

# Industrial Design and Production Projects in Secondary Schools

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This article is based on research carried out by the author during a year's full time study at Shoreditch College, Surrey, in 1972-73. It was a follow-up to the concept of school-based production lines, first pioneered by the Schools Council Design and Craft Project centred at Keele University, and set out to survey and analyse the development of school-based 'factory days' which had emerged and aroused much interest in a number of areas up and down the country. Under the general heading of Preparation for Occupational Role, the method was originally aimed at young school leavers and the so called R.O.S.L.A. pupils, but its potential for other ages and abilities as a wider and more meaningful educational experience was soon realised. The author's interest in this approach was initially aroused by being personally involved with a production line experiment in his own school and later by the suggestion of a member of the Keele Project central team that this was a worthwhile field for research.

The investigation found that school-based factory projects embraced a wide area of activity, ability and experience, involving greater scope than had, at first, been anticipated. For example, two mixed secondary Schools in Lincolnshire undertook experimental programmes involving production line projects and demonstrated that the approach was feasible for both boys and girls, while in North Wales a low ability school leavers' class in one school became motivated and industrious for the first time when given an opportunity to produce articles as a viable commercial undertaking. Reports of earlier experiments, carried out under the auspices of the 'Keele Project' similarly indicated that this was indeed an educational method of considerable promise and potential.

In endeavouring to examine this aspect, the study not only set out to look at historical precedents in this country but to make a comparative analysis of the situation

existing in other countries, especially on the continent and in America. There was ample evidence of the effectiveness of school based methods which sought to provide pupils with realistic and relevant experience whereby they could gain an insight into the industrial techniques and procedures of the real worlds. Thus, by setting up situations where all aspects of a production process from market research, product designing and costing to manufacture and marketing were involved, pupils of all abilities could participate in a meaningful activity at their own level of ability and understanding.

Certain general aims appeared to be common to the various areas involved and centred on six main aspects of development which could be enumerated as follows:

1. To widen the pupil's understanding of the world of industry.
2. To increase the pupils' awareness of the career potential in different parts of industry.
3. To involve pupils in problem selection and solution related to product and organisational design of an industrial nature.
4. To introduce pupils to the planning techniques and methods required for efficient quantity production.
5. To provide the opportunity for increased achievement and social interaction through group or team methods of working.
6. To establish a suitable vehicle for subject integration and teacher co-operation.

Within this framework a wide range of educational objectives were identified which could be categorised as broadly material in content or broadly social in effect. Thus, in the first group, these were summarised as:

- (a) To enable the pupil to acquire a better understanding of the properties of materials in relation to product manufacture.

- (b) To demonstrate the need for suitability of design and economy of materials in 'mass production'.
- (c) To establish the incentive for better quality and good workmanship with reference to commercial and aesthetic criteria.
- (d) To introduce pupils to the use of machine tools under controlled conditions and provide the opportunity to acquire the necessary skills for their use.
- (e) To offer the chance for pupils to acquire knowledge and techniques generally outside the scope of normal workshop practice.
- (f) To develop the pupils' ability in design and communication skills of a verbal, graphic and manipulative form.

The second category comprised such objectives as:—

- (a) To demonstrate the value of team working in developing practical design solutions and social interaction.
- (b) To provide a suitably wide range of activities within the programme to enable all levels of ability to participate and achieve.
- (c) To produce the incentive to complete allotted tasks within a specified period and to an acceptable standard.(d)
- (d) To establish a less formal pupil/teacher relationship whereby the latter adopts an advisory role.

Embracing all these concepts and serving as a starting point for the research, the following generalised hypothesis was adopted:

'Industrial type planning and production methods in Secondary School Design and Craft provide a relevant and effective learning experience, in preparation for the pupils' future role in society.'

The purpose of the study was therefore seen to be, in the main, a survey of the various approaches to date, supported by a Philosophical and Sociological examination

of the method and coupled with a report on three current projects, two in Lincolnshire and one in Belfast, with an analysis of these based on staff and students' questionnaires. This was to provide the basis for substantiating or rejecting the above hypothesis and also of assessing the educational potential of 'school based factory days'. It was also supported by evidence from previous production line experiments in the form of reports and interviews with many of the staff originally involved in these.

Despite the undoubted success of early experiments and the educational potential of the method, comparatively few schools throughout the country had undertaken such work. It was considered necessary therefore to contact, and where possible visit, all previous locations where such projects had been attempted. While pioneering work of a similar nature may have taken place elsewhere, the survey was to cover all traceable examples available through official sources and thereby assumed an almost national dimension. Certainly the majority of significant 'factory projects' were represented in the study and covered areas as widely apart as Lincolnshire, North Wales, Yorkshire, Cheshire, Leicestershire and Northern Ireland.

The account which follows attempts to give a synopsis of the most pertinent features of the research, with a view to assisting teachers who may be interested in adopting such projects within their own schools. An outline of the programme undertaken in the three schools, which co-operated in the 1973 experiments, is given and followed by a description of the debriefing and evaluation sessions. The results of the research findings are covered in general by a summary of the conclusions and proposals which the author found to have emerged during the investigation, and are depicted visually in a selection of the many graphs and diagrams based on the statistical evidence.



Perhaps the most far reaching and encouraging effect of the various experiments undertaken, have been the number of schools who decided to incorporate some aspects of the work as established elements of the curriculum. The methods employed to implement these developments varied considerably from place to place but all endorsed the educational potential of the earlier experiments. At Orangefield a Factory Week project has been organised with two third form classes each year since the first experiment in 1972, with a growing measure of success, and there are plans to adopt a modified form for some older groups this year. With a view to establishing a properly structured introduction to design orientated courses and projects, a pilot scheme for a First year Basic Design programme was introduced in 1973. The results of this were sufficiently satisfactory to encourage the School to proceed with the idea throughout the entire First Form entry this year.

### **Previous School Production Line Experiments in the U.K.**

It would not be possible to give a description of the early work in this field within the confines of a short article of this nature. As most of the school experiments in question were fully reported in various issues of the Schools Council's Design and Craft publication "Survey", it will suffice here to list the schools involved, and interested readers may refer to the appropriate articles. At the same time, the author would like to pay tribute to the helpfulness and co-operation he received from the headmasters and staff concerned in all of the schools which he visited or contacted. In every case the necessary information was made readily available and the teachers involved gave a valuable insight into the organisational planning, problems and achievements of the method.

The schools covered in the survey were as follows:—

Brierley Street Boys' School, Crewe.  
 Holywell High School, Holywell, Flintshire.  
 Orangefield Boys' Secondary School, Belfast.  
 Parkside County High School, Leeds.  
 Stainbeck C.S. Boys' School, Leeds.  
 Sir Thomas Jones' School, Amlwch, Anglesey.  
 Toothill Comprehensive School, Birmingham, Notts.

In addition to the various approaches covered in the projects undertaken at the above establishments, two other events which provided additional material for the research, were a training course for teachers and advisors at Trent Park College of Education, Herts, in December 1972, and a teachers' conference on the Contribution of Handicrafts to R.O.S.L.A., at London University Institute of Education in March 1973. The first of these was a Keele Project training session entitled "Industry and the School Curriculum" and provided the participants with an opportunity to examine and put into practice many of the ideas and procedures incorporated in school design and production lines. The second brought together Craft specialists from a wide area and touched upon many of the approaches inherent in Industrial methods applied to the school situation. Both occasions provided the author with an opportunity to meet and have personal discussions with teachers and advisors who had recognised the value of such methods and had either tried them or were hoping to do so. It was in this way that the preliminary arrangements for conducting further research experiments in the two Lincolnshire schools were made through the Science and Technical Studies Advisor for Kesteven, Mr. M.J. Wharton. The success of these two ventures, which are described later in fuller detail, were very much the result of his drive and initiative, coupled with the whole-hearted support of the headmasters and staff of the two schools involved. By a

remarkable coincidence, the chance to participate in both these projects was presented to the author at the most appropriate time and furthermore it subsequently appeared that only two other schools in the country were also engaged in such activities at that time.

### The Lincolnshire Projects

After official permission had been obtained to visit the two schools in the County by arrangement with the advisor, things moved remarkably quickly and preliminary discussions took place early in February with the headmasters of Bourne County Secondary and The Deepings County Secondary Schools. With their co-operation, the type of approach and two tentative schemes for undertaking production line projects were put to the various teachers in both establishments for their consideration. Interest was immediate and both groups of staff agreed to participate.

These two schools were mixed Secondary Modern types of about 450 pupils each and serving the two small townships and surrounding communities of Bourne and Deeping St. James. In the first case, the practical accommodation was in single storey huts adjacent to the main school and comprised one woodwork, one metalwork, one technical drawing and there home economics rooms. The second one had similar accommodation but it was a part of the school building complex and there was an art room in addition. About eight miles separated the two schools in this predominantly rural area of the county, the nearest, at Deeping St. James, lying about ten miles north of Peterborough.

Owing to other commitments and organisational difficulties, it was not possible to have two similar groups, in terms of age and ability, at the two schools. This was not regarded as a disadvantage, however, as the Belfast school was already committed to third form classes and it seemed sensible to

observe how the method might apply to different age and ability groups on this occasion. Thus, at the outset, it was decided to embark on the projects with a G.C.E. 6th Form Group of boys and girls at the Deepings school, and a rather larger number of C.S.E. and non-examination 4th year pupils, also of both sexes, at Bourne. Partly for this reason, it was decided to offer the older group a chance to undertake a project involving every aspect of industrial designing and manufacture, from market research to production and marketing, and the younger pupils one, where fewer stages would be involved. To initiate the schemes in both of the schools, short residential courses for the staff and young people concerned, were arranged to run consecutively at Brant Broughton House, the local authority's field centre, at the end of February. In the case of the Deeping's project, market research was to be undertaken by that time to establish what product would be designed, whereas the Bourne pupils were to be asked to solve a design problem given to them, namely a playhouse for primary school children.

The Brant Broughton courses were organised and directed by the advisor Mr. Wharton with the author's assistance and the help of teachers from both schools. It was sponsored by the Kesteven Education Authority and a full three day residential period was arranged for the schools, each having a morning, afternoon and evening in the centre. Both groups had a comprehensive practical and theoretical programme to introduce them to the procedure of designing on a commercial basis and producing ideas in model form. The Deepings' group arrived on the Wednesday afternoon and began with an introductory session in which they discussed their market research findings. After tea a preliminary period on designing was followed by a session on the setting up of a company and was conducted by an economics teacher from the school. This was most successful, especially as the



official forms and literature were provided to add authenticity to the activity. The general theme, which the students had originally been invited to consider, was that of storage units for the home and the market research had been conducted to establish preferences in this area, based on reactions by parents to eight selected articles. Working in teams of two (a boy and a girl), the group decided to concentrate their design efforts on three of the top four choices which had emerged from their survey, namely a clothes airer, magazine rack and milk bottle container. Construction of preliminary ideas in 'soft materials', as models of suggested solutions, were commenced during the morning session and later served as starting points for discussion and development back at the school.

The Bourne party was the second of the two groups to arrive and appeared shortly after the departure of the Deepings' pupils. As they were considerably younger than the first contingent and less experienced with handling materials, much of their time on the course was taken up with practical model-making, combined with talks from the staff on design methods. Although mixed work groups were formed at this stage, the boys and girls were encouraged to initially produce their ideas as individual models, leaving the modifications and development of these for subsequent analysis back in the school. Most of these young people responded well to the chal-

lenge and novelty of working with the variety of materials provided and everyone produced something to show at the conclusion of the course.

Generally speaking, this particular enterprise to initiate the two projects was very successful, and certainly as far as the Bourne pupils were concerned, an essential preliminary, as no art department existed in the school itself. It served, in the main, to give both groups a deeper understanding of the design process and an introduction to some new forms of communication, using a three dimensional manipulative approach.

From this point on, the work in the two schools followed separate and distinctly different lines of development. By this time, Management charts giving a production schedule, had been drawn up for both groups and, in the case of the Deepings School, a staggered or rota system of weekly timetable allocations was devised to provide "Project" periods throughout the term. The Management schedules, with a few minor modifications were reasonably accurate and by Easter the pupils in both schools had finalised their design solutions, on the basis of briefs issued earlier. In the case of Bourne, however, although the scale models had been produced in their ultimate form, the actual selection of one for production, by local primary school heads and staff, was postponed until the beginning of the summer term. The highlights of this design and planning stage, prior to the eventual

Playhouse Name:	1st Choice	Selection 2nd Choice	Totals
Den Block	0	3	3
Play Space	0	2	2
Igloo	8	1	9
Build-a-space	18	5	23
Space Shop	2	4	6
The Triscalion	2	2	4
Hexy House	8	0	8

choice of a design, were the visits of selected pupils to the local primary school to talk to the children there about what they liked best. This served to indicate the main needs and preferences of the potential users and in more than one case led to modifications of earlier plans.

The subsequent selection by the primary teachers was on the basis of a straightforward popularity vote, on a two point scale, and was assisted by the production of advertising literature produced for the occasion by the different design teams. Combined voting and order forms were duplicated and given to the teachers on arrival and in due course the following pattern emerged showing one design as a clear favourite.

On the other hand, the Deeping's group proceeded from their initial designs and sketches to scale models in 'harder' materials. These were the outcome of much discussions and thought by the different work teams, especially the girls, who contributed greatly to the experiment. It was decided here to enlist the aid of the teaching and catering staff to come to a final decision on the matter. Again, a voting form was produced and a sales campaign undertaken. The results clearly indicated that several items were in contention, as regards the relative popularity of these among the sample of the 'market' approached, as shown below:

In spite of the seemingly clear results of this "consumer" research, indicating items 2 and 5 as potentially the most saleable products, the Deeping's pupils eventually decided on one of the Bottle Carrier designs (No. 4) on the grounds of simpler production and availability of materials. Preparations got under way for the manufacturing session to take place towards the end of June and three main teams, Design, Production and Marketing, were formed to expedite these. Thus, design modifications, due to proposed production techniques, together with the devising of appropriate jigs and the investigation of suitable packaging techniques were put in hand at this time.

### The Belfast Project

As mentioned earlier, the production line project at Orangefield Boys' School, Belfast, followed from the experience of conducting an experiment in this method the previous year. It broadly followed the same pattern, but on this occasion, timetabling arrangements had been made for the three teachers concerned to have the two third form classes at the same time each week. Two of these staff were Craft specialists in Wood and Metal, the third a specialist Art teacher. Further periods for design and practical work were available in both Craft and Art departments, when three other teachers, one Craft and two Art, were involved with the

Item	1st Choice	Selection 2nd Choice	Totals
1. Milk Bottle Holder	2	4	6
2. Magazine Rack A	9	8	17
3. Magazine Rack B	2	3	5
4. Bottle Carrier A	6	2	8
5. Clothes Airer A	10	7	17
6. Clothes Airer B	1	2	3
7. Bottle Carrier B	0	0	0
8. Bottle Carrier C	2	6	8



groups during the early planning stages. Unfortunately, two of the groups were in workshop accommodation while the third was in an art studio some distance away in another part of the building. This presented many problems in liaison, mobility between groups and generally at times an isolation of one group, as though it was a separate class. Fortunately, however, during the preliminary planning stages, quite a lot of use was made of the B.B.C. Television programme 'Look Out' for which the groups were brought together. This helped to ameliorate the situation somewhat and also furthered the primary aim at the beginning of teaching the principles of design in relation to such factors as function, suitability and durability of materials, ergonomics and aesthetics.

With the assistance of the school economics department, and a list of suggestions provided by boys and staff, a questionnaire for market research was compiled and completed. The findings of this were sorted out by the boys under the supervision of their maths teachers, then analysed and openly discussed with the three groups combined. As a result, three of the items were selected for designing, namely a plant stand, a desk tidy and a milk bottle container.

Every boy subsequently received three design briefs, drawn up by the teachers concerned, and was required to produce one design for each brief. These were worded in such a way as to provide the widest scope and to act as a guide rather than an influence on any aspect of the design work. Following this preliminary stage, the ideas of the pupils were discussed in groups and suggestions made for improvement. A free choice was then allowed for pupils to select one which they would draw up in an improved form and subsequently produce as a model either on an individual basis or as the result of a team effort. About this time, a scheme called the "Profit Game" was introduced to give added interest and make the pupils more conscious of economy and the differ-

ing values of materials. Based upon an idea devised for an earlier Keele Project training session for teachers, this was not as successful as anticipated and was consequently not pursued. Nevertheless, the author was, and still is of the opinion that this approach, suitably modified, could provide a useful and stimulating introduction to the concept of commercial designing for pupils embarking on a production line in the school.

A date was now set for the completion and assessment of the models and at the specified time, the three groups gathered together to determine the most marketable products. The designers or spokesmen for each design team had to 'sell' their idea to the remainder of the pupils, talking about the design and describing its special features, the materials used, method of construction and proposed finish. Everybody was encouraged to discuss the items quite freely, to ask questions or make suggestions and a great many did take an active part in this. One boy, in particular, who up until that time had been disinterested and uncooperative, made some of the most valuable and constructive suggestions. The whole operation took approximately two weeks and eventually a design for each of the three articles was selected by a show of hands, for further development and the production of a prototype. The three groups then adopted a design each and began working in their respective areas on developing the prototypes and identifying the constructional methods required for the manufacture of the various components.

A somewhat unusual but interesting exception to this arrangement was the development of a second, more expensive version of the 'desk tidy' in perspex sheet, which was produced by a team of four and, although too expensive to provide a viable commercial solution, was allowed to continue, on the grounds of its originality and contemporary appeal. This was, in fact, a design chosen by the staff and considered

sufficiently promising to merit its production on a limited basis, with the design group forming a production section within the larger operation.

Another significant development which had actually occurred somewhat earlier and, indeed, had emerged as the result of the questionnaire, was the request of a local pet shop owner for the mass production of a large quantity of budgerigar and finch nesting boxes. In spite of earlier misgivings, the order was undertaken with a view to earning money to finance the main project and also to supply a form of valuable work-training. Although it did interfere somewhat with pre-production work on the milk bottle container, the benefits, financial and otherwise, made this an important contribution to the whole scheme. A total of 75 boxes were eventually delivered by the required date.

In the early stages of the prototype development some of the boys were taken to visit a local factory to see a full-scale production/assembly line in operation. Unfortunately, due to the prevailing security situation, the number of boys involved had to be limited to twenty, but in spite of this, the visit was very useful and the party was able to report back to the others what they had seen. To facilitate this, they were given specially prepared handouts in advance, drawing attention to the things of which they should take special note. There was little doubt that this experience was a valuable assistance to the production teams in setting up their own factory system.

The value of an additional incentive had been demonstrated in the first factory week experiment when the pupils had been 'paid nominal wages' in the form of tuck shop tokens. On this occasion, it was suggested that a company should be formed with the boys working for themselves and the idea was accepted after general discussion. The company was eventually called 'O.B.S. Designs Ltd.' and it was decided to issue one hundred shares at ten pence each. Every boy

was required to buy one share each but had the option to buy more when they were put 'on the open market'. Many purchased one or two extra, but one boy had the foresight to buy an additional fourteen! A few shares which were left overs at this stage were sold to the staff throughout the school. The shares themselves were designed and lino printed by the same boy whose general lack of interest or involvement had caused some problems in the early days of the project.

With the date of the factory week fast approaching, work on the making of jigs and templates got under way in each of the three groups and other preparatory work on workshop organisation and sales was undertaken.

### The Preparatory Stages

Work in both the Lincolnshire schools was now reaching a vital stage, with activity centred round organization to ensure that production would operate smoothly at the appointed time. The raw material, in each case, had been costed, ordered and either delivered or obtained, so that preliminary cutting to size was under way. Design and Production teams were not occupied with identifying operations, arranging work stations, designing jigs and either estimating or timing jobs to facilitate the making of flow charts and critical path analyses. With the Deeping's school, most of this work was in the hands of the students themselves and a feature of the project here was the designing of the production jigs. The Bourne pupils, on the other hand, were considerably younger, and much of the responsibility for this aspect devolved upon the staff concerned, although, where possible, the boys or girls were asked to assist.

At the Deepings School, the pre-production stage was marked by the number and quality of the discussion sessions which took place. Although different teams and/or individuals had assumed responsibility for various aspects of the project, such as timing operations and making charts, analysing



component structure, drawing the final 'blue print' and packaging the product, all the students took an active part in these meetings and many intelligent and worthwhile suggestions were made. Despite the heavy pressures of examination requirements, the interest was maintained and the various aspects mentioned were undertaken, with many of the group obtaining new experiences and satisfaction as a result. Thus, two girls and a boy became involved in solving the problem of producing a suitable box for the product and subsequently in the intricacies of silk-screen printing for the design of an appropriate trade mark. One boy made an excellent job of drawing up the full size details on paper, according to the specifications agreed, and this became one of the most important and widely used aids of the entire enterprise, referred to by staff and students alike. Yet another team undertook the important task of analysing the article into its component parts and identifying the operations required to produce these. With the aid of this and a numerical code, flow charts and production diagrams were then developed to determine the order of operations and the personnel required, and from these a time/operation order for each batch of products drawn up. Although this was subsequently modified somewhat, it did give some indication of the time period required and the organisation needed to achieve the targets over three full working days. From these calculations, it was decided that on the basis of a five hour day (300 mins.) twelve people would be required to produce components 1 to 6 in the morning and nine to continue and begin assembly in the afternoon of the first day. On the second day it was estimated that six people would be needed to undertake the spraying of assembled items, the making and fitting of handle rings and the screwing on of feet to the base of some of the articles. While this was going on, it was planned that three students would work on the printing of the

package design and a further three on the actual construction of the box. Day three was allocated to final finishing, inspection and the packing of the items in the boxes, for which a total of six people were estimated to be necessary.

The designing and making of jigs occupied several weeks prior to the actual production session and, in practically every case, their design and construction was the work of the students themselves with the advice and assistance of the craft department staff. This reached fever pitch in the day before the 'factory' period but, apart from a slight delay caused by the need to produce an alternative one on the first morning, everything was ready to get underway on the prescribed date.

The preparatory work at Bourne, which was proceeding at the same time as the Deeping's experiment, followed a somewhat different pattern. After the second visit to the local primary school in which the reactions of the children were sought in relation to the scale models produced, the design teams were encouraged to prepare sales pamphlets giving full details of their proposals and incorporating any necessary modifications. These were then duplicated and issued to the primary school headmasters and teachers who came to the pre-arranged sales meeting at Bourne, early in the Summer term. The teachers were asked to examine the models, talk to the representatives of the design teams and finally, on a specially printed form, indicate their personal choice of the two most suitable designs, in order of merit, from the seven ideas presented. For any school, interested in purchasing the playhouse eventually selected, a portion of the form was provided for making an order.

Although planned to take place slightly earlier and to have followed an initial sales campaign, there was an extremely good response from the teachers of the surrounding schools. Some thirty eight staff came, mainly after school hours, and took part in

choosing the final design for subsequent full scale production. Fortunately, there was a strong preference expressed for one design, which was a suitable and practicable solution for realisation. Four firm orders, including one from the county advisor, provided an encouraging incentive for the Bourne pupils to undertake the task.

Preparations now went ahead for the production session which was scheduled for the last week in June. Owing to the inexperience of many of the boys, some of the planning at this stage was undertaken by the master in charge of woodwork, Mr. Riddy, and by the advisor, Mr. Wharton, who arranged for additional equipment and some of the material to be supplied. Thus, the responsibility for ordering material, drawing up flow charts and working out a critical path analysis was not seen as appropriate for the age and ability of the pupils on this occasion. The boys were involved, however, in discussing the constructional problems, analysing the structure in terms of its various components and dividing the labour force into suitable work teams. Similarly, the girls' group under the direction of the needlework teacher, Miss Johnson, had agreed to produce the coloured hessian panels which formed part of the covering, the curtaining for the windows and applique designs in felt to decorate the walls.

In this particular project there was little need for work-training, prior to production, as most of the operations required for both the boys and girls' sections did not involve unfamiliar techniques. Some simple jigs and modifications to equipment were made but these were very straight forward and required no design analysis to produce. On the organisational side, it was arranged that both the boys and girls' groups would spend three complete days on the project, commencing on the Tuesday. During this period, their normal school timetable was to be suspended, although the usual hours were to be worked and the factory 'tea breaks' taken at

the appropriate times. The de-briefing and evaluation session was arranged for the Friday afternoon together with press coverage by the local newspaper in the area.

A prototype was produced during the weeks immediately preceding the production session and a careful note was made of the time taken to complete the various operations. This enabled a much more accurate estimate of the total production schedule to be made and greatly facilitated the drawing up of a realistic critical path analysis.

As indicated earlier, the Orangefield project in Belfast differed from those in the other two schools in that more pupils were involved, that they represented a younger age group and that the staff had the benefit of previous experience. There was the additional fact that three separate products were involved and three different production lines had to be organised. Amazingly, this ambitious scheme was duly operated successfully and much of the credit was due to the careful preparatory work undertaken by three teachers and their respective groups. To fully appreciate the scope and nature of the different problems involved, it will be necessary to describe the procedures adopted by each of these groups, firstly in their preparatory work and secondly in their production period.

### **Group 1 — Desk Tidy**

Four of the eighteen boys who had elected to produce desk tidies, formed an independent group to manufacture a limited number of different designs in perspex. Working largely unsupervised, this small sub-section tested a variety of construction and finishing techniques on scrap pieces of perspex prior to the actual factory week. A prototype was then produced and submitted to the headmaster for one week on a trial basis. Following this and further recommendations from within and outside the school, final modifications to the design were made. The article was then costed, firm orders taken, and the



amount of material required was calculated and obtained from stock. In the week before production they assembled all the necessary equipment and produced a layout sheet showing the flow of all components.

The remaining members of Group 1 were given a programme for production planning in diagram form and asked to adapt this to the specific requirements of producing the wooden desk tidy. Two versions of this were made, one in softwood and the other in mahogany ply. When the final production plan had been agreed, the constructional processes were analysed and individuals appointed to particular jobs. Customer orders were next taken and a production target of fifty fixed, after which estimates for materials were made and orders sent to the stores. The construction of suitable jigs was another aspect of this preparatory period which also included the first day of the factory week, when the production area was laid out, raw materials, equipment and jigs assembled, and some parts cut and stock piled.

### Group 2 — Milk Bottle Container

Work on the development of jigs and the prototype was delayed somewhat by the work on the bird nesting boxes, already mentioned. Once the latter were finished, however, the full attention of the group was switched to the production of a prototype and the making of jigs and templets. The design itself was comparatively simple, consisting of U-shaped members overlapped to form the bottom with the vertical arms attached to three rectangular rings which skirted the basket and formed the sides. The material used was 3 mm welding rod and 61 brazed joints were required in the construction. Originally it had been intended to paint the finished article, but near to the factory week, equipment and material was obtained for polythene plastic dip coating. A total of nine jigs were devised and constructed to facilitate production and assembly with

three of these being duplicated to speed up operations. Nearer the actual date, a number of boys analysed the production and assembly into the necessary number of processing stages and drew up simple flow diagrams with the stages numbered. Combining these with basic workshop plans showing machines, power points and water supply, etc., they eventually produced two large flow charts, one for assembly, the other for production, comparatively unaided. The question of raw materials was resolved by drawing mainly from school stock, on the understanding that the full cost would be met, while anything not kept in school was purchased with the proceeds from the sale of the bird boxes and the company shares. At this stage, every member of the sixteen strong group was working well and enthusiasm was running high. Again, like the previous group, a good part of the first day of the production week was devoted to preparations such as finishing assembly jigs, organising equipment and preparing a stock of components. Although a provisional target of twenty containers had been originally mentioned, the figure of sixteen was eventually agreed on as a more realistic number.

### Group 3 — Plant Stand

Sixteen boys were also involved with this particular design, which was probably the simplest of the four ideas produced. For this reason, target figures here were very much higher than any of the others and at a preliminary total of 150, were to provide the most realistic 'mass production' situation of any of the projects hitherto undertaken. Because of its simplicity no snags occurred, either in the preparation or the production stages and pupils were able to concentrate their entire energy on producing in quantity. Many basic jigs and templets were constructed prior to the 'factory week' and a sizeable quantity of components was prepared well in advance of actual production using materials from school stock. Allocation of

jobs was as follows: Store — two boys; Marking out — two boys; Sawing & shaping — four boys; Sanding and filling — four boys; Varnishing and painting — four boys. Material for this project was ordered a week before the production session and was delivered first thing on the Monday morning when the storemen quickly had it stacked and positioned in readiness for distribution to the various work stations.

### Production — The Factory Weeks

At the Deeping's school, production, in general, proved to be even more successful than had been anticipated. A number of 5th Form boys and one girl were invited to join the 6th Form group for this part of the project and in the main, made a valuable contribution to the whole operation. An outstanding feature of the production line was the participation and commitment of the five girls with practical operations previously outside their experience. This, allied to a remarkably high standard of workmanship on their part, indicated the value of this approach as a suitable and integrative activity for both sexes, a point also strongly demonstrated in the second school's project. The county advisor, four teachers and the author were closely involved in the 'factory days' in both an advisory and a practical fashion. Thus, apart from supervising the various operations two specialist Craft teachers actually became part of the labour force for a day when they undertook the cellulose spraying of the items, a skilled operation beyond the abilities of the pupils. Similarly, the Head of Crafts, Mr. Smith and Mr. Turner, in charge of Art were available with help and advice on numerous occasions, when required.

The target of thirty finished products was achieved on time and, in fact, was exceeded by one, a most creditable performance by everyone concerned. On the last production day, the Thursday, only a number of glueing-up operations on the packaging

needed completion at the end, and it was an interesting reflection on the enthusiasm and involvement of the students that they insisted upon finishing the operation that afternoon. Eventually, the sight of several long rows of completed articles and boxes provided a satisfying and worthwhile conclusion to their sustained effort.

The factory days at Bourne got under way quite smoothly due mainly to the preparatory work already outlined. After a short briefing session, the fifteen 4th Form boys took up their previously arranged work stations and production commenced. Within an hour of starting operations, the first frames were being assembled and by the end of the first day, output was well up to schedule and the first five door frames and panels had been undercoated in preparation for the gloss painting. Meanwhile, the ten girls in the needlework room were operating their production line with equal success and by the end of the first day had actually exceeded their quota. This was most encouraging for all concerned and again was due to careful planning and discussion among the teachers and pupils.

Although in the initial stages, the boys and girls worked almost independently, it became necessary for production to be integrated as the project progressed. It had been anticipated that some of the girls would be required to fix the hessian to the frames when that stage was reached but, in fact, the painting delayed the operation until the following day. This meant that these girls were 'unemployed' for part of the second day and although a few were drafted in to help with the painting it was clear that 'redundancy' existed at this point which might have been foreseen and avoided. Matters improved, however, on the final day and work on hessian fixing and assembly progressed unhampered, with the majority of the boys and girls involved. The target of five play houses was not reached on the Thursday, mainly because of the delay men-



tioned above and due to a late decision to add a wooden finishing strip round the edge of the hessian panels. Nevertheless, all the necessary components had been produced by then and although most of the pupils returned to their normal classes on the Friday, a small work force of the boys was retained to assemble and add the finishing touches. The final product was most impressive and exhibited a high standard of workmanship, exciting much favourable comment from other school staff and from the newspaper journalists and photographers who visited the school on the Friday afternoon.

In Belfast the 'Factory Week' got under way as planned with the three projects commencing simultaneously. With the 'Desk Tidy' group the small team engaged on the perspex design worked steadily throughout the week and achieved their target within that time. They again worked largely unsupervised and solved any problems as and when they occurred. The success of this enterprise depended largely on the attitude of the four boys concerned and to their relationship to each other. Work seemed to be shared on an equal basis and concern for standards of work was evident, a feature which was seen as the outcome of their experimental period together.

With the remaining fourteen boys of this group, work began to run smoothly on the second day of the factory week, following some reorganisation of the work schedule. Thirteen work stations were set up and quality checks were made by the designer on a regular basis at five of these bases. Activity and involvement were high at this time and despite setbacks on the third day, due to inaccurate machining of the pre-cut parts, work continued with enthusiasm. By the fourth day, several articles were ready for final finishing but it was clear that the target of fifty completed was not possible in the time remaining, although that number in various stages of finish did appear to be feasible. The final day proved to be the least

productive and constant encouragement was needed to maintain a satisfactory work rate. Owing to the repetitive nature of some of the jobs, a certain degree of boredom had inevitably crept in by this time and although an amended target had been set, declining standards of workmanship eventually forced an early stoppage of production, without reaching the agreed number. It was left to some of the more interested pupils to do the finishing and distribution during the following week so that the original targets were achieved eventually.

In the case of the milk bottle container team, the early completion of the first article, through the additional efforts of the teacher concerned, was a major factor in increasing enthusiasm for the work. The greatest amount of time was required for the brazing operations and even the addition of extra torches to speed up production was insufficient. In order to complete the number required, the teacher assisted by brazing the main joints with an oxyacetylene torch. While this was being done, one group was attending to general touch-up and repairs and another was experimenting with the plastic coating. Thus, by the Friday, fourteen containers were completely assembled of which eight still had to be plastic coated and the remaining six needed only minor attention. Both boys and staff were well satisfied with this effort and only two of the articles were considered rejects due to faulty workmanship. During the following week, all outstanding work was duly completed and orders delivered by the Friday. The quality and success of the final product prompted a number of further enquiries and orders, but these, unfortunately, had to be declined at that late stage.

Generally speaking, the factory week for the Plant Stand group was extremely successful and proceeded smoothly without any delays. As previously mentioned the target set at the beginning of the week was 150, and the number of stands produced and

sold eventually totalled 145. After some initial problems on the Monday, when only 20 articles were made, production increased rapidly with a total of 35 on Tuesday, 55 on Wednesday and 35 on Thursday. All construction work stopped on Thursday with every boy concentrating on sandpapering and on Friday some additional brushes were obtained which enabled much more painting to be carried out. Nevertheless, in spite of this, it was necessary for some of the squad to come back on the Monday to give some of the stands a second finishing coat.

### De-Briefing and Evaluation

At Deeping, the final session for de-briefing and evaluation had been arranged for the Friday morning and took place according to plan. A stimulating and revealing discussion followed the early completion of the students' assessment sheets and a number of general but important points emerged. The overall reaction was favourable and everyone who had taken part was satisfied with their individual achievement. The majority considered that the experiment had been worthwhile in the main because it had given an insight into industrial and factory methods. Several, however, had reservations because of the timing of the project in relation to G.C.E. 'O' Level examinations and there was almost unanimous agreement that operating the scheme earlier in the year would be more acceptable. Both boys and girls had enjoyed the experience and over and over again the aspect of teamwork and closer social relationships was mentioned, with the friendly atmosphere and sense of common purpose predominant. The new experience of designing and making jigs had appealed to many of the boys, while the girls had clearly enjoyed the experience of working in a practical way with different materials and having the opportunity to learn new skills. It was perhaps significant, however, that a number of the students, notably the girls, had considered the effectiveness of the 'factory

week' to have lain in appreciating the monotony of 'mass production'. (See Diagram 1).

The staff who had been actively concerned with the project from its inception were equally pleased with the results and response of the students while the remainder of the teachers were obviously impressed with the effectiveness of the experiment. So also was the headmaster, Mr. Sweet whose early encouragement and continued practical support had ensured the successful outcome of the entire project.

Fortunately, both the boys' and girls' groups at Bourne were normally timetabled for Woodwork and Needlework respectively on Friday afternoons and it was possible to bring both together again for the final discussion session and completion of the assessment sheets. The girls, on the whole, seemed to have got more from taking part in the project than the boys. They were generally more prepared to talk and discuss matters and showed a greater sense of responsibility in their attitudes. All but one of the girls expressed satisfaction with their efforts and considered the undertaking really worthwhile, while over 30% of the boys were unimpressed, four of whom considered it a waste of time. In spite of this, the general consensus was favourable and 80% of the complete group, boys and girls indicated that they would like to take part in a similar project on a future occasion.

There was little support for the idea of introducing production line work into the normal timetabled lessons over a longer period, but the suggestion was put forward of an intensive factory week outside the actual environment of the school. The idea of a nominal wage structure appealed to most of these young people as an added incentive, but having something worthwhile to show at the end also seemed to be important. Many agreed that there had been too many people on the playhouse project just completed and that a 'fully employed' working session was essential. Finally, it



emerged from the discussion and also from the subsequent questionnaire replies, that a number of the pupils, some 32% in fact, considered the designing part of the work to have been of least value to them. This may have arisen through a mis-understanding of its real purpose, coupled with the lack of facilities and materials due to the absence of an art department in the school. This view was supported by the fact that only two students from the twenty five participating felt that this was of most value to them, while 72% thought the practical realisation of more importance. (See diagrams 1 & 2).

As with the other two school projects, the pupils' comments and teachers' observations at Orangefield gave an insight into the effectiveness and value of such methods. Again, the participants were encouraged to speak freely and criticise whatever they had seen amiss, secure in the knowledge that the anonymity of such comments would be preserved. A number of especially interesting and relevant factors appeared from the general picture presented, with much of what was said having a lot in common with the replies of the Bourne and Deeping pupils.

Thus, for example, while the majority of the pupils enjoyed and were satisfied with their experience and were quite willing to undertake a similar project again, boredom was a common factor in the final stages and the monotony of repetitive work was frequently mentioned. On the other hand, the vast majority of the boys appreciated working more closely with others, rather than as individuals, and the relevance of the work, combined with the added responsibility was clearly seen as important. One lad, in connection with this, commented:

'It showed me that a production line may be boring, but you have to keep working . . . I know now how there are so many strikes!'

Yet another observed:

'I can now see all the worries which a business man has'.

Like their counterparts elsewhere, quite a few of the boys observed the emergence of a new working relationship with teachers as a positive development. As one pupil put it:

'I think that the whole thing was well organised and the teachers didn't act so superior as they usually do!'

A great many felt that they had worked well and were pleased that they had been extended, particularly in the cases where a new experience was involved. The selling aspect of the Orangefield project seemed to appeal to quite a few of the pupils and in several instances this was a strong motivating influence, as indeed was the incentive of obtaining a good financial return for their investment.

The reactions of the staff concerned were again very favourable and, in every case, they were more than ever convinced of the value of such work. They were particularly impressed by the way in which individuals, who had normally a tendency to 'opt out', had become so fully involved in one or more parts of the project. A notable example of this was the boy, who after having shown no apparent interest in the early stages, came to the fore as an outstanding salesman. His teachers subsequently remarked on the fact that he undertook this job with a degree of enthusiasm which he had seldom shown before. (See Diagram 6).

All the items produced by the four groups were eventually sold and, with the money gathered together, the staff undertook the responsibility of squaring the accounts. Eventually, with all the debts settled, a balance sheet was drawn up which revealed an amazing turnover of almost £81, with an overall profit of £45.35, including share capital. The new value of the shares was calculated at 44 pence each, an increase of 340% with a balance of 91 pence which was contributed to the school funds.

Throughout the last few days of the term, boys and teachers returned to cash in their share holdings — some wishing they had invested more like the pupil who had the foresight to acquire fourteen! There was a hint of disappointment on the faces of some of the staff working on the project — they had not bought any shares!

Generally speaking, the teachers thought the project was extremely successful, an improvement on the previous one and with the results under-lining the findings of the first experiment. Their practical recommendations can be summarised as follows:-

1. Very careful planning and organisation needed throughout the entire project to ensure adequate timing and programming of the various stages.
2. Small interesting jobs required to catch the imagination.
3. Pre-production training for technical skills essential.
4. Completion of prototypes by students and staff involved, in good time before the factory week to resolve problems, collect orders and boost enthusiasm.
5. Close co-operation and liaison needed, through regular meetings of all the staff involved, together with someone to act as co-ordinator.
6. A source of finance necessary with which to purchase materials.

## Conclusions

In broad terms, all the projects surveyed showed a remarkable degree of interest and involvement on the part of both pupils and staff, representing a very wide range of ages abilities, types of school and locations. The three undertakings directly linked with the research, namely those in the two secondary modern schools in Lincolnshire and the one in Northern Ireland produced surprisingly similar findings, despite differences in the ages, sex and experience of the participants. Perhaps the most conclusive of these and the

one supported by many of the previous experiments, was the social benefit accruing from the opportunities for team work and individual interaction. This was closely followed by widespread endorsement for the claim that school production lines offered greater opportunities for the less able to participate or contribute at their own level and share in the final sense of achievement, a conclusion supported by pupil's individual comments and by the views of teachers on earlier projects. Appreciation by pupils of the need for efficiency and planning in such enterprises, the producing of greater incentives to complete allotted tasks and the suitability of the method for the quantity production in schools were another three features of the projects which attracted majority acceptance by both pupils and teachers. Once again, earlier experiences from former undertakings underlined these aspects.

Somewhat less conclusive but partially endorsed were several factors specifically related to this particular approach, such as giving pupils an insight into the methods of industry, appreciation of the need for planning and design, production achievement as a means of assessing this planning and the chance to improve individual technical skills by repetition of operational procedures. Among some of the earlier claims that were not substantiated however, were such things as promotion of greater subject integration and teacher co-operation, understanding the need for economy of materials and quality control and as a means of careers guidance. The acquisition of new practical skills and techniques generally outside the scope of workshop practice and the development of related communication skills were another two aspects which, although evident in a few cases, were not sufficiently widespread to be acceptable as general resultants of the method (See Diagrams 1, 2 and 6).

On balance, however, the effectiveness and versatility of school based production



line projects as an educational method was indisputable. The hypothesis that the approach provided a relevant and effective learning experience in preparation for the pupils' future role in society was seen to be substantiated on the basis of the research. Thus it provided a learning experience by opening a door into a hitherto unexplored area for the pupils, while it proved effective because of the new social relationships with both staff and pupils which developed,

coupled with the opportunity for personal endeavour and achievement which was created. Moreover, it was relevant to future role in society because of the insight offered into the various facets of life in the working world and of the community to which the school belonged. Perhaps most important, however, it seemed particularly suitable for establishing a practical means of 'crossing the boundary'\* between the world of school and work in a meaningful way.

## DIAGRAM 6

Scalogram Analysis Chart for Teachers' Responses 1.

x								
School	Teacher	Pupil Evaluation O 14	Achievement for Less Able L 11	Individual Problem Solving J 9	Achieving Targets R 17	Understanding Industry P 15	Careers Guidance Q 16	Scores
Orangefield	V	1	1	1	1	1	1	6
Toothill	IX	1	1	-	1	1	1	5
Orangefield	VI	1	1	1	1	1		5
Stainbeck	X	-	1	1	1	1		4
Holywell	VIII	1	1	1	1			4
Orangefield	VII	1	1	1				3
Bourne	I	1						1
Deepings	III	1						1
Deepings	IV	1						1
Bourne	II							0

Reproductibility  
Co-efficient

= 1

No. of Errors

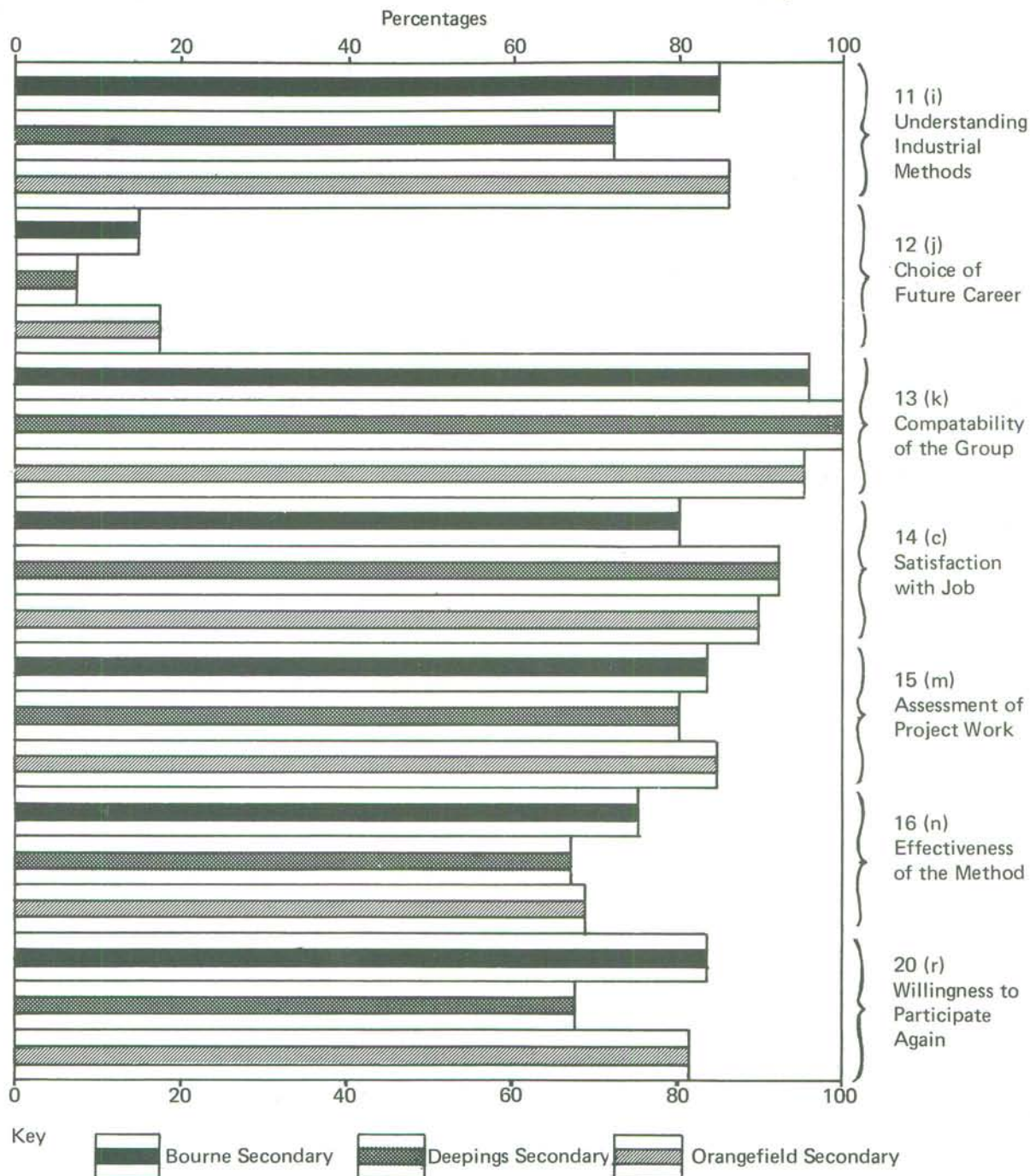
(2)

No. of Responses

= 1 - 60 = .97.

# ANALYSIS OF PUPILS' RESPONSES

Diagram 1





# ANALYSIS OF PUPILS' RESPONSES

Diagram 2

