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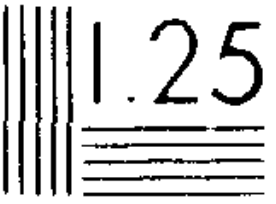
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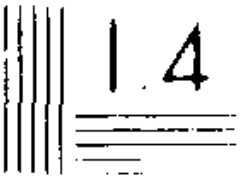
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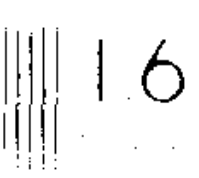
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DP/ID/SER.B/344
21 June 1982
English

PRODUCTION OF SCHOOL SCIENCE EQUIPMENT

DP/THA/74/024

THAILAND

Terminal Report*

Prepared for the Government of Thailand

by the United Nations Industrial Development Organization,

acting as executing agency for the United Nations Development Programme

Based on the work of Kurt G. Hofmann

Industrial Design Adviser

003362

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CONTENT

Summary

- IPST developed prototype equipment not easily massproducible.

- input of industrial design capacity was deemed needed.

- delay in implementing ind. des. post led to production, quality and function problems.

- the prototype equipment adapted for massproduction after trials and after the textbook is fixed.

- the OKK design team should be consulted at the beginning of the equipment development.

- IPST should share responsibility for quality control.

- the industrial design input has contributed much to the achievement of the objectives.

Introduction

The UNESCO executed project THA/72/029 established in collaboration with the Royal Thai Government, the Institute for the Promotion of Teaching Science and Technology (IPST). IPST developed the science syllabus, that was implemented in 1976. The syllabus is based on the concept of learning by doing. This approach requires that equipment is available in each school. The high cost of importing these inspired the idea of local manufacturing. Ong Karn Kha Kurusapha (OKK), being the largest supplier in the educational field, was chosen as manufacturer. UNIDO was selected as executing agency for project THA/74/024 Production of School Science Equipment.

The original project document was signed on the 28th of March 1975 and provided UNDP funds for an eighteen month period each for an Industrial Designer post and a Production Engineer post. These two posts plus a miscellaneous post and two fellowships totalled US $116,900. The projected expenditure up to August 1982 is US $649,684. The Government contribution was estimated at 2,290,000 ฿ up to March 1977. actual contribution to the end of 1981 is ≥ 20,000,000 ฿ (1 $ ≈ 20 ฿).

The overall development objective of this project is to assist the Government in the improvement of science and mathematics teaching and teacher education, as a contribution to the achievement of the objectives of the Third and Fourth Five Year Plans for Education.

The immediate objective is to assist in the design and production of science and mathematics equipment.

Major spin-off effects include employment and savings in foreign exchange.

A. Activities

One of the objectives of IPST is to design and classroom test prototype science and mathematics equipment made from locally available materials at a low enough cost to permit supply of multiple numbers of each unit to the schools.

A certain pattern has been established in the development of equipment. An IPST academic subject section decides on a certain activity. To carry out this activity an equipment is needed. The subject section design team designs the equipment and the IPST workshop makes a prototype. When the academic team is satisfied as to the performance of the equipment, a small number is manufactured by the IPST workshop and tried out and evaluated in selected schools. If satisfied, the subject section team finalises the text and a picture of the prototype equipment and instructions how to use it, is included in the textbook draft. The workshop makes a drawing and this together with a prototype, is handed over to OKK for massproduction.

In the early stages of the project (1975-78) a very limited production capacity existed within OKK. To meet demands, the main part of the manufacturing was contracted out to suppliers in Bangkok. To a great extent plastic injection was chosen as the mode of manufacturing. The supplier was given a prototype and told to supply a certain amount of pieces. OKK as a rule reserved the right of ownership of the moulding tool.

In 1978-79 production machinery was bought. An emphasis was made on plastics injection and metal sheet stamping. The machines acquired are able to perform with a high capacity and in the case of two injection machines automatically.

Before 1978 no adequate design capacity existed within OKK. In March 1978 the post of Industrial Design Expert was filled and a

functioning team of designers set up. On the author's arrival in September 1979 the team consisted of two product designers, one graphical designer and one draughtsman.

Prior to this a considerable time had been spent on trying to make working designs of a slideprojector, an overhead projector, a compound microscope and a precision balance without success. Assessing the situation, it was concluded that the development of the optical items be postponed. The optical designs produced, were based on the assumption that plastics lenses could easily be manufactured and used, neither of which is possible.

A precision balance, however, was deemed as being feasible for production. Furthermore it was the only one of these equipment which was specified in the curriculum. A fresh start had to be made as the former design was based on unworkable principles. At the time of writing the first batch of 100 balances is being produced. A prototype overhead projector and a compound microscope (~100X) have lately been developed. They are not yet ready for massproduction due to difficulties in obtaining the optical parts.

The General Science section at IPST requested in October 1979, that the OKK design team help in developing equipment for primary science. This was the first time OKK had been directly involved in the development of new equipment. As a result several equipment for grades 1-4 were designed and produced by the IPST workshop in a small number for testing in trialschools. The uncertainty as to the implementation of the new syllabus delayed equipment development for grades 5-6 until 1982.

New curricula for science in three types of vocational schools were implemented in 1981. Prototypes and drawings of the needed equipment were handed over to OKK for massproduction. The OKK designers were not consulted during the development, necessitating much time to be spent on adapting the designs for massproduction.

Some equipment have been added and some changed due to revisions of the syllabus mainly in Physics and Physical Science. The pattern of equipment development has been the same as for the vocational schools.

During the entire period the OKK design team has constantly been working on changing the designs in order to improve function and-or decrease costs.

Presently, two hundred and sixty one (261) different types of equipment are in production. OKK has managed on several occasions to persuade the different IPST academic sections to use the same equipment for similar experiments. Apart from efforts to cut down the number of equipment, the OKK designers steadfastly work on standardising parts, dimensions, materials and fasteners.

When designing new items or redesigning, the OKK design team many times developed and tested production methods. In some cases tools and jigs were designed and a few even made by the team and later used in production.

No formal training exists in the art of designing school science equipment. It is indeed a complex task and usually several specialists from different fields need to co-operate. With regards to the OKK national design staff, on-the-job training has been constantly maintained.

B. Findings

The equipment development procedure, as carried out by IPST before the start of the production project, involved mainly academic staff. This might have been the reason why designs, in which manufacturing feasability and economy had not been a close consideration, were made. The problem must, however, have been recognised and hence the provision for an international project staff post in Industrial Design.

The delay in recruiting the industrial designer resulted in OKK investing in tools (mainly plastics injection moulds) without proper guidance as to the suitability of the production method and materials for the designs in question. Subsequently the function and durability of the equipment were impeded.

The prototypes were almost entirely made in materials suitable for handwork (wood, PVC water pipe, PMMA sheet, tincans etc.). The emphasis on production methods using other materials, required a large input in adapting the designs when the ind. des. capacity was realized.

The system of having a picture of the equipment in the textbooks is certainly an effective way of solving the pedagogical problem. But, the finalising of the picture and the corresponding text should of course be made after the equipment prototype has been finalised by OKK. This has never been the case with the equipment presently in production. The result is, that when the OKK designers change the IPST prototype into one which is possible to massproduce (to be approved by IPST), it does not look like the picture, or the redesigning can not be made to it's full potential.

A major problem during the project's entire existance has been quality control. Already in the first stages of designing should this aspect be considered. Designs which require close tolerances should be avoided. The use of standardised parts, dimensions, materials and fasteners will improve the quality and facilitate its control. This means that the designer will provide tolerances and critical function information.

In spite of all the difficulties encountered the OKK design team has processed a large amount of equipment (see progress reports) currently in production and some not yet in production. This has enabled the production to become more streamlined and economical. The equipment has become better functioning and lasting. More than 1 million pieces of school science and mathematics equipment have been produced and delivered to Thai schools. This has improved the science and mathematics teaching and teacher education and contributed to the achievement of the objectives of the Third and Fourth Five Year Plans for Education.

C. Recommendations

1. When an IPST academic subject section decides on new equipment or on a change of an existing one, they should find out if equipment able to perform already exists and is produced by OKK. Maybe the activity can be slightly modified so as to enable the use of existing equipment.

2. If new equipment is deemed necessary, the academic team should provide information on required performance, if demonstration or student experiment, which level(s) it will be used in and suggestions as to which type of equipment is prefered.

3. The IPST workshop team together with the OKK design team should receive the information from the academic section. Together they should develop the equipment. This will produce for manufacturing feasable equipment and ensure good performance at low cost.

4. IPST approves every prototype equipment before it goes into production. The approval committee therefore is responsible for the design. It lends itself naturally that IPST should share the responsibility for the quality control of the produced parts. A senior technician from the workshop should make visits as required to the production plant. He should be answerable in this matter only to the co-ordinating body.

5. In the event of implementation of the production plant jointly with the technical training centre in Bang Bon, major input has to be done in product designing. The products must fit the requirements both from training and production-economy points of view. Technical assistance in the field of Industrial Design should be sought and granted.

Appendix I

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Mr. Kamthon Sathirakul M.D. OKK

Team leader:
Mr. Payong Padanupong Manager School Science Equipment Production

Fellowship.

Ms. Pranom Kamanakarn, Industrial Design, Austria - Germany,
800929 - 801218

Equipment.

Emco Unimat 3 Universal machine for prototype making, US $2,333