(See Appendix D for the Department's case study.) Moreover, 
the assimilation of knowledge usually requires students to 
spend long hours of patient work before reaching the point 
where they mastered this knowledge and acquired the ability 
to manipulate it with ease. Students must therefore be 
allowed sufficient time for in-depth study of their subjects, 
and their attention should not be distracted by requiring 
them to absorb too many subjects in small quantities.

Lastly, because designers are often called on to work 
as part of a team with subordinates or other superiors, 
students should become accustomed to group work while at 
school in order to prepare them for this aspect of their 
professional life.
These considerations led to a recommendation that a maximum of two subjects be studied each day, and each subject should compliment one another, so that the student would realize the close relationship between theoretical knowledge and its practical application. This arrangement makes it possible to link, by means of alternating, the teaching of theory and practical applications, so that a unit of instruction is created on which the student's work is based. In implementing these recommendations, the instructor should be available during the entire session to help the students and to make sure the lessons have been understood. Lectures, although an important part of traditional teaching which is increasingly important as the number of students increases, should not be used as the only means of providing students with the knowledge they must acquire. Lectures should be supplemented by the study of reading material which would consist of a course written by the lecturer or of any other work.

Supervision of Students' work. It is one of the Department's objectives to train men for the functions they will be assigned. The teaching staff must ensure that the student actually has the requisite aptitudes and standard. This means that students' efficiency and work must be tested throughout their school life. Oral and written examinations are usually held at the end of each semester or on completing a course to serve this purpose.
This "traditional" type of examination, however, believed to have caused some negative effect on student knowing that he will be judged on the basis of an examination. A student then concentrates all his efforts on preparing it. This is not to mention that during the course of his study the student is required to know far too much and too many fragmented subjects, so he crams for the examination and then forgets as quickly as he learned, and so has wasted his time.

It is recommended that students be encouraged to work steadily and efficiently. The traditional system of examination should be gradually phased out and replaced by one of continuous supervision of students' work.

To implement this recommendation, teaching staff should draw attention at any time to students whose works are not up to "standard." At the end of the semester, these students, and these only, will be required to take an examination. According to the results, they will either be allowed to continue normally at the Department or spend time training in industry.

The replacement of traditional examinations should not mean that students are not required to work hard. On the contrary, working discipline which is already strict at CU, will have to be even more demanding. For instance, attendance at all classes should be compulsory.

In order to facilitate the utilization of the aforementioned instructional programs, a model is developed to portray the structure of industrial design instructional system.
FIGURE 15

The Instructional System Model for the Industrial Design Educational Program
CHAPTER VI

CONCLUSION AND GUIDELINES FOR FUTURE RESEARCH

On the History of Design and Design Education

The history of design is rather loosely defined because it represents a discipline of a progressive process of self-awareness. Because the history of design, along with the history of design education, is closely linked to the history of technology, both histories are interrelated. The evolution of the designer's role in industry has been involved with larger areas of production. This trend can also be seen in design education in the form of a more demanding curriculum. Another major trend in design education is represented by the change from applied art-oriented programs to greater attention to the way design is related to science. As a result, there has been a tendency towards further rationalization and systematic inquiry.

Schools of industrial design are less institutionalized than are other design schools, such as architecture. With the rapid expansion and innovation in the traditional sense, and because of strong challenge, it is believed that the future of industrial designers' education depends very much on the ability of the school to respond to new situations in the social and economic environments.
On the Broad Objectives of Design Education

By analyzing various needs, designers appraising their own roles have concluded that their role in relationship to industry is going through a process of profound redefinition. This has two major implications:

1) Design education programs will have to expand their objectives beyond the education of the specialist designer;

2) The education of the industrial designer will have to impose more demanding objectives.

The first implication represents the need for improving two aspects of producer's and general public's awareness:

1) Raising the level of involvement of the consumer in the different stages of designing (design participation); and

2) Providing the consumer and producer (industry) with the highest possible level of awareness of design.

On the Impact of Technological Innovations

Two primary considerations have emerged from this discussion: the existing level of technology, and the general strategies for social and economic development. Because of these considerations, there are reasons for
believing that industrial design should seek its own identity in the present environment. First, although technological innovation is a vitally important component of social and economic development, this process does not take place alone in developing countries. Second, the role of technological innovation in a developing economy is (or should be) different from the role it plays in the case of the industrialized economies. Third, the structure of the economy in developing countries is such that the subject matters of design have to respond to different types of demands.

It can be concluded from this study that one of the main responsibilities of the designer is to gain recognition of his profession by industry and society at large. In achieving that recognition, the designer must display a very active attitude. It is necessary that an active role in the promotion of industrial design should also be reflected in the designer's curriculum.

On the Curriculum Development

An important step towards understanding the general processes through which education develops might come from research in developmental psychology. Those processes by which a student develops sensibilities and skills with which to identify problems and develop solutions to design problems and which are not explained in learning processes are likely to be better explained through this approach. However, this
does not necessarily mean that the models of interpretation ought to be the same, or even similar. What appears to be attractive about developmental psychology is the order which its research methodology gives to what seems to be a chaotic process.

The problem of developing a curriculum has been acknowledged as one of defining objectives at various levels from the very general to those that are quite specific. The objectives can be defined, if we keep in mind that the changes in behavior that learning experiences are expected to produce on students. This behavioristic approach is considered to be a good starting point in order to make education a feedback activity. The control of the direction of education and the evaluation of its process are believed to gain a great deal from this approach.

An analysis of the existing industrial design curriculum shows that there has been very little effort to define and evaluate the objectives and results of design education. In the particular case at Chulalongkorn University, the design program is the work of well-intending people whose curriculum has had great significance and importance originally, but which has become progressively impoverished due to the lack of systematic control and research on the goals and social validity of the program.

It is very important that the people in charge of design education be involved with subjects such as those
Guidelines for Future Research

What has been presented by this study, either in forms of research or its results, should not be considered to be final or without needs for further study. Following are the main subjects that have been identified as requiring further development and needing advanced knowledge:

Empirical Research on the Demand for Design Education. In view of the importance of understanding students' decisions about the type and amount of education they seek to acquire, there has been surprisingly little research on this topic. The Ministry of Education, in 1972, cited three reasons for this lack of research:

First, there has been a lack of adequate theory to guide empirical research. The lack of adequate theory has been a consequence of both the infancy of the subject and its interdisciplinary nature.

Second, there have been serious conceptual problems involved in empirical analysis of students' educational decision-making. The most serious problems have arisen in the treatment of the expected return to investment in education (Sylvia, 1972:10).

The third reason for lack of empirical research on students' decision about acquiring education has been the insufficiency of data. Until recently it has not been possible to construct a reliable time series on student enrollment except at the highest levels of aggregation (Sylvia, 1972:11).
In an essence of the program undertaking, an understanding of the student demand for education is as important to educational development as to planning for the education itself. Empirical models of the demand for education can be used to indicate the implications for enrollment and the direction of the program to be developed.

**Evaluation of Design Needs through Design Manpower Surveys.** A more extensive survey than what have been presented in this study is deemed necessary. More of such surveys should be taken on a regional basis, covering areas outside the country as well. Employment opportunities also need to be estimated in the light of the projected economic growth and not limited to established positions. The job qualifications of industrial designers may exceed the specialized role of the profession prescribed in the study.

**Redefinition of Educational Policy.** As a guiding principle of the program development, there is a need for further development of strategy and data base of industrial design on a national scale.

**Evaluation of Curriculum.** In order to assess the results of the proposed education, an evaluation schema (Figure 16) presents the overall plan that has been developed for the purpose of assessment and revision of both the (1) total curriculum development, and (2) instructional program components. The schema has been adapted from that proposed by Buffer (1971). The evaluation strategy which involves both formative and summative evaluation needs more in-depth study.
FIGURE 16

Industrial Design Curriculum Development Evaluation Model
BIBLIOGRAPHY


APPENDIX A

LITERATURE SEARCH
THE EVOLUTION OF INDUSTRIAL DESIGN

Industrial design is a relatively recent phenomenon. It had its beginning, approximately, in the Industrial Revolution. Design, however, has been a part of man's culture from the very dawn of civilization. This section concerns the evolution of that particular aspect of design referred to as industrial design. Problems and movements affecting the evolution of industrial design through the periods of the craftsman-designer, Industrial Revolution, and the emergence of the industrial designer are discussed.

Craftsman-Designer: Industrial design, as it concerns the products of industry, is usually considered to have emerged from the period of the Industrial Revolution in which man attempted to apply art to the products being produced.

In the period of the handicraft, the man who made the article usually designed it (Gloag, 1957:23). The craftsman's design was determined by the character of the materials available, the customary methods for fabricating them, and the function of the article. He notes that the inventive faculties of the craftsman-designer were stimulated only when he was confronted by some new problem, or when he was ornamenting his work:

With primitive peoples the forms of their utensils, weapons, and shelters persist for generations, until migration -- enforced by change of climate or the exhaustion of hunting grounds-- or the advent of foreign traders, brings them into contact with new ideas...The independent,
directing, designer appeared when industries began to use mass production methods, based on slave labour, though this designer's status would vary according to the industry, and it is unlikely that he would be more than a highly-skilled, inventive slave himself.

(Gloag, 1957:23)

Gloag further points out that, as the manufacturing enterprise grew, the work of the craftsman in many industries was increasingly directed by a master designer. Consequently, the individual scope for invention was correspondingly reduced.

Long before industry was gradually mechanized, during the first industrial revolution, the skill of craftsmen had been circumscribed by a pattern of organization which imposed repetitive tasks...Monotony is not invariably a hardship; to the uncreative mind it may be congenial, particularly when it allows the expression of personal dexterity; but executant skill in a craftsman does not imply a capacity for invention.

(Gloag, 1957:25)

The master craftsman-designed, however, had become very sensitive to the design of his products, as exemplified by the furniture designs of Chippendale. This concern for design and its form of aesthetic expression was soon to face a sudden change.

With the phenomenal development of the application of machinery, the age of the handicrafts controlled by engineers and factory owners, who were, in the early days of the Industrial Revolution, the same people. He notes that skill in design disappeared and the directors of the new industrial power were too preoccupied with the new forms of skill which
arose when production was mechanized to realize that good
design was missing from the products produced. The craftsman-
designer with his sensitivity for design did not fit into the
new industrial complex, and the engineer-industrialist
concentrated his attention on the mechanical methods for
producing goods, the machines themselves, and the materials
they consumed and fabricated. Consequently, there was a
marked neglect of design in the early phases of machine
production.

There were, however, men who realized that the products
of industry had to appeal to the potential purchaser by
their visual appearance. They believed that "art" could be
applied or put on the product and, with other things being
equal, the most "artistic" product would win the market:

The record of art in the machine and its
products was until the 1920's almost exclusively
one of inappropriate borrowing with unfortunate
visual results. It was for this reason that
Lewis Mumford could write that "Ornament
conceived apart from function was as barbarous
as the tattooing of the human body."

Only the crude pioneering stages of industry's
organization...and the movements of breakup and
reform that ran through all the arts can account
for the wrong direction from the outset: for the
misunderstanding of machine function and the
superficial adornment of machine parts and forms,
or for the prostitution of handicraft effects to
machine imitation and mechanical duplication.

(Cheny, 1936:41)
Read, in his book *What Is Design?*, points out that this "applied art" concept of design began with a proposal by Sir Robert Peel in 1832 to the House of Commons. The essence of Peel's proposal was that the English manufacturers were superior in all matters connected with machinery, but in the pictorial designs of their products which should appeal to the taste of the consumer, they were not as equally successful. Therefore, Peel recommended that money be granted for the construction of a suitable building in which could be housed a collection of famous and noble pictures to which manufacturers could refer. They could then adorn or embellish their products with similar artistic designs. This proposal was very significant in that for the first time, art was admitted into an official discussion of economic affairs. It also laid the foundations for a policy for dealing with the matter which Read considered "fundamentally false and futile."

In 1836, an official committee was appointed and, as a result of their deliberations, art schools were opened, museums were founded; and exhibitions as the predominant producer of goods was over.

The Industrial Revolution: Toynbee (1967:67) states that the essence of the Industrial Revolution was the substitution of competition for the medieval regulations which had controlled the production and distribution of wealth. However, one of the
principal features of the revolution was the rise of the factory system. Toynbee points out that of the numerous inventions of that period, the two most important in bringing the factory system into prominence were the steam engine in 1785 by Boulton and Watt and the power-loom in 1785. He notes also that the iron industry had been equally revolutionized by the invention of smelting by pit coal introduced between 1740 and 1750, and by the application in 1788 of the steam engine to blast furnaces. Another factor which contributed to the growth of the factory system was the expansion of trade, which in turn was due to the great advance made in the means of communication.

Art and the Machine

According to Gloag, it was during this period of sudden change that the activities of mechanics and the nature of the new machine-made goods were organized. (Gloag, 1954:27). Similar movements were taking place in France, with particular emphasis placed on exhibitions. The French exhibitions provided precedent, and led to the first World's Fair of Industrial Design and Art at the Crystal Palace in London in 1851. (Cheny, 1936:42).

Cheny also points out that today the building, which at that time was considered a temporary structure, is considered to be one of the great 19th century monuments of engineering, and was a creative forerunner of the age of
steel construction. The Crystal Palace, a name given the building by Punch, was, from a design aspect, far superior to the majority of products exhibited. The building, designed by Joseph Paxton, was actually a huge glass greenhouse. Pevsner states (1964:15) that Paxton's design was a triumph of logical construction, independent of any borrowed architectural traditions. Paxton faced two major problems: the first being how one could best light an exhibition building, and the second how could a building 1,848 feet long and 408 feet wide be rapidly constructed. Pevsner notes that Paxton solved these two problems by using iron and glass as building materials and by introducing a new principle of prefabrication using standardized parts. He also points out that Paxton left two full-grown elm trees standing inside the building to contrast with the rigid grid of the iron framework.

It is significant to note that Paxton, with his functional approach to the problem, achieved a unity and simplicity of design, but the products exhibited which were intended to exemplify the best of machine design have been characterized by many scholars as being inappropriate and debased.

Read concludes that underlying this whole movement from the beginning of machine production to the late nineteenth century there was still the concept that good design meant taking all the best art of all periods and applying it to the machine products in which inappropriate ornament has been
put on to the object. He states (1953:8) that this concept is still somewhat prevalent:

...the fallacy underlying the whole of this movement is by no means yet fully exposed. In the minds of our manufacturers, underlying the activities of our art schools, is still the supposition that art is something distinct from the process of machine production, something which must be applied to the manufactured objects.

Read's point of view is also shared by many current industrial designers.

**Critic - William Morris**

There were men of this era who felt that machine production was destroying the aesthetic sensibilities of man. Notable among these critics was William Morris, a poet, socialist, and craftsman. Morris condemned the tawdry and imitative manufactured articles. He advocated the life of simplicity and the revival of handicrafts. Morris spoke about the decline of art among manufacturers:

...a few artists of the kind so-called new, what can they do working in the teeth of difficulties thrown in their way by what is called commerce, but which should be called greed of money? Working helplessly among the crowds of those who are ridiculously called manufacturers, i.e., handicraftsmen, though the mere part of them never did a stroke of handwork in their lives, and are nothing better than capitalists and salesmen. (Morris, 1902:17)

Morris was further distressed by the social consequences arising from the factory system, and hoped that society might return to a life of simplicity. He believed that two
virtues of life, honesty and simplicity, were necessary in "sowing the seed of an art which is to be made by the people and for the people, as a happiness to the maker and the user." (Morris, 1902:21).

The history of technology has shown that machine products need not be shoddy or imitative and that great good can come to society through mass production. Ironically, as a result of the machine, man now has more leisure time which one hopes will be devoted to the values that Morris expounded. Morris may have been wrong in his assessment of the machine, but an examination of his writings reveals that he had great insight concerning the needs of man, design, and the therapeutic nature of creative work.

Emergence of the Industrial Designer

Bauhaus Movement: The Bauhaus movement is notable among those movements and factors which account for the emergency of the industrial designer. The Bauhaus idea grew out of the Deutsche Werkbund founded by Hermann Muthesius in 1907. The Werkbund attempted to synthesis between the "machine style" and the "arts and crafts" movement. Unlike that of William Morris, an effort was made to bring together the best artists and craftsmen with industry.

In 1919 Walter Gropius, one of the Werkbund leaders, at Weimar, Germany, combined the Weimar Art Academy with the Weimar Arts and Crafts School to create an art center known
as the Bauhaus. He felt that the artist had been isolated from the world of handicraft and industry and thus, from the community itself. The principal purpose of the Bauhaus was, therefore, to unite the many "arts" movements and break down the barriers which existed between the structural and the decorative arts.

A number of formative ideas and methods were developed by the Bauhaus. For instance, the importance of industry and mass production was emphasized in the curriculum. Gropius stated (1945:22) that he saw a demand for products which were not only technically and economically acceptable, but aesthetically appealing as well. The "artists" who were employed to apply art to the products lacked the skills and techniques to adjust their conceptions of form to the practical processes of production. The merchants and factory owners also failed to understand that good design began with the inception of the products and was not something to be applied at a later date.

The faculty of the Bauhaus was chosen on the basis of excellence in their profession or craft, not merely on academic standing. At Bauhaus, the conventional distinction between "fine" and "applied" arts was disregarded and the various arts of architecture, painting, theater, photography, furniture design, and weaving were all brought together. The students at Bauhaus were taught design by providing first-hand experience with materials. Industrial methods and
established processes of treating materials were taught only after the students were given the opportunity to experiment and handle the materials without concern for practical aims. Design was taught by avoiding the teaching of particular stylistic trends and conventional patterns of thought. Personal experiences and discoveries were made paramount.

Bauhaus, under the leadership of Gropius, also formulated a new approach to architecture. It was Gropius' feeling that architecture was weakly sentimental and too concerned with ornamentation and formalistic use of motifs. (1905:28). He felt that architecture had lost touch with new methods and materials and he wanted to restore it to a level commensurate with the modern technological world. Standardization of units and prefabrication of housing were only a few of the Bauhaus ideas which were ahead of their times. Steel tubular furniture, fabric seat and back rests, bent plywood chairs, modern lighting fixtures, typography, and textiles attest to the fruitfulness of the Bauhaus movement, but more important than these products were the ideas and concepts which continue to affect contemporary thought, and which became a part of a larger philosophy emerging during this era: the philosophy of functionalism.

**Philosophy of Functionalism:** The concept of functionalism is not simply defined. With its various interpretations and
origins, it can be generally defined as "form following function" (Louis Sullivan). DeZurke, in his book *The Origins of Functionalism* states that historically, the functionalist trends are those which have stressed the importance of fitness and utility (1957:4). He notes that in architecture those advocating functionalism are those who make strict adaptation of form to function the basic principle of design and the means by which they measure the excellence or beauty of architecture. The extreme functionalist contends that beauty results automatically from the most perfect mechanical efficiency, and that correctly engineered products achieve beauty without a conscious search for it by the designer.

Most criticism of functionalism is based on this extreme view. DeZurke, however, notes that today, certain positive features of functionalism are emphasized: 1) designers should "seize eagerly the idea of the newness of our contemporary problems and invent wholly new forms to solve these new problems most efficiently; 2) that designers should exploit fully these potentialities of the new materials and methods of production. While some functionalists disregard ornamentation completely, Louis Sullivan, acknowledged to be one of the outstanding functionalists, did not feel that ornamentation was necessarily incompatible with the functionalist approach. Sullivan suggests that the principle condition of ornament is that it should justify its existence by serving some particular function:
A building which is truly a work of art is in its nature, essence and physical being an emotional expression... I believe, as I have said, that an excellent and beautiful building may be designed that shall bear no ornament whatever... I hold to the (idea) that the presence or absence of ornament should, certainly in serious work, be determined at the very beginning of the design... An ornamental design will be more beautiful if it seems a part of the surface or substance that it receives than if it looks "stuck on," so to speak. (Sullivan, 1957:187).

Read states (1954:35) that with the emergence of the industrial designer the question is not whether the machine can continue the tradition of ornament characteristic of European art since the Renaissance. He points out that today the machine product does not need this type of ornamentation and in the early development of the machine, attempts to produce this type of ornament failed. Read feels the real question is, can the machine, since it has rejected this type of ornament, now produce a work of art? He feels it can, if the functionalist theory of art is properly understood.

He points out that there are two types of art: humanistic, which concerns the expression of human ideals or emotions in plastic form, and abstract art of non-figurative art which "has no concern beyond making objects whose plastic form appeals to the aesthetic sensibility." He notes that objects of abstract art appeal to one's sensibility for either physical or rational reasons in that they obey certain rules of symmetry or proportion, or they may appeal to one's unconscious intuitional faculty:
...My contention is that utilitarian arts--objects designed primarily for use -- appeal to the aesthetic sensibility as abstract art; and that this appeal might be intuitional as well as rational; that the form of objects...is not simply a question of harmony and proportion... but may be created and appreciated by intuitional modes of apprehension. (Read, 1954:36)

He concludes, however, that the highest kinds of abstract art are not rational and cannot be produced by "rule and measure," but "depend on an intuitional apprehension of form:"

Whenever the final product of the machine is designed or determined by anyone sensitive to formal values, that product can and does become an abstract work of art in the subtler sense of the term. It is only the confusion between art and ornament, and the inability to see the distinction between humanistic and abstract art, and the difference between rational abstraction and intuitional abstraction, that prevents us from regarding many of the existing products of the machine age as works of art...(Read, 1954:37).

The machine can, according to Read, produce good design in the highest meaning of that term.

Beginning of Industrial Design in the United States: When in 1920, Joseph Sinel stamped on his letterhead the term "industrial designer," this was the first recorded occasion of the use of this term in the United States. At that time, no university offered a title in industrial design. (In the U.S., 20 institutions offered that title in 1960, and 42 offered it in 1973. Source: IDSA, 1973:2).
When the Bauhaus was closed in 1933, many academics who left Germany started working at American universities. For example, Moholy Nagy founded the Chicago "Institute of Design" which greatly influenced the way design education was understood in the United States. From 1930-1940, the U.S. took the lead in developing the practice of industrial design, largely as a consequence of the economic depression. Industry, desperate for improving its financial situation, asked people like Bel Geddes, Loewy, T. Teague, Dreyfuss, and others to restyle their products. Teague took the first steps in officially establishing professional status for industrial design in 1922, after getting special tax treatment from the U.S. Government. In 1938, this same group of people set up the Industrial Designers Institute.

The orientation of American industrial design can be said to have been decisively determined by the commercial viability of the U.S. market. But, when this happened in the development of European industrial design, the emphasis differed. Industrial design no longer existed as an activity in Germany after the Bauhaus closed. Great Britain, making use of its historic background and industrial tradition, emphasized the diffusion of design among industries and commerce in a campaign promoted by the Council of Industrial Arts.
Industrial Design After the Fifties: World War II had a major influence in the development of industry and design. Before the war, all design was evolutionary, engineers relied on "rules of thumb" for their professional practice while research was mainly the work of scientists. (Archer, 1968:152).

When technology was pushed into a hostile environment, a large number of artists, craftsmen, and people in the humanities went into war tasks which utilized their professional skills but which also required a new appraisal of the laws of science, i.e., camouflage, technical illustration, logistics.

At the same time the development of new disciplines, technologies (e.g., cybernetics) and mass communication led to many significant events which occurred during and after the war. A Design Council was established in 1944; the Design Research Unit was founded in 1945; Ergonomics was established as a separate discipline in 1947; the Royal College of Art is reformed in 1948, becoming a university environment with a great, fresh emphasis on design. Finally, many people who had the opportunity to work in multi-disciplinary teams during the war continued to work along their broadened lines. For instance, Abercrombie, a zoologist, went into architecture; L.B. Archer, a mechanical engineer, became a lecturer at the "Arts and Crafts," etc.

By that time, the Marshall Plan brought to Europe massive American technological literature which was greatly responsible for the shift that design was to have towards
becoming a more rational-based activity. But, at the same time, design became more pragmatic and committed with the new trends in production techniques which developed in America.

ULM and the Tendency Towards a Rational Approach: When the "Hochschule fur Gestaltung" opened in Ulm in 1955 under the direction of Max Bill, Germany was once more the country which proved for a major innovation in the field of industrial design education. Two years later, the ICSID, the International Council of Societies of Industrial Designers, was founded. Although differing substantially from the Bauhaus in many respects, the "Hochschule fur Gestaltung" inherited the fundamental task of forming the professional that the Bauhaus was intended, but failed, to be.

Ulm was born at a time when aesthetic values were in a state of anarchy, a situation which has changed little since then. The fundamental aesthetic patterns which had remained rather stable since the beginning of the early Industrial Revolution had completely disappeared after the Functionalists. This situation, together with Ulm's emphasis on the scientific commitments of industrial design, have since meant the denial of any involvement with aesthetics (one of the most controversial dimensions of industrial design). Nevertheless, this could have hardly been the right attitude for a school declaring its fundamental goals beyond the purely scientific or technological developments for their own sake.

The following paragraph, taken from Ulm's official
publication, provides a picture of the school's stance on this matter:

The concept of 'educated person' has grown frail, and the idea of taste with it...put to the service of industry, taste is deprived of just that spontaneity which it needs for its development. Taste would only be present where the artificial surmounted its artificiality, and changed into naturalness. He...who left taste behind him, would have it. This is not appreciated either by those who ...claim to have no taste, or by those who would like to glorify taste as a condition sine qua non of design. (Ulm, 1957:57)

Another important side of Ulm's contribution is its preoccupation about design theory and, in particular, design methodology. Much of the initial effort of the school was dedicated towards the understanding of the processes of thought underlying the design activity. Because of this, the outcome of the work did not take the form of traditionally accepted "pieces of good design."

Reyner Banham wrote in the "Architectural Review:"

Ulm...although small, has proved extremely influential in the world of design, at least the level of ideas...but it has so far produced no characteristic style of design. Rather, it has become a cool training ground for a technocratic elite. (Banham, 1961; )

During this history of the school's existence, internal struggles arose. These were due primarily to discrepancies over the importance that design methods should be given in the context of the whole program, and the position that the designer should have in relation to the other members of a
design team. But the most important problems that the school had to face were of a different nature: political problems caused by the reaction of influential sectors which saw the ideas of the school as a threat to the recently re-emerging cultural and industrial German scene. (Gomez, 1976:158) Confronted with the "alternative" of disappearing physically or disappearing by renouncing its ideal of giving "structure and sense to the human environment," Ulm ceased its activities on September 30, 1968.

Two of the educational objectives of Ulm represent better than any other the legacy that the school has left in the history of industrial design education:

1) The study of the impact of modern industrial products upon man and his environment:

2) An intensive, scientifically-based search for the mechanisms underlying the design activity.

The identification of these objectives represent the maturation of a professional from one who a few years before was working anonymously on the shaping of industrial products to a well-established specialist conscious of the whole spectrum of his possibilities, and fully aware of the necessity for understanding the mechanisms governing his action.
The Sixties: The Decade of Design Methods: By the time design methods had become one of the main subjects of research in Ulm, much was going on in Britain in the same field. It is here where design methods were to have their most significant development. Christopher Jones went to Manchester, Alexander was working at Harvard, and Archer joined the Royal College of Art at the invitation of Misha Black, who had come as professor of the emerging School of Industrial Design (Engineering).

Three conferences on design methods were to have a tremendous impact on design thinking and design education almost everywhere: in 1962, at Imperial College in London, where Alexander presented his famous "Indian village;" in 1965, in Birmingham, under Gregory; and in 1969, in Portsmouth, under Broadbent.

After the publication of Alexander's "Notes on the Synthesis of Form" (1949) and Jones' "Design Methods," the arguments as to whether design can be represented as a "black box" or a "transparent box" and the subsequent attempts to model the design activity spread rapidly, and greatly influenced research and education in design in Britain, the U.S., Europe, Asia, and influential countries in Latin America. The evolution, from an intuitive approach to design towards the rationalization of the processes underlying that activity had its climax during the late sixties.
APPENDIX B

SOME DEFINITIONS OF INDUSTRIAL DESIGN

161
Some Definitions of Industrial Design*

1. "All men are designers."
   (Papanek, 1972)

2. "Man became a designer as soon as he began to modify the form of natural objects."
   (W.H. Mayall, 1967)

3. "Design is the initiation of change in man-made things."
   (Jones, 1962)

4. "The designer is a planner with an aesthetic sense."
   (Munari, 1966)

5. "(When designing) we are concerned, not with the works of art whose only purpose is to please the senses or intellect, but with works of art which must in addition perform a utilitarian function."
   (Read, 1935)

6. "The opposite of design chaos."
   (Fuller, 1972)

7. "Design is the conscious effort to impose meaningful order."
   (Paneck, 1972)

8. "Designing is finding the right physical components of physical structure."
   (Alexander, 1962)

9. "Design is to conceive the idea for some artefact or system and/or to express the idea in an embodiable form."
   (Archer, 1971)

10. "Design is the deliberate ordering or planning of space, matter, or activity for a given purpose."
    (Holmes, 1934)

11. "The question of design is a social question; it is an integral part of the social question of our time."
    (Pevsner, 1964)

12. "Briefly the designer is one who experiences, perceives, analyzes, symbolizes, synthesizes."
    (Rand, 1951)
13. "The industrial designer is a person who offers society alternative futures."
   (Piper, 1970)

14. "Designing is relating products with situations to give satisfaction."
   (Gregory, 1972)

15. "Designing is finding the optimum solution to the sum of the time needs of a particular set of circumstances."
   (Matchett, 1962)

16. "The ultimate job of design is to transform man's environment and tools, and by extension, man himself."
   (Papanek, 1972)

17. "Design is a highly innovative cross-disciplinary process through which man seeks to satisfy himself but also seeks to satisfy the needs of others."
   (Gasson, 1974)

18. "An industrial designer is understood by the Society of Industrial Artists and Designers, as one in whose work the creative and visual aspect of the process forms an essential part; he is also one who has experiences working to a certain scale. He is used to concentrating on design detail rather than large scale relationships of solid and void, structure and landscapes; he is concerned for the most part with components forming the environment itself."
   (Society of Industrial Artists & Designers, 1970)

19. "The term 'design' embraces those elements which are unique to products, and which regards these products as not only the making of a mechanism of an object, content, a way of life, and hence having social and cultural intention."
   (Fossatti, 1973)

20. "The factory designer's job is to advise on design matters in the formulation of the firm's policy, to keep the firm in touch with general developments in design and fashion and to give advice on the general styling of the ranges of each session."

21. "Industrial design is a creative activity, the aim of which is to determine the formal qualities of objects produced by industry. These formal qualities are not only the external features but principally those structural and functional relationships which convert a system to a coherent unity both from the point of
view of the producer and users. Industrial design extends to embrace all aspects of human environment which are considered by industrial production." (ICSID, 1957)

22. "Artefacts like human things, evolve. Unlike living things, however, artefacts evolve through the intervention of our human culture. Design processes are these conscious human processes which cause artefacts to evolve. They may be feedback processes, in which design activity is the result of the perception of a need (an error signal) and are aimed at correcting or removing the need, or they may be feedforward processes which are more mysteriously rooted in human culture and result in 'creative' works." (Mallen, 1974)

23. "Design is the area of human experience, skill, and knowledge that reflects man's concern with appreciation and adaptation of his surroundings in the light of his material and spiritual needs. In particular, it relates with configuration, composition, meaning, value and purpose in man-made phenomena." (Archer, 1976)
APPENDIX C

THE STRUCTURAL ELEMENTS OF THE DISCIPLINE OF INDUSTRIAL DESIGN
1. Industrial Design Communication Practices

1.1 Encoding

1.1.1 Formulating

1.1.1.1 Defining Goals

1.1.1.1.1 Identifying purposes of communication
1.1.1.1.2 Identifying response to be elicited
1.1.1.1.3 Defining policy (e.g., corporate or trading policy)

1.1.1.2 Defining constraints

1.1.1.2.1 Identifying the source's and receiver's attitudes
1.1.1.2.2 Identifying the environmental, cultural and social context
1.1.1.2.3 Identifying the source's and receiver's levels of knowledge
1.1.1.2.4 Identifying factors which determine effectiveness of communication
1.1.1.2.5 Identifying appropriate channel(s); i.e., mode, message vehicle and message carrier
1.1.1.2.6 Identifying types and sources of noise
1.1.1.2.7 Identifying sources of knowledge; e.g., oneself, data banks, books, etc.
1.1.1.2.8 Identifying motivational level of receiver
1.1.1.2.9 Identifying investment constraints; e.g., time, effort or money
1.1.1.2.10 Identifying any contractual constraints
1.1.1.2.11 Identifying and analyzing feedback

1.1.1.3 Predicting

1.1.1.4 Programming
1.1.2 Reviewing

1.1.2.1 Locating
1.1.2.2 Describing
1.1.2.3 Critiquing
1.1.2.4 Relating
1.1.2.5 Recording

1.1.3 Analyzing

1.1.3.1 Identifying sub-problems
1.1.3.2 Analyzing sub-problems about means
1.1.3.3 Analyzing sub-problems about ends
1.1.3.4 Preparing performance specifications

1.1.4 Synthesizing

1.1.4.1 Hypothesizing
1.1.4.2 Modelling
1.1.4.3 Postulating alternative solutions
1.1.4.4 Inferring
1.1.4.5 Comparing
1.1.4.6 Resolving

1.1.5 Structuring

1.1.5.1 Selecting a channel

1.1.5.1.1 Selecting a message vehicle (physical signal)
1.1.5.1.2 Selecting mode(s) of encoding and decoding
1.1.5.1.3 Selecting vehicle carrier

1.1.5.2 Selecting a code
1.1.5.3 Selecting elements from the code
1.1.5.4 Selecting methods for structuring the elements of the code
1.1.5.5 Selecting content
1.1.5.6 Selecting elements from the content
1.1.5.7 Selecting methods for structuring the content
1.1.5.8 Selecting treatment
1.1.5.9 Selecting elements from the treatment
1.1.5.10 Selecting methods for structuring the treatment
1.1.5.11 Controlling noise
1.1.5.12 Controlling redundancy
1.1.5.13 Interrelating selected code, content, and treatment
1.1.6 Transmitting

1.1.6.1 Verbalizing

1.1.6.1.1 Structuring (relating signs)
1.1.6.1.2 Denoting (relating sign to object)
1.1.6.1.3 Connoting (relating sign to person)
1.1.6.1.4 Interrelating all of the above
1.1.6.1.5 Reviewing
1.1.6.1.6 Evaluating
1.1.6.1.7 Revising

1.1.6.2 Visualizing (graphic elements, alphanumeric characters, etc.)

1.1.6.2.1 Assembling

1.1.6.2.1.1 Assembling message vehicle(s)
1.1.6.2.1.2 Assembling message carrier(s)
1.1.6.2.1.3 Assembling tools

1.1.6.2.2 Structuring (relating visual signs)

1.1.6.2.2.1 Grouping
1.1.6.2.2.2 Contrasting
1.1.6.2.2.3 Juxtapositioning
1.1.6.2.2.4 Forming
1.1.6.2.2.5 Transforming
1.1.6.2.2.6 Joining

1.1.6.2.3 Denoting/symbolizing

1.1.6.2.3.1 Silhouetting
1.1.6.2.3.2 Graphing
1.1.6.2.3.3 Picturing
1.1.6.2.3.4 Juxtapositioning
1.1.6.2.3.5 Modeling
1.1.6.2.3.6 Universalizing
1.1.6.2.3.7 Superimposing
1.1.6.2.3.8 Diagramming
1.1.6.2.3.9 Inscribing
1.1.6.2.4 Connoting
   1.1.6.2.4.1 Stylizing
   1.1.6.2.4.2 Distorting
   1.1.6.2.4.3 Juxtapositioning

1.1.6.2.5 Reviewing
1.1.6.2.6 Evaluating
1.1.6.2.7 Revising

1.1.7 Generating
   1.1.7.1 Specifying message vehicle(s) (Physical signal)
   1.1.7.2 Specifying vehicle carrier(s)
   1.1.7.3 Specifying joining methods
   1.1.7.4 Reviewing
   1.1.7.5 Evaluating
   1.1.7.6 Revising

1.1.8 Specifying reproduction
   1.1.8.1 Production programming
   1.1.8.2 Production supervising
   1.1.8.3 Overseeing production implementation

1.1.9 Specifying distribution
   1.1.9.1 Planning for warehousing and storing
   1.1.9.2 Planning for dispatching
   1.1.9.3 Planning for storehousing (storing and retrieval systems)

1.2 Decoding

1.2.1 Perceiving (seeing, hearing, touching)
   1.2.1.1 Receiving stimulus
   1.2.1.2 Discriminating
   1.2.1.3 Selecting/filtering
   1.2.1.4 Recognizing
   1.2.1.5 Generalizing

1.2.2 Analyzing
   1.2.2.1 Analyzing elements selected from code
   1.2.2.2 Identifying underlying structure of elements of the code
   1.2.2.3 Analyzing content elements
   1.2.2.4 Analyzing structural aspects of content
   1.2.2.5 Analyzing treatment elements
   1.2.2.6 Analyzing structural aspects of treatment
1.2.3 Synthesizing

1.2.3.1 Structuring (perceptions)
1.2.3.2 Referring
1.2.3.3 Relating
1.2.3.4 Comparing
1.2.3.5 Generalizing
1.2.3.6 Inferring
1.2.3.7 Associating
1.2.3.8 Concluding-deciding
1.2.3.9 Evaluating

1.2.4 Responding

1.2.4.1 Reflexive behaving
1.2.4.2 Learning
1.2.4.3 Encoding
1.2.4.4 Evaluating
1.2.4.5 Retaining trial response or
1.2.4.6 Discarding trial response
1.2.4.7 Recording
1.2.4.8 Storing

2. Industrial Design Systematic Planning Practices

2.1 Formulating the problem area

2.1.1 Defining the problem

2.1.1.1 Identifying needs
2.1.1.2 Defining the problem in relationship to purpose, goals, environment, user, etc.
2.1.1.3 Deriving the mission profile
2.1.1.4 Determining functional objectives
2.1.1.5 Deriving conceptual requirements
2.1.1.6 Qualifying limits and constraints
2.1.1.7 Determining inputs, outputs, boundaries
2.1.1.8 Developing system design
2.1.1.9 Partitioning into sub-systems or sub-problems and assigning functions and responsibilities
2.1.1.10 Establishing specific requirements
2.1.1.11 Developing communication channels
2.1.1.12 Determining authority/management requirements

2.1.2 Proposing plausible problem solutions

2.1.2.1 Establishing preliminary strategy
2.1.2.2 Hypothesizing problem solutions
2.1.2.3 Postulating design concepts
2.1.2.4 Development models
2.1.2.5 Deriving performance and achievement requirements
2.1.2.6 Developing quantitative specifications
2.1.2.7 Establishing managerial controls and staffing

2.1.3 Selecting plausible problem solution

2.1.3.1 Evaluating alternatives by comparing, contrasting, correlating
2.1.3.2 Organizing by coding, ordering
2.1.3.3 Performing functional, task, method-means, cost-effectiveness, and program objective analysis
2.1.3.4 Performing feasibility study
2.1.3.5 Estimating tractibility, creditability, pervasiveness, timeliness
2.1.3.6 Justifying apparent utility and inherent significance
2.1.3.7 Selecting by examining, eliminating, adopting, or adapting

2.2 Researching problem solution information and data

2.2.1 Reviewing information and data sources

2.2.1.1 Locating
2.2.1.2 Describing
2.2.1.3 Critiquing
2.2.1.4 Relating
2.2.1.5 Recording and/or reporting

2.2.2 Structuring the experimental or investigatory plan

2.2.2.1 Outlining overall research design, variables, controls, processes, sources of data, instruments, sample
2.2.2.2 Detailing internal and external validity and reliability
2.2.2.3 Operationalizing instruments and devices
2.2.2.4 Qualifying special conditions
2.2.2.5 Scheduling work and resources

2.2.3 Collecting information and data

2.2.3.1 Specifying/selecting desired information
2.2.3.2 Specifying/selecting population or sources
2.2.3.3 Specifying/selecting sampling procedures
2.2.3.4 Specifying/selecting instruments and methods of collection
2.2.3.5 Specifying/selecting arrangements and schedules for collection
2.2.3.6 Implementing collection procedures
2.2.3.7 Retrieving information and data instruments

2.2.4 Organizing information and data
2.2.4.1 Specifying organization format
2.2.4.2 Obtaining information
2.2.4.3 Coding information
2.2.4.4 Ordering information
2.2.4.5 Storing information (recording)

2.2.5 Analyzing information and data
2.2.5.1 Specifying/selecting procedures for analysis
2.2.5.2 Specifying/selecting means for performing analysis
2.2.5.3 Retrieving data
2.2.5.4 Operating through statistical or non-statistical procedures

2.2.6 Synthesizing information and data
2.2.6.1 Testing hypothesis for acceptance or rejectance
2.2.6.2 Determining findings
   2.2.6.2.1 Presenting
   2.2.6.2.2 Examining
   2.2.6.2.3 Summarizing
2.2.6.3 Drawing conclusions
   2.2.6.3.1 Critiquing
   2.2.6.3.2 Interpreting
   2.2.6.3.3 Projecting
2.2.6.4 Deriving recommendations
   2.2.6.4.1 Suggesting procedures and processes
   2.2.6.4.2 Reporting product recommendations

2.3 Preliminary designing (system and/or product)
2.3.1 Retrieving and summarizing research report and data
2.3.2 Researching additional system/product variables
2.3.3 Formulating analogues of the chosen design concept

2.3.3.1 Analyzing problem situations
2.3.3.2 Describing design concept in terms of parameters and variables
   2.3.3.2.1 Proposing idealizations
   2.3.3.2.2 Determining interrelationships

2.3.3.3 Writing performance equations
   2.3.3.3.1 Assembling criterion function factors

2.3.3.4 Testing archetypes
2.3.3.5 Simplifying the formulation
2.3.3.6 Summarizing the mathematical description verbally and visually

2.3.4 Performing sensitivity, compatibility, and stability analyses on the archetype

2.3.4.1 Testing solutions in the abstract against the spectrum of requirements
2.3.4.2 Investigating characteristic tolerances of major components and critical materials
2.3.4.3 Examining the extent of perturbations within internal and external (environmental) forces

2.3.5 Optimizing the archetypal representation

2.3.5.1 Selecting proper mathematical archetype
2.3.5.2 Translating performance criteria function
2.3.5.3 Optimize functional constraints (which constitute the mathematical description of the archetype of the proposed object)
2.3.5.4 Optimizing regional constraints (allowable limits on design parameters or on divided groups of parameters representing more complete attributes of the proposed object)

2.3.6 Estimating performance in light of future standards of excellence

2.3.7 Predicting performance under various operational conditions

2.3.8 Evaluating design concept by subjecting critical parts to hard realities of physical testing
2.3.9 Simplification of design concept

2.4 Detail designing

2.4.1 Estimating time and cost, and scheduling work and resources
2.4.2 Mobilizing technical and supportive manpower
2.4.3 Establishing design sub-systems
   2.4.3.1 Translating mathematical archetypes or analogues into visualizations or verbal messages

2.4.4 Establishing design components
   2.4.4.1 Transforming visualizations and verbal messages into graphic representations suitable for designing parts
      2.4.4.1.1 Creating
      2.4.4.1.2 Experimenting
      2.4.4.1.3 Adapting
      2.4.4.1.4 Refining

2.4.5 Designing parts
   2.4.5.1 Selecting appropriate materials
   2.4.5.2 Determining production phases
   2.4.5.3 Describing parts through visual specification
   2.4.5.4 Describing parts through verbal specification

2.4.6 Preparing assembly drawings
   2.4.6.1 Developing component drawings
   2.4.6.2 Developing sub-system drawings
   2.4.6.3 Developing grand assembly drawings

2.4.7 Revising expected manufacturing costs
2.4.8 Producing prototypes for experimental purposes
2.4.9 Constructing working prototypes
2.4.10 Testing the product/system
2.4.11 Evaluating the product/system
2.4.12 Redesigning or refining the product/system
2.4.13 Presenting the product/system and securing approval

2.5 Specifying product/system design production
   2.5.1 Planning manufacturing process
2.5.2 Specifying or designing tools and fixtures
2.5.3 Specifying or designing production facilities
2.5.4 Planning production control
2.5.5 Planning quality control
2.5.6 Planning communication and information flow

2.6 Diffusing product/system design

2.6.1 Planning for dissemination

2.6.1.1 Designing the packaging
2.6.1.2 Planning the warehousing
2.6.1.3 Planning the promotional activity

2.6.2 Planning for installation, implementation, and institutionalization

2.6.2.1 Planning for consumption
2.6.2.2 Planning for adequate duration of service
2.6.2.3 Planning for retirement of the product

2.7 Evaluating product/system design

2.7.1 Providing
2.7.2 Obtaining
2.7.3 Delineating
2.7.4 Refining - redesigning

3. Industrial Design Manufacturing Practices

3.1 Manufacturing Management Practices

3.1.1 Planning

3.1.1.1 Formulating

3.1.1.1.1 Determining goals
3.1.1.1.2 Establishing specific objectives
3.1.1.1.3 Setting policies
3.1.1.1.4 Forecasting
3.1.1.1.5 Programming

3.1.1.2 Researching/Analyzing

3.1.1.2.1 Retrieving
3.1.1.2.2 Describing
3.1.1.2.3 Experimenting

3.1.1.3 Synthesizing/Designing
3.1.1.3 Determining function
  3.1.1.3.1 Determining function
  3.1.1.3.2 Preparing performance specification
  3.1.1.3.3 Postulating a solution-in-principle
  3.1.1.3.4 Making simple models
  3.1.1.3.5 Postulating alternate solutions
  3.1.1.3.6 Making working or scale models
  3.1.1.3.7 Selecting solution
  3.1.1.3.8 Communicating design solution
  3.1.1.3.9 Making prototype

3.1.1.4 Detailing
  3.1.1.4.1 Detailing
  3.1.1.4.2 Detailing specifications and standards
  3.1.1.4.3 Establishing work design (methods, standards, processes)
  3.1.1.4.4 Estimating
  3.1.1.4.5 Scheduling

3.1.2 Organizing
  3.1.2.1 Structuring
    3.1.2.1.1 Analyzing work tasks
    3.1.2.1.2 Determining worker function
    3.1.2.1.3 Establishing roles
    3.1.2.1.4 Setting work conditions

  3.1.2.2 Supplying
    3.1.2.2.1 Requisitioning
    3.1.2.2.2 Procuring and sub-contracting
    3.1.2.2.3 Routing
    3.1.2.2.4 Storing

3.1.3 Controlling
  3.1.3.1 Directing
    3.1.3.1.1 Supervising
    3.1.3.1.2 Coordinating
    3.1.3.1.3 Assigning
    3.1.3.1.4 Administrating

  3.1.3.2 Monitoring
    3.1.3.2.1 Inspecting
    3.1.3.2.2 Inventorying
    3.1.3.2.3 Timekeeping
3.1.3.3 Reporting

3.1.3.3.1 Compiling
3.1.3.3.2 Appraising
3.1.3.3.3 Notifying

3.1.3.4 Correcting

3.1.3.4.1 Adjusting
3.1.3.4.2 Expediting
3.1.3.4.3 Restraining
3.1.3.4.4 Replanning
3.1.3.4.5 Redirecting
3.1.3.4.6 Retraining

3.1.3.5 Authorizing

3.1.3.5.1 Verifying
3.1.3.5.2 Certifying
3.1.3.5.3 Approving or disapproving
3.1.3.5.4 Redefining

3.1.3.6 Programming

3.1.3.6.1 Evaluating
3.1.3.6.2 Scheduling
3.1.3.6.3 Routing

3.1.3.7 Financing

3.1.3.7.1 Appraising
3.1.3.7.2 Estimating probable cost
3.1.3.7.3 Funding
3.1.3.7.4 Documenting
3.1.3.7.5 Budgeting

3.2 Manufacturing Personnel Practices

3.2.1 Hiring

3.2.1.1 Recruiting
3.2.1.2 Selecting
3.2.1.3 Inducting

3.2.2 Training

3.2.2.1 Training on the job
3.2.2.2 Other Training

3.2.3 Working
3.2.3.1 Providing economic rewards
3.2.3.2 Providing physical setting
3.2.3.3 Providing social environment

3.2.4 Advancing
3.2.4.1 Promoting
3.2.4.2 Demoting
3.2.4.3 Discharging

3.2.5 Retiring
3.2.5.1 Counselling
3.2.5.2 Pre-retirement job engineering
3.2.5.3 Recognizing service
3.2.5.4 Awarding retirement benefits

3.3 Manufacturing Production Practices

3.3.1 Pre-processing
3.3.1.1 Receiving
3.3.1.2 Unpacking
3.3.1.3 Handling
3.3.1.4 Storing
3.3.1.5 Protecting

3.3.2 Processing
3.3.2.1 Material Separating
   3.3.2.1.1 Classifying
      3.3.2.1.1.1 Screening
      3.3.2.1.1.2 Floating
      3.3.2.1.1.3 Sedimenting
      3.3.2.1.1.4 Filtering
      3.3.2.1.1.5 Magnetizing
      3.3.2.1.1.6 Distilling
      3.3.2.1.1.7 Evaporating
      3.3.2.1.1.8 Centrifuging
      3.3.2.1.1.9 Drying
      3.3.2.1.1.10 Adsorbing
      3.3.2.1.1.11 Dissolving
      3.3.2.1.1.12 Crushing
      3.3.2.1.1.13 Milling
      3.3.2.1.1.14 Leaching
      3.3.2.1.1.15 Stripping
      3.3.2.1.1.16 Electrostatic separating
3.3.2.1.2 Removing

3.3.2.1.2.1 Turning
3.3.2.1.2.2 Shaping
3.3.2.1.2.3 Planing
3.3.2.1.2.4 Drilling
3.3.2.1.2.5 Boring
3.3.2.1.2.6 Milling
3.3.2.1.2.7 Broaching
3.3.2.1.2.8 Sawing
3.3.2.1.2.9 Abrading
3.3.2.1.2.10 Shearing
3.3.2.1.2.11 Etching
3.3.2.1.2.12 Burning
3.3.2.1.2.13 Clearing

3.3.2.2 Material Combining

3.3.2.2.1 Mixing

3.3.2.2.1.1 Beating
3.3.2.2.1.2 Blending
3.3.2.2.1.3 Kneading
3.3.2.2.1.4 Masticating
3.3.2.2.1.5 Impregnating

3.3.2.2.2 Coating

3.3.2.2.2.1 Spraying and vaporizing
3.3.2.2.2.2 Brushing
3.3.2.2.2.3 Rolling
3.3.2.2.2.4 Dipping
3.3.2.2.2.5 Printing
3.3.2.2.2.6 Dyeing
3.3.2.2.2.7 Calendar coating
3.3.2.2.2.8 Electrodeposition
3.3.2.2.2.9 Oxide coating
3.3.2.2.2.10 Enamelling
3.3.2.2.2.11 Spreading
3.3.2.2.2.12 Sodding

3.3.2.3 Assembling

3.3.2.3.1 Gathering
3.3.2.3.2 Positioning
3.3.2.3.3 Fastening

3.3.2.3 Material Forming

3.3.2.3.1 Working
3.3.2.3.1.1 Peening
3.3.2.3.1.2 Rolling
3.3.2.3.1.3 Drawing
3.3.2.3.1.4 Pressing
3.3.2.3.1.5 Forging
3.3.2.3.1.6 Stamping
3.3.2.3.1.7 Bending
3.3.2.3.1.8 Extruding
3.3.2.3.1.9 Spinning
3.3.2.3.1.10 Molding
3.3.2.3.1.11 Vacuum forming,
3.3.2.3.1.12 Pounding

3.3.2.3.2 Thermal conditioning

3.3.2.3.2.1 Curing
3.3.2.3.2.2 Crystallizing
3.3.2.3.2.3 Casting
3.3.2.3.2.4 Vacuum depositing
3.3.2.3.2.5 Heat treating
3.3.2.3.2.6 Melting
3.3.2.3.2.7 Freezing
3.3.2.3.2.8 Chilling

3.3.2.3.3 Combing
3.3.2.3.4 Winding
3.3.2.3.5 Knitting
3.3.2.3.6 Displacing

3.3.2.3.6.1 Bulldozing
3.3.2.3.6.2 Disassembling
3.3.2.3.6.3 Grading
3.3.2.3.6.4 Flowing
3.3.2.3.6.5 Ripping
3.3.2.3.6.6 Scarifying
3.3.2.3.6.7 Wrecking

3.3.3 Post-processing

3.3.3.1 Distributing
3.3.3.2 Altering
3.3.3.3 Installing
3.3.3.4 Maintaining
3.3.3.5 Repairing
3.3.3.6 Recycling
APPENDIX D

AN UNDERGRADUATE INDUSTRIAL DESIGN PROGRAM AT CHULALONGKORN UNIVERSITY
An Undergraduate Industrial Design Program at Chulalongkorn University.

The Department of Industrial Design, formerly called the Fine and Applied Arts, is an educational facility established with the Faculty of Architecture at Chulalongkorn University. It has approximately ninety students distributed amongst five "specialized options," leading to the "Bachelor of Industrial Design" (B.I.D.) degree.

The program itself has been organized philosophically and structurally in a manner which is similar to its predecessor. The differences between the two, as a consequence of the expanded curriculum, are in relationship to breadth and depth. This modification, however subtle, can also be seen as a shift from the architectural-based applied art program to a more direct and technologically-oriented industrial design study (Departmental of Industrial Design, 1979, 5.5.1:2). Of the five general objectives described, the Department of Industrial Design maintains its educational goals in strict adherence with the National, Social, and Economic Development Plan (NSEDP). The objectives prescribed by the Department are:

1) To produce industrial design graduates who are conceptually and creatively able (to design the products) in meeting the country's industrial expansions (Article 4.1);

2) To increase the number of knowledgeable industrial
design graduates who are capable of producing and improving the various products for industrial and handicraft production (Article 4.2);

3) To encourage and promote new and innovative product development. Such products should be produced with maximum utilization of the available resources (manpower, materials, technology, etc.), representing both aesthetically and functionally, a high standard of quality products (Article 4.3);

4) To increase industrial productivity through which the balance of national trade deposit can be (feasibly) achieved (Article 4.4);

5) To cause graduates to become responsible designers for their society (Article 4.5).

The Program Content. The current program is designed to last for five years. The first two years are mainly dedicated to the formation of an architectural basis, while the remaining three years are dedicated to the various "specializations."

Students are required to take a total of 190 credits in ten semesters. The subjects are distributed among four major categories which can be described as follows:

1. Core Subjects which include 12 credit hours in Science, Mathematics, Social Science and Humanities, plus nine credits in English language.

2. Architectural Subjects which contain a total of 30 credit hours of course work with the Faculty of
TABLE 7
The Undergraduate Program

<table>
<thead>
<tr>
<th>SEMESTER 1</th>
<th>SEMESTER 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YEAR 1</strong></td>
<td><strong>YEAR 2</strong></td>
</tr>
<tr>
<td><strong>SEMESTER 1</strong></td>
<td><strong>SEMESTER 2</strong></td>
</tr>
<tr>
<td>Fundamental of Design........2 (2-0-4)</td>
<td>Fundamental of Architectural Dsn.2 (2-0-4)</td>
</tr>
<tr>
<td>Design Practice...............4 (0-8-2)</td>
<td>Architectural Design........4 (0-8-4)</td>
</tr>
<tr>
<td>Material and Construction I..2 (2-0-4)</td>
<td>Material and Construction II.....3 (1-4-4)</td>
</tr>
<tr>
<td>Architectural Drawing........2 (1-2-3)</td>
<td>Architectural Drawing........2 (0-4-2)</td>
</tr>
<tr>
<td>Architectural Structure......2 (2-0-4)</td>
<td>Thai Ornamentation............2 (1-2-3)</td>
</tr>
<tr>
<td>Art History...................3 (3-0-6)</td>
<td>Cultural Heritage...............3 (3-0-6)</td>
</tr>
<tr>
<td>Mathematics (for Architects).3 (3-0-6)</td>
<td>Basic English II..............3 (3-0-6)</td>
</tr>
<tr>
<td>Basic English I..............3 (3-0-6)</td>
<td>Electives (2)................2 (2-0-4)</td>
</tr>
<tr>
<td>21</td>
<td>19</td>
</tr>
</tbody>
</table>

| **SEMESTER 3** | **SEMESTER 4** |
| **YEAR 2** | **YEAR 2** |
| **SEMESTER 3** | **SEMESTER 4** |
| Architectural Theory........2 (2-0-4) | Textile II..................3 (1-4-4) |
| Architectural Design.........5 (0-10-5) | Interior Design...............3 (1-4-4) |
| Textile I....................3 (1-4-4) | Machine Operation Worksho......2 (1-2-3) |
| Mechanical Drawing..........2 (1-2-3) | Research Methodology & Report Writing......2 (2-0-4) |
| Natural Science.............3 (3-0-6) | Man and Society.............3 (3-0-6) |
| Architectural Research.....3 (3-0-6) | Electives (2)................4 ( ) |
| Elective....................2 ( ) | 19 |
| 20 | 19 |


<table>
<thead>
<tr>
<th>SEMESTER 5</th>
<th>SEMESTER 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thai Arts and Crafts</td>
<td>Design Theory I</td>
</tr>
<tr>
<td>Textile</td>
<td>Interior Design III</td>
</tr>
<tr>
<td>Interior Design II</td>
<td>Graphics I</td>
</tr>
<tr>
<td>Appropriate Technology</td>
<td>Ceramics I</td>
</tr>
<tr>
<td>Industrial Field Trip</td>
<td>Material and Process I</td>
</tr>
<tr>
<td>Basic Photography</td>
<td>Humanities</td>
</tr>
<tr>
<td>Photographic Lab</td>
<td>Elective</td>
</tr>
<tr>
<td>Psychology</td>
<td></td>
</tr>
<tr>
<td>Electives</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEMESTER 7</th>
<th>SEMESTER 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Theory II</td>
<td>Graphic III</td>
</tr>
<tr>
<td>Graphic II</td>
<td>Product Design II</td>
</tr>
<tr>
<td>Product Design I</td>
<td>Ceramics III</td>
</tr>
<tr>
<td>Ceramics II</td>
<td>Industrial Economics</td>
</tr>
<tr>
<td>Ergonomics</td>
<td>Public Administration</td>
</tr>
<tr>
<td>Material and Process II</td>
<td>Marketing</td>
</tr>
<tr>
<td>Mechanics for Industrial Dsn.</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective</td>
<td></td>
</tr>
</tbody>
</table>

| YEAR 4                         |                                |
|--------------------------------|                                |
|                                |                                |
|                                |                                |
|                                |                                |
|                                |                                |

| YEAR 3                         |                                |
|--------------------------------|                                |
| Thai Arts and Crafts           | Design Theory I                 |
| Textile                        | Interior Design III             |
| Interior Design II             | Graphics I                      |
| Appropriate Technology         | Ceramics I                      |
| Industrial Field Trip          | Material and Process I          |
| Basic Photography              | Humanities                      |
| Photographic Lab               | Elective                        |
| Psychology                     |                                |
| Electives                      |                                |

<table>
<thead>
<tr>
<th>SEMESTER 7</th>
<th>SEMESTER 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Theory II</td>
<td>Graphic III</td>
</tr>
<tr>
<td>Graphic II</td>
<td>Product Design II</td>
</tr>
<tr>
<td>Product Design I</td>
<td>Ceramics III</td>
</tr>
<tr>
<td>Ceramics II</td>
<td>Industrial Economics</td>
</tr>
<tr>
<td>Ergonomics</td>
<td>Public Administration</td>
</tr>
<tr>
<td>Material and Process II</td>
<td>Marketing</td>
</tr>
<tr>
<td>Mechanics for Industrial Dsn.</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective</td>
<td></td>
</tr>
</tbody>
</table>

| YEAR 4                         |                                |
|--------------------------------|                                |
| Thai Arts and Crafts           | Design Theory I                 |
| Textile                        | Interior Design III             |
| Interior Design II             | Graphics I                      |
| Appropriate Technology         | Ceramics I                      |
| Industrial Field Trip          | Material and Process I          |
| Basic Photography              | Humanities                      |
| Photographic Lab               | Elective                        |
| Psychology                     |                                |
| Electives                      |                                |

<table>
<thead>
<tr>
<th>SEMESTER 7</th>
<th>SEMESTER 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Theory II</td>
<td>Graphic III</td>
</tr>
<tr>
<td>Graphic II</td>
<td>Product Design II</td>
</tr>
<tr>
<td>Product Design I</td>
<td>Ceramics III</td>
</tr>
<tr>
<td>Ceramics II</td>
<td>Industrial Economics</td>
</tr>
<tr>
<td>Ergonomics</td>
<td>Public Administration</td>
</tr>
<tr>
<td>Material and Process II</td>
<td>Marketing</td>
</tr>
<tr>
<td>Mechanics for Industrial Dsn.</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective</td>
<td></td>
</tr>
</tbody>
</table>

| YEAR 4                         |                                |
|--------------------------------|                                |
| Thai Arts and Crafts           | Design Theory I                 |
| Textile                        | Interior Design III             |
| Interior Design II             | Graphics I                      |
| Appropriate Technology         | Ceramics I                      |
| Industrial Field Trip          | Material and Process I          |
| Basic Photography              | Humanities                      |
| Photographic Lab               | Elective                        |
| Psychology                     |                                |
| Electives                      |                                |

<table>
<thead>
<tr>
<th>SEMESTER 7</th>
<th>SEMESTER 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Theory II</td>
<td>Graphic III</td>
</tr>
<tr>
<td>Graphic II</td>
<td>Product Design II</td>
</tr>
<tr>
<td>Product Design I</td>
<td>Ceramics III</td>
</tr>
<tr>
<td>Ceramics II</td>
<td>Industrial Economics</td>
</tr>
<tr>
<td>Ergonomics</td>
<td>Public Administration</td>
</tr>
<tr>
<td>Material and Process II</td>
<td>Marketing</td>
</tr>
<tr>
<td>Mechanics for Industrial Dsn.</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective</td>
<td></td>
</tr>
</tbody>
</table>

| YEAR 4                         |                                |
|--------------------------------|                                |
| Thai Arts and Crafts           | Design Theory I                 |
| Textile                        | Interior Design III             |
| Interior Design II             | Graphics I                      |
| Appropriate Technology         | Ceramics I                      |
| Industrial Field Trip          | Material and Process I          |
| Basic Photography              | Humanities                      |
| Photographic Lab               | Elective                        |
| Psychology                     |                                |
| Electives                      |                                |

<table>
<thead>
<tr>
<th>SEMESTER 7</th>
<th>SEMESTER 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Theory II</td>
<td>Graphic III</td>
</tr>
<tr>
<td>Graphic II</td>
<td>Product Design II</td>
</tr>
<tr>
<td>Product Design I</td>
<td>Ceramics III</td>
</tr>
<tr>
<td>Ceramics II</td>
<td>Industrial Economics</td>
</tr>
<tr>
<td>Ergonomics</td>
<td>Public Administration</td>
</tr>
<tr>
<td>Material and Process II</td>
<td>Marketing</td>
</tr>
<tr>
<td>Mechanics for Industrial Dsn.</td>
<td>Elective</td>
</tr>
<tr>
<td>Elective</td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 7 (Continued)

<table>
<thead>
<tr>
<th>SEMESTER 9</th>
<th>SEMESTER 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internship</td>
<td>Seminar II</td>
</tr>
<tr>
<td>2 (0-4-2)</td>
<td>3 (0-6-3)</td>
</tr>
<tr>
<td>Product Design III</td>
<td>Thesis</td>
</tr>
<tr>
<td>4 (1-6-5)</td>
<td>12 (0-24-12)</td>
</tr>
<tr>
<td>Seminar I</td>
<td>15</td>
</tr>
<tr>
<td>3 (0-6-3)</td>
<td></td>
</tr>
<tr>
<td>Individual Design Practice</td>
<td></td>
</tr>
<tr>
<td>4 (1-6-5)</td>
<td></td>
</tr>
<tr>
<td>Individual Study</td>
<td></td>
</tr>
<tr>
<td>2 (0-4-2)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

### GRADUATE STUDY

<table>
<thead>
<tr>
<th>YEAR ONE</th>
<th>YEAR TWO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pending Development</td>
<td></td>
</tr>
</tbody>
</table>
Architecture; and

3. Major Field of Study which includes 115 credit hours of accumulated lecture and laboratory work in three areas of emphasis; supporting subjects (19 credits), technical subjects (20 credits) and professional specialization courses (76 credits);  

4. Electives, which are chosen by the student, who has the option to take either from his own or from the other departments the elective courses which total 15 credit hours.

There has been no clear-cut definition regarding the present curriculum as to what "schemas" have been employed as the conceptual basis for the organization and presentation of instructional content. The common practice, particularly at the university level, is that the university is responsible for drawing up its own curriculum. Although the National Education Council (NEC) has to approve all proposed curriculum, there are numbers of different curriculums in operation for the same field of study in different universities. Apart from checking to see that any proposed curriculum involves similar standards to existing curriculum in the same field, and also checking that the subjects covered bear quite close relationship to the needs of employers for manpower in that field, the NEC allows the universities a considerable amount of freedom in formulating their curriculum.  

As far as the design curriculum of Chulalongkorn
University is concerned, it can be defined as a "catalog-oriented approach" because of the very nature of its procedural inquiries. Gysler called this method "the problem-centered approach." The content is derived from the lives of the students, the contemporary scene, and the traditional instructional material (subject matter). Through this process, the end product (the problem solution) becomes more important than its developmental component parts or the actual learning process involved (E.R. Gysler et al., 1974: 54). In this situation, in spite of the high standards of the theoretical courses being offered by the Department, the final outcome of the "career" does not seem to match very well with the necessities of reality, nor with the vision that students initially have about it as a creative and stimulating profession.

Methods of Instruction. The teaching method which is consistent in most universities is closer to that used in the United States than to any other foreign system. It includes lectures, seminars, practical works (projects), term papers, field trips, and credit evaluation systems. Because of the acute shortage of instructional material and specialized technical books, the "traditional" lecture-type teaching is still the most commonly used mode of instruction. A new method is now being experimented with to offset this problem by hiring 17 people from government agencies, industrial and design professionals to teach the regularly-scheduled
courses on a part-time basis. This has substantially reduced the school dependency on textbooks while at the same time has reduced the gaps between the school and industry. Emphasis is now being shifted to library development so that students have greater opportunity for self-study.

One setback that has evolved from hiring "part-timers" is the difficulties found in coordinating and controlling the teaching format, which results in unnecessary redundancy in lectures and classroom projects. The problem becomes more acute when considering most instructors are responsible for developing their own teaching material based on what has been described in the program objectives and in the course outline. With limited amounts of information that are available to them, they have few resources from which to base and exercise their expertise to the fullest benefit and potential. The Faculty of Architecture, in 1974, attempted to alleviate this problem by requesting all instructors to submit detailed course outlines including "course objectives" and "student behavior objectives", but the project did not materialize due to lack of participation.
APPENDIX E

WORLD DIRECTORY OF SCHOOLS OF INDUSTRIAL DESIGN
### TABLE 8

**World Directory of Schools of Industrial Design**

**ARGENTINA**

1. Instituto de Diseño Industrial, Rosario

**AUSTRALIA**

2. Tasmanina College of Advanced Education, Mount Nelson  
3. Torrens College of Advanced Education, Keswick, S. Australia  
4. Gordon Institute of Technology, Geelong, Victoria  
5. Swinburne College of Technology, Hawthorn, Victoria  
6. Royal Melbourne Institute of Technology  
7. The University of New South Wales, Kensington, NSW  
8. Western Australian Institute of Technology, Bentley South  
10. Prahran College of Advanced Education  
11. Riverina College of Advanced Education, Wagga Wagga, NSW  
12. Bendigo Institute of Technology, Bendigo, Victoria

**BELGIUM**

13. Institute Saint-Luc, Liege  
14. Stedelijke Academie Voor Schone Kunsten en Vormgeving, Genk  
15. Ecole Nationale Superieure d'Architecture et des Arts Visuels, Brussels

**BRAZIL**

16. Superior School of Industrial Design (ESDI), Rio de Janeiro  
17. Universidade, Mackenzie Faculty of Architecture, Sao Paulo

**CANADA**

18. Nova Scotia College of Art and Design, Halifax  
19. Conestoga College of Applied Arts and Technology, Kitchener, Ontario  
20. Ryerson Polytechnical Institute, Toronto  
21. Southern Alberta Institute of Technology  
22. University of Alberta, Edmonton  
23. Carleton University, Ottawa  
24. Universite de Montreal

**CHILE**

25. University of Chile, Valparaiso

**REPUBLIC OF CHINA**

26. Ming-Chi Institute of Technology, Taipei Hsien, Taiwan  
27. Tatung Institute of Technology, Taipei ROC  
28. Eastern College of Polytechnic Science, Kaohsiung

**CZECHOSLOVAKIA**

29. College of Applied Arts, Prague  
30. Vysoka Skola Vytvarnych Umeni, Bratislava
<table>
<thead>
<tr>
<th>#</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>Mainosgraafikkojen koulu, Helsinki</td>
</tr>
<tr>
<td>32</td>
<td>Lahti Institute of Industrial Arts, Helsinki</td>
</tr>
<tr>
<td>33</td>
<td>The Institute of Industrial Arts, Helsinki</td>
</tr>
<tr>
<td>34</td>
<td>Fachschule fur angewandte Kunst Schneeberg</td>
</tr>
<tr>
<td>35</td>
<td>Kunsthochschule Berlin - Weissensee, Berlin</td>
</tr>
<tr>
<td>36</td>
<td>Hochschule fur Industrielle Formgestaltung Halle, Burg Giebichenstein</td>
</tr>
<tr>
<td>37</td>
<td>Fachschule fur angewandte Kunst - Heiligendamm</td>
</tr>
<tr>
<td>38</td>
<td>Technische Universitat, Hannover</td>
</tr>
<tr>
<td>39</td>
<td>Staatliche Akademie der Bildenden Kuste, Stuttgart</td>
</tr>
<tr>
<td>40</td>
<td>Fachhochschule, Schwabisch Gmunden</td>
</tr>
<tr>
<td>41</td>
<td>Fachhochschule fur Gestaltung, Pforzheim</td>
</tr>
<tr>
<td>42</td>
<td>Gesamthochschule, Wuppertal</td>
</tr>
<tr>
<td>43</td>
<td>Fachhochschule, Darnstadt</td>
</tr>
<tr>
<td>44</td>
<td>Fachhochschule, Hannover</td>
</tr>
<tr>
<td>45</td>
<td>Staatliche Hochschule fur Bildende Kuste, Hamburg</td>
</tr>
<tr>
<td>46</td>
<td>Fachhochschule Niederrhein, Krefeld</td>
</tr>
<tr>
<td>47</td>
<td>Staatliche Fach- und Berufsfachschule fur Glas, Zwiese/Bayern</td>
</tr>
<tr>
<td>48</td>
<td>Fachhochschule Bielefeld</td>
</tr>
<tr>
<td>49</td>
<td>Manchester Polytechnic</td>
</tr>
<tr>
<td>50</td>
<td>City of Birmingham Polytechnic</td>
</tr>
<tr>
<td>51</td>
<td>Royal College of Art, London</td>
</tr>
<tr>
<td>52</td>
<td>Chesterfield College of Art and Design</td>
</tr>
<tr>
<td>53</td>
<td>Berkshire College of Art and Design</td>
</tr>
<tr>
<td>54</td>
<td>LONDON College of Furniture</td>
</tr>
<tr>
<td>55</td>
<td>Central School of Art and Design</td>
</tr>
<tr>
<td>56</td>
<td>Lanchester Polytechnic</td>
</tr>
<tr>
<td>57</td>
<td>Leeds Polytechnic</td>
</tr>
<tr>
<td>58</td>
<td>City of Leicester Polytechnic</td>
</tr>
<tr>
<td>59</td>
<td>North East Essex Technical College &amp; School of Art, Colchester</td>
</tr>
<tr>
<td>60</td>
<td>Croydon College of Art and Design</td>
</tr>
<tr>
<td>61</td>
<td>The Polytechnic, Wolverhampton</td>
</tr>
<tr>
<td>62</td>
<td>Salford College of Technology</td>
</tr>
<tr>
<td>63</td>
<td>Ulster College, The Northern Ireland Polytechnic</td>
</tr>
<tr>
<td>64</td>
<td>Hong Kong Polytechnic, Kowloon</td>
</tr>
<tr>
<td>65</td>
<td>Academy of Art and Crafts of Hungary, Budapest</td>
</tr>
<tr>
<td>66</td>
<td>National Institute of Design, Ahmedabad</td>
</tr>
<tr>
<td>67</td>
<td>Indian Institute of Technology, Bombay</td>
</tr>
<tr>
<td>Table 8 (Continued)</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>IRELAND</strong></td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>University College, Dublin</td>
</tr>
<tr>
<td>69</td>
<td>National Institute for Higher Education, Limerick</td>
</tr>
<tr>
<td>70</td>
<td>School of Art and Design, Ballininde, Sligo</td>
</tr>
<tr>
<td>71</td>
<td>School of Art, Waterford</td>
</tr>
<tr>
<td><strong>ITALY</strong></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>Instituto Europeo di Design, Milan</td>
</tr>
<tr>
<td><strong>JAPAN</strong></td>
<td></td>
</tr>
<tr>
<td>73</td>
<td>Tokyo University of Art and Design</td>
</tr>
<tr>
<td>74</td>
<td>Tokyo National University of Fine Arts and Music</td>
</tr>
<tr>
<td>75</td>
<td>Chiba University</td>
</tr>
<tr>
<td>76</td>
<td>Musashino Art University, Tokyo</td>
</tr>
<tr>
<td><strong>KOREA</strong></td>
<td></td>
</tr>
<tr>
<td>77</td>
<td>College of Fine Arts, Hong-Ik University</td>
</tr>
<tr>
<td>78</td>
<td>Fine Art College, Ewha Womans University, Seoul</td>
</tr>
<tr>
<td>79</td>
<td>Kyunggi Technical College, Seoul</td>
</tr>
<tr>
<td>80</td>
<td>Induk Institute of Design</td>
</tr>
<tr>
<td><strong>NETHERLANDS</strong></td>
<td></td>
</tr>
<tr>
<td>81</td>
<td>Koninklijke Akademie van Beeldende Kunsten, Den Haag</td>
</tr>
<tr>
<td>82</td>
<td>State Agricultural University, Wageningen</td>
</tr>
<tr>
<td>83</td>
<td>Akademie Industrielle Vormgeving, Eindhoven</td>
</tr>
<tr>
<td>84</td>
<td>Royal Academy of Fine and Applied Arts, Den Haag</td>
</tr>
<tr>
<td>85</td>
<td>Delft University of Technology</td>
</tr>
<tr>
<td><strong>NEW ZEALAND</strong></td>
<td></td>
</tr>
<tr>
<td>86</td>
<td>University of Auckland</td>
</tr>
<tr>
<td>87</td>
<td>University of Canterbury, Christchurch</td>
</tr>
<tr>
<td>88</td>
<td>Auckland Technical Institute</td>
</tr>
<tr>
<td>89</td>
<td>Wellington Polytechnic</td>
</tr>
<tr>
<td><strong>POLAND</strong></td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>Panstwowa Wyzsza Szkoia Szruk Plastycznycy, Wroclaw</td>
</tr>
<tr>
<td>91</td>
<td>PWSP Wroclaw</td>
</tr>
<tr>
<td>92</td>
<td>Akademia Szkuk Pieknycy, Warszawa</td>
</tr>
<tr>
<td>93</td>
<td>Akademia Sztuk Pieknycy, Krakow</td>
</tr>
<tr>
<td>94</td>
<td>Panstwowa Wyzsza Szkoia Sztuk Plastycznycy, Poznan</td>
</tr>
<tr>
<td>95</td>
<td>Panstwowa Wyzsza Szkoia Sztuk Plastycznycy, Gdansk</td>
</tr>
<tr>
<td><strong>SPAIN</strong></td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>Escuela de Diseo Elisava, Barcelona</td>
</tr>
<tr>
<td>97</td>
<td>Escola Massana</td>
</tr>
<tr>
<td>98</td>
<td>Ecole d'Arts Appliques et Metiers Artistques, Barcelona</td>
</tr>
<tr>
<td>99</td>
<td>EINA, Barcelona</td>
</tr>
<tr>
<td><strong>SWEDEN</strong></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Konstfackskolan, Stockholm</td>
</tr>
<tr>
<td><strong>SWITZERLAND</strong></td>
<td></td>
</tr>
<tr>
<td>101</td>
<td>The Arts and Crafts of Zurich</td>
</tr>
<tr>
<td>102</td>
<td>Ecole Cantonale des Beaux Arts et d'Art Applique, Lausanne</td>
</tr>
<tr>
<td>School Code (1)</td>
<td>Speciality in Product Design (2)</td>
</tr>
<tr>
<td>----------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>E</td>
</tr>
<tr>
<td>2</td>
<td>E</td>
</tr>
<tr>
<td>3</td>
<td>E</td>
</tr>
<tr>
<td>4</td>
<td>E</td>
</tr>
<tr>
<td>5</td>
<td>E</td>
</tr>
<tr>
<td>6</td>
<td>E</td>
</tr>
<tr>
<td>7</td>
<td>E</td>
</tr>
<tr>
<td>8</td>
<td>E</td>
</tr>
<tr>
<td>9</td>
<td>E</td>
</tr>
<tr>
<td>10</td>
<td>E</td>
</tr>
<tr>
<td>11</td>
<td>E</td>
</tr>
<tr>
<td>12</td>
<td>E</td>
</tr>
<tr>
<td>13</td>
<td>E</td>
</tr>
<tr>
<td>14</td>
<td>E</td>
</tr>
<tr>
<td>15</td>
<td>E</td>
</tr>
<tr>
<td>16</td>
<td>E</td>
</tr>
<tr>
<td>17</td>
<td>E</td>
</tr>
<tr>
<td>18</td>
<td>E</td>
</tr>
<tr>
<td>19</td>
<td>E</td>
</tr>
<tr>
<td>20</td>
<td>E</td>
</tr>
<tr>
<td>21</td>
<td>E</td>
</tr>
<tr>
<td>22</td>
<td>E</td>
</tr>
<tr>
<td>23</td>
<td>E</td>
</tr>
<tr>
<td>24</td>
<td>E</td>
</tr>
<tr>
<td>25</td>
<td>E</td>
</tr>
<tr>
<td>26</td>
<td>E</td>
</tr>
<tr>
<td>27</td>
<td>E</td>
</tr>
</tbody>
</table>

**Continued...**
<table>
<thead>
<tr>
<th>School Code (1)</th>
<th>Speciality in Product Design? (2)</th>
<th>Type of School (3)</th>
<th>Number of Students in Main Institution (4)</th>
<th>Source of Financing (5)</th>
<th>Age of Admission (6)</th>
<th>Admission Procedure (7)</th>
<th>No. of Staff (8)</th>
<th>No. of I.D. Students (9)</th>
<th>Length of Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>E</td>
<td>C</td>
<td>250</td>
<td>P</td>
<td>16</td>
<td>21</td>
<td>6</td>
<td>250</td>
<td>5</td>
</tr>
<tr>
<td>29</td>
<td>*</td>
<td>A</td>
<td>350</td>
<td>S</td>
<td>17</td>
<td>8</td>
<td>5</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>30</td>
<td>E</td>
<td>C</td>
<td>224</td>
<td>S</td>
<td>18</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>31</td>
<td>A</td>
<td>C</td>
<td>30</td>
<td>P</td>
<td>18</td>
<td>5</td>
<td>0</td>
<td>20</td>
<td>5</td>
</tr>
<tr>
<td>32</td>
<td>A</td>
<td>C</td>
<td>120</td>
<td>M</td>
<td>18</td>
<td>18</td>
<td>1</td>
<td>34</td>
<td>3</td>
</tr>
<tr>
<td>33</td>
<td>E</td>
<td>J</td>
<td>839</td>
<td>S</td>
<td>18</td>
<td>18</td>
<td>8</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>34</td>
<td>E</td>
<td>P</td>
<td></td>
<td>S</td>
<td>18</td>
<td>8</td>
<td>4</td>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>35</td>
<td>E</td>
<td>J</td>
<td></td>
<td>S</td>
<td>18</td>
<td>10</td>
<td>5</td>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>36</td>
<td>E</td>
<td>C</td>
<td></td>
<td>S</td>
<td>20</td>
<td>14</td>
<td>4</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>37</td>
<td>E</td>
<td>P</td>
<td></td>
<td>S</td>
<td>18</td>
<td>4</td>
<td>4</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>38</td>
<td>E</td>
<td>U</td>
<td></td>
<td>S</td>
<td>18</td>
<td>7</td>
<td>1</td>
<td>40</td>
<td>4</td>
</tr>
<tr>
<td>39</td>
<td>E</td>
<td>P</td>
<td></td>
<td>S</td>
<td>18</td>
<td>17</td>
<td>4</td>
<td>36</td>
<td>4</td>
</tr>
<tr>
<td>40</td>
<td>E</td>
<td>P</td>
<td></td>
<td>S</td>
<td>18</td>
<td>17</td>
<td>4</td>
<td>36</td>
<td>4</td>
</tr>
<tr>
<td>41</td>
<td>E</td>
<td>P</td>
<td></td>
<td>S</td>
<td>18</td>
<td>5</td>
<td>3</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>42</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>19</td>
<td>8</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>43</td>
<td>E</td>
<td>P</td>
<td></td>
<td>S</td>
<td>17</td>
<td>35</td>
<td>16</td>
<td>240</td>
<td>3</td>
</tr>
<tr>
<td>44</td>
<td>E</td>
<td>P</td>
<td></td>
<td>S</td>
<td>19</td>
<td>10</td>
<td>2</td>
<td>35</td>
<td>4</td>
</tr>
<tr>
<td>45</td>
<td>E</td>
<td>P</td>
<td></td>
<td>S</td>
<td>19</td>
<td>15</td>
<td>12</td>
<td>245</td>
<td>4</td>
</tr>
<tr>
<td>46</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>22</td>
<td>10</td>
<td>1</td>
<td>30</td>
<td>4</td>
</tr>
<tr>
<td>47</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>3</td>
<td>3</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>48</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>4</td>
<td>4</td>
<td>46</td>
<td>6</td>
</tr>
<tr>
<td>49</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>6</td>
<td>6</td>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>50</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>10</td>
<td>5</td>
<td>52</td>
<td>3</td>
</tr>
<tr>
<td>51</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>14</td>
<td>13</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>52</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>17</td>
<td>3</td>
<td>2</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>53</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>16</td>
<td>29</td>
<td>9</td>
<td>245</td>
<td>3</td>
</tr>
<tr>
<td>54</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>33</td>
<td>13</td>
<td>75</td>
<td>3-2</td>
</tr>
<tr>
<td>55</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>56</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>29</td>
<td>19</td>
<td>107</td>
<td>3-4</td>
</tr>
<tr>
<td>57</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>28</td>
<td>21</td>
<td>10</td>
<td>203</td>
<td>2-3</td>
</tr>
<tr>
<td>58</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>8</td>
<td>6</td>
<td>45</td>
<td>3</td>
</tr>
<tr>
<td>59</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>16</td>
<td>14</td>
<td>9</td>
<td>35</td>
<td>3</td>
</tr>
<tr>
<td>60</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>21</td>
<td>21</td>
<td>80</td>
<td>3</td>
</tr>
<tr>
<td>61</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>16</td>
<td>8</td>
<td>45</td>
<td>3</td>
</tr>
<tr>
<td>62</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>16</td>
<td>16</td>
<td>140</td>
<td>2</td>
</tr>
<tr>
<td>63</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>13</td>
<td>7</td>
<td>86</td>
<td>3</td>
</tr>
<tr>
<td>64</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>25</td>
<td>10</td>
<td>32</td>
<td>4-1</td>
</tr>
<tr>
<td>65</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>12</td>
<td>7</td>
<td>50</td>
<td>5-4</td>
</tr>
<tr>
<td>66</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>24</td>
<td>4</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>67</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>6</td>
<td>6</td>
<td>45</td>
<td>4</td>
</tr>
<tr>
<td>68</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>17</td>
<td>4</td>
<td>3</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>69</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>5</td>
<td>2</td>
<td>200</td>
<td>3</td>
</tr>
<tr>
<td>70</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>13</td>
<td>0</td>
<td>150</td>
<td>3</td>
</tr>
<tr>
<td>71</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>15</td>
<td>5</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>72</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>6</td>
<td>3</td>
<td>34</td>
<td>4</td>
</tr>
<tr>
<td>73</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>23</td>
<td>16</td>
<td>160</td>
<td>4</td>
</tr>
<tr>
<td>74</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>31</td>
<td>8</td>
<td>180</td>
<td>5</td>
</tr>
<tr>
<td>75</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>12</td>
<td>4</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>76</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>8</td>
<td>6</td>
<td>200</td>
<td>2</td>
</tr>
<tr>
<td>77</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>15</td>
<td>5</td>
<td>55</td>
<td>2</td>
</tr>
<tr>
<td>78</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>16</td>
<td>16</td>
<td>160</td>
<td>3-5</td>
</tr>
<tr>
<td>79</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>4</td>
<td>1</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>80</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>20</td>
<td>16</td>
<td>16</td>
<td>160</td>
<td>3</td>
</tr>
<tr>
<td>81</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>17</td>
<td>16</td>
<td>16</td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td>82</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>25</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>83</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>20</td>
<td>12</td>
<td>22</td>
<td>220</td>
<td>5</td>
</tr>
<tr>
<td>84</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>85</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>18</td>
<td>16</td>
<td>160</td>
<td>3</td>
</tr>
<tr>
<td>86</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>16</td>
<td>4</td>
<td>1</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>87</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>16</td>
<td>11</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>88</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>4</td>
<td>1</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>89</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>11</td>
<td>5</td>
<td>42</td>
<td>4-5</td>
</tr>
<tr>
<td>90</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>12</td>
<td>4</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>91</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>18</td>
<td>12</td>
<td>4</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>92</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>19</td>
<td>12</td>
<td>8</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>93</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>19</td>
<td>12</td>
<td>8</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>94</td>
<td>*</td>
<td>E</td>
<td></td>
<td>S</td>
<td>19</td>
<td>12</td>
<td>8</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
TABLE 8
(Continued)

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>96 *</td>
<td>A C</td>
<td>150</td>
<td>P</td>
<td>21 *</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>97 *</td>
<td>A C</td>
<td>2000</td>
<td>S</td>
<td>17 *</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>98 *</td>
<td>A C</td>
<td>100</td>
<td>P</td>
<td>18 *</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>100 *</td>
<td>A C</td>
<td>1100</td>
<td>S</td>
<td>21 *</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>102 *</td>
<td>E</td>
<td>C</td>
<td>100</td>
<td>S</td>
<td>19 *</td>
<td>15</td>
</tr>
<tr>
<td>103 *</td>
<td>E</td>
<td>U</td>
<td>13800</td>
<td>S</td>
<td>17 *</td>
<td>7</td>
</tr>
<tr>
<td>104 *</td>
<td>E</td>
<td>U</td>
<td>31000</td>
<td>S</td>
<td>17 *</td>
<td>3</td>
</tr>
<tr>
<td>105 *</td>
<td>E</td>
<td>U</td>
<td>15000</td>
<td>S</td>
<td>19 *</td>
<td>22</td>
</tr>
<tr>
<td>106 *</td>
<td>A C</td>
<td>1200</td>
<td>M</td>
<td>13</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>107 *</td>
<td>A U</td>
<td>30000</td>
<td>S</td>
<td>13 *</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>108 *</td>
<td>E</td>
<td>U</td>
<td>23000</td>
<td>P</td>
<td>18 *</td>
<td>5</td>
</tr>
<tr>
<td>110 *</td>
<td>E</td>
<td>U</td>
<td>31807</td>
<td>S</td>
<td>18 *</td>
<td>9</td>
</tr>
<tr>
<td>111 *</td>
<td>E</td>
<td>U</td>
<td>27500</td>
<td>S</td>
<td>13 *</td>
<td>8</td>
</tr>
<tr>
<td>112 *</td>
<td>E</td>
<td>U</td>
<td>44000</td>
<td>P</td>
<td>18 *</td>
<td>37</td>
</tr>
<tr>
<td>113 *</td>
<td>A U</td>
<td>19000</td>
<td>S</td>
<td>13 *</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>114 *</td>
<td>A C</td>
<td>4500</td>
<td>S</td>
<td>19 *</td>
<td>24</td>
<td>3</td>
</tr>
<tr>
<td>115 *</td>
<td>A C</td>
<td>800</td>
<td>S</td>
<td>18 *</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>116</td>
<td>A C</td>
<td>10000</td>
<td>S</td>
<td>18 *</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>117</td>
<td>E</td>
<td>P</td>
<td>17 *</td>
<td>4</td>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>118</td>
<td>A C</td>
<td>330</td>
<td>S</td>
<td>19 *</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>119</td>
<td>E</td>
<td>U</td>
<td>1172</td>
<td>S</td>
<td>17 *</td>
<td>46</td>
</tr>
<tr>
<td>120</td>
<td>E</td>
<td>U</td>
<td>1172</td>
<td>S</td>
<td>17 *</td>
<td>6</td>
</tr>
<tr>
<td>121</td>
<td>A</td>
<td>142</td>
<td>S</td>
<td>19 *</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>122</td>
<td>E</td>
<td>340</td>
<td>S</td>
<td>15 *</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>123</td>
<td>E</td>
<td>300</td>
<td>S</td>
<td>15 *</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

Legend:

1. The code number refers to the school listed.
2. Type of school refers to the distinction between engineering based schools, and applied arts oriented ones.
3. U = University; C* = College or Ecoles d'Art; P = Polytechnic or Institute of Technology.
4. S = State financed
   P = Private financed
   M = Mixed combination
5. Column N*1 = Submission of Portfolio
   N*2 = Interview
   N*3 = Examination
   N*4 = Other
6. This figure refers to students whose main specialty is industrial design

Note: Please note that some school codes are missing. It was decided not to include schools whose main activities were outside the traditional forms of design (e.g. schools of Architecture without a specialized industrial design course).

Source: ICSID