The College of Aeronautics

Cranfield

Proceedings of Work Study School Conference

Cranfield 1954

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THE WORK STUDY SCHOOL

THE COLLEGE OF AERONAUTICS

CRANFIELD

Proceedings of the Work Study School Conference. Cranfield, March 1954

The Conference was arranged by request of the students of the Work Study School who attended the three courses. Out of a potential 56 students, 34 attended the Conference, and apologies for their absence were received from most of the remainder.

The intention of the Conference was to give students the opportunity of renewing contact with their former colleagues, and to hear reports from people who had been putting Work Study into practice during the previous months.

It was generally agreed that the Conference was a success, and arrangements are in hand for such conferences to be held annually.

List of Papers Presented

J.B. DAVIS	The ruminations of a Work Study Officer.
L. JULIUS	Work Study in Design
G.H. BRAYSHAW.	Alternative Methods of Machine Milking a Dairy Herd.
J.A. HARRIS	New Work
R. WHITCHURCH	Method study in Newhaven
W. LEES	An application of Work Study in a Ring Room.
W.E.J. WOOTTON	Management Consultants and the Work Study Officer.
R.A.G. TIDD	Aircraft Maintenance.
H.E. WILLIAMS	A Trades Union Negotiation.
F.G. FISH	Multi-Factor Control
E. TUNSTALL	Introduction of a Work Study Training Centre.
G.J. MOORHEAD	Can the small firm afford Work Study.

This Note includes precis of the papers by Davis, Julius, Brayshaw, Harris, Lees, Wootton, Tidd, Fish and Tunstall. The paper by Moorhead was published in 'The Manager' for March 1954.

"The Ruminations of a Work Study Officer"

(J. B. Davis)

Company Background

A. Boake Roberts & Co. are manufacturing chemists established in 1869, at a small factory in Stratford engaged in the manufacture of brewing specialities. The Company now has six factories and manufactures such diverse products as plasticisers, perfumery chemicals, essences, fine chemicals and some heavy chemicals. A large site has been purchased and development is now in process.

Work Study was introduced into the Company in August, 1953, and the Company was fortunate in having a director with a wide first-hand experience in this subject. Initially, a chemist and an engineer were sent on a Work Study Course at Cranfield and subsequently two further chemists were sent to Cranfield for training. This team now forms a small department in the Company and is engaged on a Method Study programme in the Works.

Putting it Across

The Work Study team started off in the fortunate position that top management were already satisfied of the need for Work Study. A large number of senior management attended the Association of British Chemical Manufacturers Conference on Work Study at Buxton, where their interest was further aroused. The team has followed up with lectures to Junior Management, foremen and shop stewards on the broad outlines of Work Study and the scope for it in the Company. The policy has been to educate by example, rather than by lectures, and on reflection there is little doubt that the policy has been sound. Advantage has been taken of outside courses, and our foremen have benefitted from courses in Foremanship at Pendley Manor and weekend Work Study courses organised by the Institute of Industrial Supervisors. In talks to shop stewards, area representatives of the principal Trade Unions gave strong support to the introduction of Work Study in the Company.

Practical Progress

On returning from the Cranfield course, the team spent a profitable two weeks touring all departments of the Company. In this way not only did the team get to know personally a very broad section of Company officials, but these officials had first-hand knowledge of the Work Study team. The team was then in a very favourable position when the need for consultation arose from their first job. From this tour, certain points were listed as a basis for selecting jobs for Work Study. Since that date a tentative programme of work has been drawn up for some twelve to eighteen months ahead.

The team also spent a short period with another company which had long experience in Work Study with a view to getting some first-hand practical experience of the subject in the chemical field.

From an initial survey of the Company it was felt that a fairly intensive Method Study programme would be most beneficial. This decision was based on high material cost and low labour costs within the Company, and the evident need for improvement in method before applying detailed Work Measurement.

The first job selected was carefully chosen, being an easy study which could show quick and dramatic results, and help to convince all members of the Company in a more effective manner than any amount of talking. From this method study it will be possible to reduce from shift work on a seven day week to day work on a five day week for the same output. A number of amusing points were brought to light during the application, all of which were based on the old adage "Its always been done that way". A large saving in services and time resulted from an enquiry into the process. Over the years the

"The Ruminations of a Work Study Officer" (Cont.)

dilution had increased from 350 gallons to 500 gallons, and this liquor had to be evaporated at the next stage. The foreman concerned was most co-operative but unconvinced in the early stages until by practical demonstration he was converted, and gave active support to the scheme.

The team are consulted at the drawing board stage on all new projects. In the design of a new engineers' shop shortly to be erected, some costly mistakes have been avoided. In connection with this project stores layout has been considered, and from an investigation into stores holding it has been possible to reduce the number of items held by nearly 50%, showing a saving in terms of working capital of some 38%.

Another application has been in a plant working shifts on a seven day week in which sales demand exceeded production. A production increase of 24% has been achieved, the investigation showing that the root cause of the trouble was inadequate supervision, coupled with low plant utilisation. The foremen concerned were responsible for several other departments and had not enough time to control the process and plant. Three new shift chargehands were appointed, and given a week's special training not only on the practical aspects of the job but also in rough costs, sales information, personnel functions and Method Study. The Work Study team was actively concerned in this training programme, and from Method Study some new ideas have emerged.

In addition to the above schemes which are just a few of the jobs tackled by the Work Study Department, the team is working on problems which do not come directly under the heading of Work Study. These include such items as factory planning, instrumentation as it affects productivity and job evaluation schemes.

The Work Study team takes every opportunity of visiting other companies' engaged in Work Study to further their knowledge and exchange ideas, and has given lectures on the subject outside the Company with a view to publicising this "Tool of Management".

"Work Study in Design"

(L. Julius)

This is a story where apparently Work Study started the wrong way round. In other words it was started by the Designer rather than by Management.

Design is one of the most important tools of management. It affects us aesthetically, functionally, and it also affects our pockets. By design I mean the design of an end product, i.e. a machine, or in my particular case, a chair. This is a subject which often is ignored, and this is the reason, I think, why some of our products fail miserably in many of the world's markets.

Design is a matter for highly qualified, technically trained personnel. A good designer thinks in terms of aesthetics. He wants something which will look good, sell well, is pleasant both to the touch and to the eye, and even to other senses such as smell. He must also consider the people who are to make the product. Management often imposes an impossible task on a designer, insisting that he designs to the machines which are available. This stultifies the design as far as any development is concerned, and also the development of any new machines.

In out own plant the designer has a practically free hand, and in reason can do what he likes. The sales staff are not allowed to influence him in any way, but it is the designers responsibility to consult all the way down the line those people who have to make the product. Our Designer is extremely sensitive, both as a designer and also, which is important from the Work Study point of view, to the requirements of the factory. He realises the limitations of small plant, and tries to get as much out of it as he can by the interchange of parts, i.e. the designer imposed Work Study on the firm.

Since my return from Cranfield, we have gone carefully through every single product which we manufacture. Illustrated are thirteen cabinets, and we also make a further ten. Amongst these there are a great many common pieces. This has been done purposely in order to assist production, and now instead of ordering in batches of 100, we order in the thousands, thus getting the benefit of long runs on a number of our products. We found during our investigation that certain items were slightly different for no apparent reason, and these were made common by making slight alterations. All these things effected very considerable savings, and were all done in the three months since my return.

From the pamphlets which I have handed you, you will see that although we have standardised to a very considerable extent, we are still able to produce by different combinations of the same units, a wide variety of pleasant furniture. We are able to increase this variety still further by buying out certain metal parts and combining these with parts of our own manufacture.

By reason of the standardisation we have been able to work out an Incentive Scheme very much more quickly than we should normally have done, and we have been able to build up a lot of synthetic data by the use of graphical set ups.

We also hope in the future to use M.T.M. to give further information.

Closing remarks: "Good design is good business, aesthetically good to live with, functionally good to use, and, finally, it reduces costs."

"Alternative Method of Machine Milking a Dairy Herd"

(G. H. Brayshaw)

(The first part of this paper dealt with the application of Work Study in order to improve existing methods of animal feeding. Owing to limited space we are confining ourselves to the portion of the paper dealing with machine milking a Dairy Herd.)

On a certain farm a herd of Channel Island cows were looked after by three full-time cowmen. The herd was housed in yards and milked in a six-standing milking parlour by two men using three bucket machines. Forty-one cows were milked but an expansion to fifty-five cows in milk was planned. As milking already took a long time, the problem was to increase the size of the herd, but not the time required to milk. The farmer hoped to increase herd size by one-third without increasing his labour force.

Time study indicated that :-

1. It took 190 man minutes to milk 41 cows, a rate of 13 cows milked per man hour. On this basis 255 man minutes would be required to milk 55 cows. An additional 30 man minutes were needed to assemble equipment, wash up and sterilise. Milking twice a day, expansion would be prohibited unless the milking operation could be speeded up.

2. With the routine employed, 11.5 minutes elapsed between washing a cow's udder and taking a machine off. This time must not be increased, as washing temporarily stimulates the let down of milk.

3. A low rate of milking was due to underemployment. 2.2 minutes were spent waiting to strip and machine stripping each cow. Of this 2.2 mintes, stripping averaged 0.39 minutes and the men waited for cows to milk out for 1.81 minutes. With 55 cows milked twice a day, total waiting time would approximate 3.32 man hours a day.

4. The average time the machine was on each cow was 6.4 minutes but individual times varied from 3.0 to 11.8 minutes. A new method must provide for flexibility.

The solution to the problem depends upon balancing men and machines. Two men operating 3 bucket machines are not a successful combination. In this case one man operating 3 units would reduce labour requirements but lengthen the duration of the work. If an additional machine were purchased, two men operating two machines EACH would improve balance, but eight standings would be required. On this farm structural alterations would be necessary.

A second alternative would be to "double bank" machines so that six could be operated in the original 6 standings. This has been done on a number of farms already and may be gaining in popularity.

Finally, existing machines could be replaced by an auto-releaser or auto-recorder. With a bucket machine milk flows from cow to bucket. The milking cluster and lid of the bucket are then transferred to a spare which is immediately used on the next cow. The full bucket must be carried to a spring balance, weighed, and the milk tipped into a filter and cooler. Using an auto-releaser or recorder, the milk is piped to the cooler and churns. With a recorder, milk is temporarily stored in a graduated glass jar. The yield of each cow can be noted before a lever is tripped and milk permitted to flow to the cooler. Several jobs are eliminated as compared with bucket machines. The saving in time will vary with the number of cows milked, but additional labour for cleaning and assembly will be a fixed charge. As a result, bucket machines will require less labour with a small herd whilst an auto-recorder will save time when many cows must be milked.

"Alternative Methods of Machine Milking" (cont.)

Average times were used to forecast the effect of alternative arrangements. Not as accurate as standard values, it was felt that they should indicate wide differences in the labour efficiency of alternatives.

Synthesis indicated that:-

1. If the present equipment were retained, 2 men, 6 units and 6 standings would be most satisfactory. An annual saving of 1,010 hours would reduce costs by £162. There would be roughly double the assembly work and additional washing up. The net saving should be about £92 a year.

2. Recording is necessary if inferior cows are to be culled. It is not possible with an auto-releaser. Two men, 6 standings and an auto-recorder would save 1,460 hours @ 3.2 shillings an hour, and reduce costs by £234 a year. Deducting depreciation and interest on additional investment, and the cost of extra labour for assembling and washing up, a net annual saving of £138 could be expected as a result of the change. This assumes the recorder to be used as a releaser 6 days a week, and recording to be carried out on one day only.

The farmer was advised to install an auto-recorder and this has now been done. A second time study suggests that the time to milk has been reduced by 865 hours a year. The net saving is 494 hours or £54 a year. The farmer is satisfied as the herd can be increased, but improvements are far less than expected. The sole reason for this discrepancy is a rise in the average time the machine is on each cow. In the second study, the machine was on for 8.7 minutes as compared with 6.4 minutes originally. This alone reduces savings from £138 to £54 a year.

It becomes necessary to consider the probable cause of the rise in machine time. If it is due to the new equipment, costs have only been reduced by £54. If due to seasonal or individual changes in the herd, which would have occurred in any case, then £138 will have been saved. An auto-recorder should operate at least as quickly as bucket units but heifers may take longer to milk than older cows. When the second study was taken, the herd had already been expanded and the discrepancy may well be due to the increase in the proportion of heifers to cows.

The savings achieved would be small in industry. To a farmer they may represent a considerable addition to profits. Alternatively, a saving of 852 hours is equivalent to 27% of the time needed with original methods.

One further point may be considered. By graphing the probable savings with alternative equipment against the average number of cows milked it can be shown that an auto-recorder may have been advantageous on this farm with 23 or more cows in milk. As 41 were milked originally, the change would have been profitable even without an expansion of the herd size. Secondly, whilst the practice of double banking bucket units may result in a saving with 24 cows or more in milk, with this size of herd it is already more profitable to install an auto-recorder. If this is so on other farms, double banking should not be encouraged.

"New Work"

(J. A. Harris)

On my return from Cranfield I was asked by Management to have a look at certain aspects of our office procedures as they were creating bottle necks. As an engineer this request seemed a little odd, but it was abundantly clear that there was plenty of scope for even a raw beginner such as myself.

The first project tackled was in the Job Card Control Room, were three women were employed. Their job was to issue cards as raw materials became available for manufacturing. Information about the availability of material was supplied to this office via a vacuum tube, and people requiring service from the room came to a window in the glass partition where they asked one of the girls to give assistance.

The internal telephone for the office was also positioned alongside this glass partition, and was at a distance of some seven feet from the nearest girl. The vacuum tube was about six feet from the nearest girl.

As the inevitable result of complete non-organisation in the department it was quite usual for the girl furthest from the window (they were sitting in a line at right angles to the partition) to be walking from her desk to the window to attend to a caller whilst the girl at the other end of the table would be passing across her path attending to the delivery of containers in the vacuum tube system. As the traffic in this department was quite heavy the very lack of organisation was in itself creating a bottle neck.

I studied the job using a flow process chart and a flow diagram, and took some photographs of the situation as it then was. Analysis of these charts indicated the need for a modification of the paper work system, and the result of this analysis was that it was immediately apparent that two girls could carry out the work instead of three. This immediately reduced the number of occasions on which they would be in each others way whilst walking about.

I next looked at the layout of the room, and made certain modifications which now appear quite obvious.

(Mr. Harris showed a film strip of the before and after of the layout and flow diagram.)

The desks for the girls were moved up to the glass partition, and those filing racks most generally in use were located near to them.

At no cost other than that of labour to relay-out the room it now became possible for these two girls (in theory) to carry out all the necessary work without moving from their desks.

Within this same department we had another function concerned with record cards, and this was carried out by two women sitting at a glass partition window serving out record cards as required. The average distance walked for these cards was about sixty-eight feet, and by altering the layout of the department we were able to reduce this average walking distance to twenty-eight feet. As these operators are practically employed full time in handling record cards this saving of forty feet for each transportation amounts to a considerable amount of time and energy in the day.

These two projects, simple though they were, were quite dramatic in the saving of time and energy, but perhaps more important was the saving in space effected. As a result we were able to bring into the room the specification filing cabinets and general filing cabinets (these are very large storage rack fixtures, and should not be confused with the four drawer filing cabinets generally in use in an office.)

"New Work" (Cont)

Among other things this made the room fully enclosed, the filing cabinets forming a partition around this particular section of the larger office.

The general filing cabinets were reduced from seven to two by introducing a "live" filing system in place of the existing "dead" filing. This brought about a saving conservatively estimated at £700 in filing cabinets alone, apart from the tremendous space saving. To underline the effect of the saving in space, I can tell you that on these three minor projects alone we unearthed sufficient space to build two personnel offices, a reception hall, a conference room and a stairway from the office to the general machine shops. I have not evaluated that in terms of £. s. d. for the construction of new buildings to house this accomodation, but it is quite obvious that the study was self supporting.

I then had a look at the system in use in the production control centre. This arose because the operator complained of having too much work, but there was obviously no justification for an additional full time operator. The system was such that the operator had to work out two separate cards for each item of traffic through her department, and she had fifty card containers to house the cards. A very great number of cards were required to make up the production data for any one job, and the permutations and computations on the cards likely to be required was quite terrific. By combining the cards into one newly designed card, it was possible to so reduce the work that one operator can now handle it easily, and in fact, do other work within the day. The card containers were reduced to ten which shows a saving of 80% in space, and indicates the degree of reduction of paper consumption as the new card called for a quantity of paper in the same ratio of reduction.

I was then asked to study the working of one of the general offices, and to produce fairly rapid results. At first glance this appeared to be almost impossible, as a vast variety of activities were taking place in this general office. However, after a preliminary survey I decided to look at the most important pieces of paper in use in this office and from which all other activities arose. I found that there were in fact two main items, and so if it was possible to eliminate or speed the operations of these, the effect would be mutiplied throughout the whole office. It was obvious that the best method of illustrating the movements and activities surrounding these pieces of paper was by means of a string diagram, and this is reproduced on the film strip.

As is often the way with Method Study, there is a degree of compromise necessary between the demands of two or more activities going on in the same area. The result in this particular case was that we had to modify our views on the ideals for either of the two main items and although we were unable to give the best possible solution for any one flow, the final result of our studies was to reduce the travel distances of the paper in the department from 1,000 feet to 450 feet approximately. That is something like 55% improvement in distance travelled. The effect of this was again to save space, time, energy and operators, and was happily received by both management and employees.

I think that perhaps the most significant thing about these early efforts was that by using the principles of straight forward Method Study, it was possible for some one as unfamiliar with office procedures as myself to introduce satisfactory modifications with such gratifying results.

I have, since carrying out the above investigations, gone into some of the problems in the factory, and find that I am having just as great success in production problems as were available to me in the clerical field.

"An Application of Work Study in a Ring Room"

(Walter Lees)

In view of the fact that in my Company there was no index of efficiency in any department, with the exception of two, the Work Study Department was commissioned to investigate all departments, record efficiency and produce sufficient informations to act as the basis for production and labour cost control statements.

The latest department to be investigated was the ring room and the statements for the first few weeks showed that the production of the ring room was in the region of 50% efficiency. This called for a further investigations to discover the reason and the remendy for this low efficiency.

First it is necessary to explain the function of the ring room and how it works.

The processes preceding the ring room are concerned with the opening and cleaning of the cotton (which looks like cotton wool) and the arranging of the short lengths into a sliver in which all the short lengths are parallel.

When the cotton arrives in the ring room it is in the form of a supply package, rather like a large bobbin approximately 8" by 5" in size, filled with a sliver of cotton approximately 3/16" in diameter. In the ring room 324 of these supply packages are placed on a ring spinning frame. The cotton sliver from each supply package is passed through three sets of rollers, each set running at an increasing speed to give a continual pull on the yarn which comes out eventually much the same thickness as that in an ordinary cotton reel. It is then spun on to a bobbin which is later used in the shuttle of a loom to provide the weft or cross thread of the cloth. The ring frames hold 324 of these bobbins, 162 on each side, and they all start to fill with cotton yarn at the same time. When the bobbins are full the frame stops automatically and the bobbins have then to be removed and replaced with empty ones. To do this there are teams of collectors consisting of two girls to a team, whose job it is to go along the frame, one on each side removing the bobbins and replacing with empty bobbins. This is known as doffing.

As there are a total of 29 ring spinning frames in the room, this means five teams of collectors, each team being responsible for 6 frames, except one team which is responsible for five frames. The only reason for a team being allocated to six frames is that "they have always been allocated six frames".

As the efficiency of the frames depends on the length of time they are stopped for "doffing" we concentrated on the collecting teams.

We first studied their motion pattern but dicovered no way in which it could be improved, both hands being continuously used. We therefore turned our attention to time study. As a result of these studies we discovered that the time required to doff a ring frame at an 80 performance was equal to 6.69 minutes. There is in fact an Incentive Scheme already in operation, based on this time, but the majority of the collectors were not earning more than 2% or 3% bonus.

The work load, on the basis of one team per six frames, when the collectors worked at an 80 performance proved to be equal to 109%. So even if the collectors worked at an 80R all day long they would be over-loaded by 9% and frames would be stopped waiting for their attention.

"Work Study in a Ring Room" (Cont.)

To discover the actual rate of working we then took two-day production studies of each team and found that the collectors were taking 9.0 minutes in which to doff a frame. The calculated work load when responsible for six frames was then 138%. In other words the collectors were overloaded by 38% when working at their normal rating of a 60.

Our first thought was to re-train the collectors in order that they should improve their performance. They were, however, using the correct method as taught in the training school. We did in fact discover that there were two reasons why their performance was so low. We found that a high base wage was being paid in order to attract labour to an occupation that has been known in the past as being very unattractive. This high base wage left very little margin for an incentive scheme. We found too that the majority of the collectors were unsuited for the task and quite incapable of reaching an 80 performance.

With an allocation of six frames per team of collectors, we found that the highest efficiency we could expect was 51.8%. A chart was then drawn up and showed the amount of waiting time that could be expected if the collectors worked at a 60R and were allocated to six frames. The chart also showed the effect on the waiting time if teams were allocated five frames each or four frames each.

This chart was shown to the manager and he could see that with an allocation of six frames per team, out of each hour each frame would be:

Stopped for doffing:	9.05 minutes	=	15%
Waiting to be doffed:	19.91 "	=	33.2%
Running:	31.04 "	=	51.8%
	60.00		100.0%

The efficiency which could be expected with five frames per team was 62% and with four frames per team was 73%. It was agreed that with the type of labour available we should base the time to doff a frame at a 60 rating and allocate four frames to each of six teams. The five frames left would be the responsibility of a team whose rate of performance was around the 75 mark.

The times we could expect per hour with this arrangement were:-

Frame being doffed:	12.75 minutes	=	21.3%
" awaiting to be doffed:	3.59 "	=	6.0%
" running	43.66	=	72.7%
	60.00		100.0%

This represents an increase in production of 40.2%.

This increase in production would have its effect on other occupations in the ring room and we had therefore to take time studies of each occupation in order to calculate the work loads. An incentive scheme was then calculated for each occupation to ensure that everyone in the ring room should be striving to attain maximum efficiency.

To ensure that sufficient packages could be produced by the previous processes we have suggested that certain machines previously lying idle should be brought into production, others would have to operate at an increased speed and one section would be required to operate on double shifts.

Two department are concerned with supplying cotton yarn on the bobbins which are used in the shuttle of a loom. These two departments, the ring room and the winding room, receive their supply of empty bobbins from the bobbin stripping section. This section is responsible for stripping off the bobbin any yarn left on after the weaving process. To ensure a constant supply of empty bobbins an incentive scheme is being calculated for this section.

During our investigations it was discovered that three different

"Work Study in a Ring Room"(Cont.)

sizes of shuttles are being used in identical looms. The amount of yarn which can be spun on to a bobbin is governed by the size of the smallest shuttle used, and the smaller the shuttle the lower the efficiency possible in the ring room and in the weaving room. The size of the shuttles to be used has now been determined at the largest size.

As a result of these improvements we hope to save something in the neighbourhood of £10,000 per annum.

"Management Consultants and the Work Study Officer"

(W. E. J. Wootton)

The Management Consultant is a new-comer to the industrial life of this country. Twenty five years ago his profession was unknown. Today its status is well established and rests on high standards of skill and integrity. The successful growth of this new profession springs from a genuine need for its services. It exists and grows because it produces the desired results. New clients are made generally through introductions from other satisfied clients. It is simply that if the Management Consultant is not successful he will not obtain new clients and will eventually go out of business

The role of the Management Consultant is to provide the business executive with the newest and most efficient administrative techniques and skills. The increasing demand for his services is due to an appreciation that the task of developing and introducing these techniques is as skilled and specialised as the design and development of machinery; and just as essential for obtaining the full potential from industry today.

Generally firms use the services of consultants for the following reasons :-

(a) By reason of their background, experience and knowledge reputable consultants are experts in modern management techniques.

(b) Because Managers and Administrators lack the time and the skilled staff to do a specific job.

(c) Because Management are unfamiliar with the problem or feel the need of the unbiased and fresh outlook of an outside specialist

The next remarks apply equally well to the small or large consultancy business. Has the consultant any inherent advantages over the executive staff of an organisation in general and has he any advantages over a Work Study Officer in particular ? When you try to form the answer to this question in your own minds I would like you to bear in mind these observations. The consultant enters the organisation at 'top level' with the status of a senior executive without of course any authority. This means that he is free from the day-to-day problems of administration, and is able to concentrate the whole of his energies on a specific programme. Provided the client will benefit, and by that I mean all grades of employees, the consultant can make recommendations which appear to be revolutionary, because he is free from a vested interest in any part of the organisation or its personnel. He is not prohibited from proposing action by the fear of its possible repercussions upon his position. He is free from self interest and is without prejudice or partiality to personnel at all levels. On the very important issue of labour negotiations and relations, the consultant's independence of both management and labour enables him to become a direct and intimate channel for information. Real causes of dissension can be found which would otherwise in formal discussion be deliberately or unconsciously concealed. And in all problems which arise between the operatives and management the consultant can use the advantage of his position to bridge the gap. Though not too often we hope, like Horatius on his bridge which he defended single handed against all comers. The consultant because of his status sometimes is more able to get action taken than is possible to a junior executive. Finally, in many cases the consultant is greatly assisted in his work because in his dealings with Trade Unions they know that he is an impartial observer.

To augment my statements about the advantages of a Consultant over the client's staff, it is interesting to analyse the proportion of time spent by a consultant in working on pure techniques and in negotiations etc. It has been suggested that approximately 30% of a consultants time is spent in actually working on specialised techniques the remaining 70%

is spent in negotiation, persuasion coercion, leading, advising. Hence a knowledge and practice of techniques alone will not produce the full results. A consultant with his wider experience and knowledge, especially in his dealings with men and managements is in a position to achieve the highest efficiency.

If I can now consider the work of the average Work Study Officer - our 'new' Work Study Officer, that is the unfortunate individual who has had to start up a department on his own, will, no doubt, be treated as a novelty, not necessarily by his Managing Director, but by the other executives, supervision and operatives. He is given or selects if he is very wise, a small section on which to try his method study. He is successful and persuades the management to engage more staff to help him. The 'empire' and his influence grow, but he is still a member of the Company doing something different and he will receive the usual hostility. This will make it more difficult for him to cure the troubles and probably results in mere 'patching up'. Initially the Work Study Officer is an expensive hobby, and within the normal span of life can, I suggest, achieve only limited success as compared with consultancy standards. Your Companies are enlightened, otherwise you would not be here today. But are they enlightened enough ? It is for you to judge.

To conclude I would like to state the following points:

Where a Work Study Department exists, consultants and Work Study Officers would form a good combination in a factory. Each should gain from the other's experience. The Work Study Officer would be acquainted with most, if not all of the production methods, and I would anticipate that the consultant's work would be completed in a shorter time. Before the arrival of the consultant the ground would have been broken, favourably we hope ! Consequently the initial impact of the consultant upon the organisation would be softened; a matter which will be to his and the firm's advantage.

The wider concept of the Consultant's work leads to major changes. The client may need these changes. There is sometimes a vast difference between what a client wants and needs. Frequently the introduction of method study and work measurement brings to light problems of organisation which must be solved if full efficiency is to be obtained. Personalities enter into this picture and only an outside specialist working at a high level can give the necessary advice.

Finally, on this, perhaps, contravertial subject of outside specialists I would like to read to you a quotation from the book "We Too Can Prosper" by Graham Hutton. The book condenses the work of the Anglo-American Council on Productivity. He says: "While separate consulting specialists have much to offer, there is the natural danger that the medium sized and smaller firms - who make up the bulk of their clientele both here and in America - will tend to bring in the 'outside consultants' and think that, therewith, the need to improve the firm's own management as a whole has been met. Management itself today needs to be staffed with at least some specialists in the art, skills, and techniques of modern industrial management - even if, for no other reason, in that way, the regular management will know which 'outside consultant' it can most profitably employ. Thus, since the large businesses in both America and Britain tend to be self-sufficient in all managerial specialists, and since new managerial specialisms are being rapidly developed, there is now plenty of room for such specialists. They are needed both 'inside' and 'outside' ".

"Aircraft Maintenance"

(R.A.G. Tidd)

The basis of aircraft maintenance is the number of hours which the aircraft has been in the air over a given period. There are normally four progressive checks carried out. Over a total of 1,200 hours one Check No. 4, or major overhaul, is carried out; one Check No. 3, or part major overhaul, is carried out: two Checks No. 2, one at 300 hours and one at 900 hours; and a series of Checks No. 1 at approximately 85 hrs. There is a further check over and above the 1,200 hour check, which is for the Certificate of Airworthiness, which has to be renewed each year from the time that the aircraft was first put into service, and this check entails a considerable amount of extra work.

To avoid grounding aircraft for long periods we have made arrangements to superimpose over these normal checks a series of sections of the Certificate of Airworthiness check, so that over four cycles of Check No. 4 we get sections A, B, C and D of the Certificate of Airworthiness. The Air Registration Board have agreed to this procedure.

It is necessary to have a very large inspection staff to ensure that maintenance is carried out to the correct standard, and also that the correct amount of work has been carried out up to a given date. To do this the Inspection Department produce for each aeroplane an inspection schedule which includes all items requiring removal, renewal etc. at a given time. These schedules are broken down into sets of inspection sheets which cover Checks 1 to 4. We felt that this Inspection Schedule might act as a useful basis upon which to start work, from which we hoped to produce a method of working which could act as a basis for an incentive scheme. We, therefore, rewrote the inspection sheets, without deleting any items, in five parts in view of the fact that we worked with five major trades - riggers, engine fitters, electricians, instrument mechanics and radio mechanics.

The next step was to produce a sequence of work for each of these five trades to perform, and we had to ensure that this sequence would not interfere with any of the other trades. We tried to show in the form of a chart for the foreman's use what jobs had to be done at any one time, and what man or men to put on the job.

We then decided to group various itens on the inspection schedule and call them operations, these being in fact small jobs of not longer than about 4 hours duration. To arrive at times to be allowed for the various jobs, the best we could do was to get our rate-fixers to make an intelligent guess, as stop-watch timing is at present unacceptable to our Unions.

All the jobs were written out in very great detail, including the material required, part numbers etc. Having specified each job carefully we then went through timing each individual element by intelligent guessing. We now had a number of operations - we knew by the nature of the job the number of men required, and had a reasonably accurate idea of the amount of time which should be allowed. On this basis we were able to build up a detailed chart for each of the 4 Checks. This chart was presented to the foremen, who were at once extremely sceptical and ignored our suggestions to give it a trial. It then became necessary for us to go into the department ourselves and carry out all the paper work whilst the men carried on as usual. After three or four months had elapsed one foreman came up and asked to be allowed to try the scheme out on his own. We then withdrew, and after a number of arguments and a certain amount of corrections had been made it was decided that they would accept the scheme which is now running reasonably successfully. We are trying to persuade the Unions to accept stop watch timing, but we still have a long way to go before they are likely to agree.

"Aircraft Maintenance" cont:

So much for the maintenance side, but to provide inspection with an incentive has proved a separate and difficult problem. We decided to divide the aeroplane into sections for the purposes of inspection, and certain sections of the aeroplane were allotted for this purpose whilst other sections were having their routine checks carried out by maintenance engineers. It can be appreciated that the Inspectors produce a lot of additional unscheduled work, the content of which is very difficult to forecast. After considerable investigation it was possible to allow a certain period of time to cover unscheduled jobs which proved fairly accurate. Atpresent unscheduled work consititutes 50% of the total work done on an aeroplane. We are constantly endeavouring to reduce this figure by adding certain parts to routine work and carrying out modifications to the aircraft, and we hope eventually the figure will be reduced to about 30%.

The difficulties of providing a satisfactory incentive for maintenance workers can be appreciated, as there is, of course, no end product, but only an empty hangar.

We do find that using a system of operations of about four hours duration. coupled with incentives does help to provide a target to aim at. Another method used with good results was to have two gangs working side by side and encourage the spirit of competition.

"Multi-Factor Control"

(F. G. Fish)

Monetary incentives should be designed to stimulate the desire to work according to prescribed methods at an optimum or target performance; they should also be set up in such a manner as to provide Management with a form of control that on the one hand enhances production efficiency and output, and on the other hand exposes inefficiency and poor productivity.

Quite often the control aspect of incentives is overlooked or not readily appreciated. The monetary influence is sometimes allowed to obliterate or submerge the aspect of control.

The most elementary form of quality control is that provided by the type of scheme where the operator is given a time or price for each unit produced, providing the unit conforms to pre-set standards. With such schemes there is a qualitative and a quantitative inducement. The relative weighting of these two factors, however, varies according to the work content of each unit, the frequency by which they are performed, and the extent of inspection control.

From a control point of view the disadvantages are the cost of inspection and the limited weighting of the quality control.

A more complex control is that needed to assist the supervision and maintenance of operating conditions, and process control. It is in this field that multi-factor control is particularly useful, especially in view of the fact that the work content often varies inversely to process efficiency.

One method of providing process control is to utilise available process allowance by relating it to process operating efficiency.

The disadvantages of this method are that the extent of control is dictated by the work content, and should additional work be introduced, the process allowance would be substituted, thereby partially or fully eliminating the control.

Another method of control is to split the bonus rate, apportioning one part to quality and the other to quantity. This system affords a quality control, but has the disadvantage of reducing the quantity inducement.

There are some jobs in industry where responsibility and control are the most important features.

Jobs in this category would include certain grades of foremen and process control operators. Although the work content may be assessed for such jobs, it may not be practical or appropriate to relate bonus calculations to measured work values, In such circumstances multi-factor set-ups are particularly useful.

Let us look at a typical work sheet such as might be used with a type of multi-factor scheme which could be applied to Supervisors such as Maintenance Foremen.

"Introduction of a Work Study Training Centre".

(E. Tunstall)

My Company are manufacturers of plate and sheet glass, and the manufacturing processes are highly mechanised, requiring a limited labour force, the majority of the labour therefore is employed on subsidiary processes - e.g. the processing of the glass after manufacture (edge working etc.), warehousing, case and box manufacture, building amd maintenance of glass furnaces, mechanical maintenance, raw material handling etc. etc.

In addition we also manufacture pressed glass ware, and associate companies make glass fibres, safety glass, plastics etc. In this country we have four main works in St. Helens, one in Doncaster, one at Pontypool, and one at Queenborough, but this latter is not producing at present.

Time Study has been applied throughout the Company for the past 20 years, followed by the application of Incentive Bonus Schemes. 60% of the 12,000 employees are now paid by incentive and the remaining 40% are equally divided between those where agreement has been reached and those where no agreement has been made to accept incentive payment.

We have a staff of 40 time study men, who are responsible for maintenance of existing schemes and measurement of new work. Previously time study training had been carried out within each department and in addition certain selected men had been sent on courses at Birmingham University, the Anne Shaw Organisation and Cranfield, and the information obtained on these courses has been passed on to the other members of the Time Study Departments. There was, however, no organised method of training, and it was decided to set up a central Work Study Training Centre.

The type of work to be studied in the Company calls for a high degree of skill and Method Study consciousness, and the objectives of the training centre therefore were:

i) To train Time Study men in the other aspects of Work Study, Method Study, Incentives etc.

ii) To provide suitable training for Managers and Trade Union Representatives nominated by the Works Management.

At the commencement we were confronted by a number of problems, the first of which was that the members of the time study department have varying degrees of experience, some considerable and some very small, and we therefore decided that it would be necessary to run two different courses to meet these different needs. We called these the Senior and Junior Courses.

We decided to start with the more experienced men on the Senior Course, and with this in view we drew up a syllabus, the main contents of which were:

1) Detailed instruction in Method Study techniques,

2) The opportunity for each member to complete a job of methods investigation,

3) Revised instruction on Work Measurement techniques, and some instruction on Pre-determined Motion Time systems.

The next problem was to decide upon the duration, which was controlled chiefly by the length of time which a man could be released from his particular works. We decided that the senior course would be run for five weeks, and the junior course for one week, the latter being in the nature of an appreciation course rather than detailed instruction on the techniques involved.

"Introduction of a Work Study Training Centre" (cont.)

Owing to the fact that there was only one instructor, the number of students per senior course was limited to three, and for the junior course five or six at the most.

As far as the actual preparation of the course was concerned, we decided that there would be no hand outs given, as it was considered that if individuals made their own notes it was likely that the instruction would be more effective.

Suitable operations on loop films were collected and these are used for Method Study practice, thus eliminating waste of time and reproducing the actual scenes as found on the shop floor.

For time study purposes a rating film was prepared composed of jobs within our own industry, and this has been used both for training purposes and also consistency checks within our Time Study Department.

The way in which the course is now running is that during the first week we have intensive training in Method Study techniques, using films for fact recording and small assembly jobs, for arriving at the new method.

The second week sees the beginning of the main Method Study investigation, for which the equivalent of two weeks is allowed, this time being spread over the remaining four weeks of the course.

Normally we give advice on the sort of job to be selected, which has to be kept within certain limits with regard to size, but the important thing is that each member of the course should complete his investigation successfully, and so far this has always been accomplished. We also introduced Methods Time Measurement into the course, not for the purpose of practical application, but mainly for the purpose of stressing the importance of defining the job and specifying the method for time study purposes, and also to emphasize the need of advantages to be derived from synthetics.

The results have been quite encouraging, those who have attended the course now having a much wider knowledge of all work study techniques and the average savings made per job on method study investigation has been £850 per annum.