

## Discussion

The **Chairman** said it had been an interesting and stimulating lecture, although somewhat different from the usual Association lectures. The Author had made a good point when he said people had not the time to look into these matters. One often knew perfectly well where something was wrong but, before it could be put right, something else arose and the job was never done. The Author had shown that work study could be an important help in the production of all sorts of things, including helicopters.

The Chairman said he came from the design side and in the circumstances he preferred to call on some of the representatives of the production side to air their views on the Paper and, particularly, its relevance to the problems of helicopters.

**Mr D D G Frankland** (*Chief Production Planner, Westland Aircraft Co Ltd*), said usually when someone was asked to start a discussion it was because it was thought that he would begin and stimulate argument. He would not do that, however, indeed, he might be the wrong person to open the discussion since he had been trained initially as a work study engineer.<sup>1</sup>

In congratulating the Author on his excellent Paper, he complimented him on his courage in presenting it in the sanctum of the aircraft industry, which, after all, considered his subject as one not to be taken too seriously.

It must not be forgotten however, that work study was introduced to a large number of firms in this country by the foresight of the late Sir Stafford Cripps, when Minister of Aircraft Production. He established courses on Motion Study at Manchester during the last war and many Work Study Engineers received their initial training there.

The Author had said that it was not possible to give a clear indication of how large a staff was required to undertake a work study function in such an industry as the Helicopter industry, and, although he had been in the industry for some years, Mr Frankland said he would not like to give an assessment either. It depended on the number of production aspects which were to be investigated. The aspects which he thought should be investigated, and the order in which they should be investigated—and, if he had interpreted the Paper correctly, the Author did not agree with this—were as follows: work study should be started on the shop floor on a certain number of selected jobs which had been running for some time and which constituted production bottlenecks. When improvements were effected there, the work study department was automatically given a great psychological boost, and that was an important step forward.

In order of priority, in a helicopter factory perhaps, the next step should be consideration of capital equipment utilisation. There was a great deal of very expensive capital equipment in the aircraft industry, indeed, it probably had more money tied up in capital equipment than the majority of industries, and efforts should be made to economise in this direction as much as possible, by increased utilisation.

Materials handling came next, then stock holding, and paperwork systems including movement of manufacturing paperwork.

Helicopter and aircraft production quantities did not, as a whole, warrant the amount of work study on the production side which was warranted for mass production components. This, at any rate, was his opinion. Without a very large work study department it would probably never be possible to tackle more than 5–7 per cent of the total components of any helicopter. The Author might be shocked by that statement, but there were many aspects to consider in the aircraft industry which would repay early investigation more than component manufacture. Perhaps the Author would comment on that point.

In the Paper the Author made several references to material specifications, he said that the immense number of specifications being manufactured by the industry could well be investigated and cut down to a more acceptable figure. Undoubtedly the production side would leap in the air with pleasure about that but Mr Frankland was not sure what the designers would say, for they would lose many happy hours choosing specifications from the large selection available.

Mr Frankland said his firm had started a work study section, they had had a work study engineer on a course, and one of the first jobs he tackled—a good example from their point of view, because they produced many of them—was that of rotor blade pockets on metal blades. This was the nearest approach they had to mass

production. The Author had suggested that a saving of 25 per cent could be achieved. In this case, in fact, they saved 27 per cent with only minor alterations to Method.

It was suggested in the Paper that if we had good technical management it would not be necessary to indulge in the amount of work study which would otherwise be necessary. Mr Frankland did not agree that technical management could perform a work study function. On the more general side, it could definitely help, but there was a definite place for work study in all industry.

Work study was a description which had been coined not long ago, and most of the function of work study was based on motion economy. He preferred to think of this aspect as motion study and believed that in anything associated with motion—even shaving or cleaning one's shoes—one could benefit by introducing work study. Whether they was any motion at all in helicopter production he preferred the Meeting to decide, but he liked to think that there was <sup>1</sup>.

The Author (in reply), said he would not like to give an indication of the size of the work study staff required for the helicopter industry. In the non-mass producing organisations, it was not surprising to find that 2–4 per cent of the pay roll were involved in work study alone. In the one-off jobs, such as those in the helicopter industry, they would probably need at least 5 per cent of the total pay roll employed directly on some aspect of work study, if they were to get full value out of it. On the other hand, if they employed 1 per cent, it would take five times as long. Many well-trained people were needed to do the work.

Mr FRANKLAND had suggested starting on the shop floor. This was correct with a new man, but it was not necessarily where work study should start. A trainee work study officer would need to begin on the shop floor, largely in order to strengthen his teeth, but this was not the case with a qualified and competent man. If they called in a consultant to do the job—a qualified and trained man—they would find that he would not start at the shop floor level, he would look at the books and the office procedures and, unless he had been instructed to put in an incentive scheme—which was perhaps the worst instruction to give, although it was often given—he would almost certainly look at procedures and office and paper work before getting down to the shop floor. There was a lot of scope on the shop floor, but there was a great deal to be said, psychologically, for having a go at the offices. The man on the shop floor was very interested to see the people in the offices at long last having their ivory towers attacked, it made work study acceptable, which was important. Work study was not always highly respected and was not necessarily acceptable on the shop floor.

Recently, he had seen the results of an attempt to introduce a pre-determined time system into an organisation on the North-East coast, where there had for years been a resistance to time study. The workers did not like the idea of a pre-determined time system, and the Company concerned received a letter from the senior officials in the Union saying, "We do not like your suggestion of a pre-determined time system. We insist on the guarantee of the stop watch." Since they had been opposed to the use of stop watches for 25 years, it was felt that reasonable progress had been made <sup>1</sup>.

He would not argue with Mr Frankland's statement that only 5–7 per cent, of helicopter components could be tackled by work study, to do so would be to become involved in technicalities. From what he had seen of helicopter production he thought that if they tackled the 5–7 per cent they would make enough money to be able to afford to tackle the remainder <sup>1</sup>.

**Mr Frankland** said this was possibly true.

The Author agreed with Mr FRANKLAND on the reduction in the number of specifications.

Dealing with his reference to good technical management, he said he did not mean there was a shortage of ability in existing technical management, but there was a shortage of technical managers. We needed—and we did not possess—a sufficiency of good technical managers. This country had a greater inventive genius than any other country in the world. Some of it was being used in our technical management and some in our research, but very little in production. This was where we were so very short and why we had to introduce other techniques in order that our best brains could be turned on to the jobs which demanded inventive genius.

That left the rest of us—the Author and Mr Frankland, too—in the work study field. There was a dreadful shortage of this great technical skill, and work study must supplement this aspect of management in order that management might carry on its job to the best of its ability.

**Mr Frankland** said he had perhaps not clearly explained why he would prefer to start work study on the shop floor. It was necessary to sell work study—not so much to the operatives, although this was difficult, but to management, which was more difficult. Psychologically, management appreciated savings made on the shop floor, more than savings made in the accounts or other non-productive departments. This was mainly due to present management having a production bias.

In the aircraft industry managements are inclined to say, “Work Study is all right if you are building bomb fuses at 2,000 an hour, but not applicable for helicopters where, if you are lucky, you start with an order for two and hope that it will be increased to ten during the year.” This was why he suggested that only 5–7 per cent of the components could be tackled by the Works Study Department unless they were dealing with a successful helicopter where production continued for a long time, because the longer the production run obviously the greater the percentage of components investigated.

If introducing a work study department, one had to start by showing management what could be done on the shop floor, and then ancillary departments, such as servicing and non-production departments could be investigated when the work study department had proved its worth.

The **Author** (in reply), said that he would hate anyone to think that the aircraft industry was the only industry which regarded itself as peculiar. Every industry said the same thing. The aircraft industry could not be blamed for thinking itself different—it was different, in the same way that chalk was different from cheese—but in this country we had factories making chalk as well as factories making cheese, and in both cases work study was successful. He agreed that 60 per cent of the job in work study was selling it, mostly to management. 20 per cent, was the technique of work study and the remaining 20 per cent, was perhaps the technology within the industry in question. Much the biggest part of the job was persuading people to let go of their predetermined ideas and their little empires.

**Mr J S Shapiro** (*Consulting Engineer*) (*Founder Member*), referred to a remark by the Author that they were faced with resistance from the hierarchy with its “empires.” There seemed to be insufficient comment in the Paper on this point. How was this resistance to be overcome? It was not simply a question of ignorance, so that the resistance could be overcome by information, people were afraid of work study, and this fear on the floor and in management had to be broken down.

In the aircraft industry, the Air Industrial Developments was a much more important point than perhaps had been apparent from the discussion. He thought that there was no one present from the A I D—or A I B—which was a pity, because he thought this question had not been really tackled. This was not so much the fault of the inspector on the job as due to lack of directive from above. People whose job it was to watch quality must also have an eye on cost and productivity. The phrase “irrespective of cost” arose only through a fault of attitude, if challenged, they would say, “It is not our job,” when in fact it was everybody’s job.

As an example, Mr Shapiro said they could get ball bearings or roller bearings released for about 1s over the cost of the industrial bearing, whereas with a tube, especially certain cold-drawn tubes, the cost was about doubled by inspection for release. Why was this? Why was it possible for ball bearing manufacturers to release a bearing, costing perhaps £1, for an extra 1s, when the equivalent cost for a tube manufacturer was not 5 per cent but 100 per cent? Something was wrong. This was one of the possibilities of work study, and he was glad the Author had dwelt on the general aspects rather than on the techniques of the industry, on which he would no doubt have been “shot down.”

This feeling of the aircraft industry that it was the only watchdog of quality was one of the biggest obstacles in cost studies. He did not believe that the quality in the aircraft industry was so very much higher than in many other industrial processes—and his evidence for saying that was the ball bearing industry. There was more promise on those lines than on any other. Would the Author comment on this view?

The **Author** (in reply), said that unfortunately there was not a little black book

which gave the complete answer to such questions as, "How do we break down resistance?" This was one of the questions which they were trying to tackle at Cranfield, not at the College but at the Work Study School, and they were trying to tackle it by getting at top level management. Appreciation courses were held at Board of Directors level, and other means were employed, such as his Paper to the Association, which would reach the senior levels of those affected by this resistance to work study. If enough were said about the need for work study, people became accustomed to the general idea of it. Those being trained at Cranfield were usually in that line of management which fell half-way down the hierarchy—at the production engineering-works management level. Inevitably there had been difficulties with titles, for they had received managing directors from factories employing 80 people and foremen from factories employing 5,000 people, and in this case the managing director and the foreman were doing the same job.

In dealing with major management, the School appreciated that it could teach them things only in relation to what they already knew, and when a point was made, it was interesting to observe the student linking it with a situation with which he had been connected, although usually not one for which he had been responsible. At first, the student did not see his own faults, but after a while he became completely honest with himself, checked on what he had been doing and made the School check on what it was doing. When enough of this had been done, the student had learned from the approach adopted how to break down his own resistance, and he then had to use the same technique in breaking down the resistance of other people.

This was a very delicate subject, for in work study they were dealing with one of the most delicate things in human nature—a man's self-respect. To look at a job which a man had been doing for 20 years, to record it and analyse it, to find a new method and then to say to the man, "You have been doing this job badly for 20 years," was to make a bad name for work study. If the man carrying out work study was conscious of the human factors involved in his work he would adopt a different approach. He would not tell people that they had been doing a job badly, or how to do it properly, but by discussion, and with common consent and mutual understanding, he would get the people whose job he was studying themselves to produce the answers. Who knew more about the job than the man doing it? Who was a better technician than the technician doing the job? Usually such a man already knew the answers, and it was necessary merely to bring them out.

Perhaps this was getting rather close to the psychiatrist with his patient on the couch, although it was a little more grown up than that on the industrial scene. Largely, it meant the man carrying out work study had to sell himself as a person and to obtain a proper *entree* into a department in order to speak on equal terms with those with whom he was dealing and to acquire an ability to use other people's ideas, to bring out other people's ideas, so that they realised that they—and not the work study man—had produced the solution. This was a quality which could be trained into a man, but not in 10 minutes. One of the Author's first students had appeared to be quite incompetent in this aspect of work study, but within two months of returning to his organisation he had introduced work study into one of the most militantly anti-work study factories in the country, and, what was more, he had carried out time study where nobody had dared take even a calendar before!

The Author said they were well aware that a great part of their work involved human factors. They made this a big feature, in order to sell work study.

Turning to the question of the A I D, he said the amount of propaganda going on at the very top nowadays was surprising. At long last the R A F had appointed a high-ranking officer, Air Vice-Marshal Freebody, on Section Q work study, as commanding officer. He was to organise work study in the R A F. There was already a large organisation in the Army, apart from the Army Operations Research Group. Even Government offices were beginning to awaken to the chimes of money to be saved through work study. A great deal of pressure was being applied to Government Departments which had been thorns in the sides of those advocating work study and, provided there was pressure from industry as well, there could be a constant jab at the A I D man.

The A I D man in the factory often said he was doing what was laid down in the book of words. Why was this necessary? Did they themselves ever ask whether what was laid down was, in fact, necessary? He incited those present occasionally not to do what was laid down in the book of words—and still to get the component past the inspection, for sooner or later the man must ask himself, "Is this right?"

He had come across many A I D chief inspectors who had made their own interpretation of the book of words. They were in charge of the job and they interpreted the book in order to cover themselves and to ensure that there could never be a blot on their escutcheon. When industry checked on these things it would often find that there was a way of complying with the book of rules without continually doing all the things on which the inspector insisted. The chief inspector was not second cousin to the Lord, he was not so important as that and he was not necessarily the best person in the world to interpret the instructions which he had been given. But, the Author added, he did not have to live with the chief inspectors.

**Mr R Lennox-Napier** (*de Havilland Propellers Ltd*) (*Member*), said that he had found the lecture fascinating, and had been glad to hear the emphasis placed, in the discussion, on the psychological aspects of work study. He wished to offer for criticism some ideas in this category which the lecture had brought out from the back of his mind. These were relevant to the causes of the opposition of individuals to improvements in their method of working.

In approaching most problems it was useful to consider the extremes on either side which bracketed the correct answer. Following this line he would suggest, though he was no psychologist, that the negative human attributes of fear and laziness were at the root of the trouble. In civilised people these components were so overlaid with the more obvious positive qualities that their effect could easily be overlooked.

He thought that a person, proceeding comfortably in a well-established groove, tended to avoid the effort of getting out of the groove until forced to do so by fear of damage to his ego, arising from exposure of inefficiency or by ridicule. At the same time, the person feared that the introduction of more efficient organisation might mean harder work, lower income or loss of employment. This could be regarded as one extreme. The other extreme was represented by the fact that many were driven in their work by the positive psychological features of keenness on the chosen activity and by ideals of efficiency and integrity, and were inhibited against anti-social activities—or lack of activity—by conscience. These would offer the minimum resistance to improvement in organisation. But Mr Lennox-Napier thought that probably all of us suffered in some degree from the effects of the basic weaknesses already mentioned. In fact, anyone devoid of these would hardly be human. These, in his opinion, were the prime cause of the barrier previously discussed which interferes so seriously with work study and the introduction of improved methods.

The other idea offered was that in overcoming this resistance, as an alternative to the gradual winning over of the individual, as evidently practised by Mr HARPER, the technique of shock tactics would appear to be very effective. One way of applying this was to make a frontal assault on the habitual philosophy of the person in respect of his methods of working. A good example came to mind from a recent experience in a well-established instrument firm. Here, in considering the causes of frequent failure to meet programmes, he was disturbed to find that at all levels the traditional and typical attitude towards design and manufacture featured the aim to produce the highest possible performance and quality, irrespective of product application and of all other considerations. In other words, "only the best is good enough."

The total effect of this in terms of time and cost must have been enormous, but the feeling was that on their type of work these considerations were relatively unimportant. A basic error appeared to be the tacit assumption that a product must necessarily be more successful, the more its quality was raised above the specified requirements. He felt that if the original specification were properly conceived in relation to the application, and included adequate factors of ignorance and of safety, it should certainly ensure achievement of the required degree of performance and safety without help from unofficial improvements superimposed by other people in the design and production chain.

Mr Lennox-Napier had found it most effective to challenge each person on his maximum-quality philosophy, and to say "Surely the best design (or product) is the one which is *only just good enough*." Each time he had tried this out he had seen the person staggered at the conception of refraining from making the product any better than the minimum adequate standard. Setting an upper limit on quality seemed to him such an obviously desirable principle that he was surprised that more people did not advocate it. It seemed to cover many of the efficiency faults which could be found in all their activities. This was specially true on the design side—and that was why, as one concerned with design, he was emphasising it.



A vast amount of effort was wasted both on design and in production in making the products, or parts of the products, too good for their purpose. That was where the A I D tended to push too far upward in quality. There was a feeling that making the quality as high as possible was very laudable, but he felt that this was largely a result of unthinking pandering to instinct and tradition, and of avoidance of the extra effort and responsibility involved in applying a bi-lateral instead of a unilateral tolerance on quality.

He requested Mr Harper to criticise the principle that the best design or product was that which was good enough, but only just good enough, to ensure achievement of its object.

The Author (in reply), said that Mr LENNOX-NAPIER had suggested that we all instinctively avoided any effort except that which was to our advantage and that we were primarily motivated by fear. The Author did not think so ill of his fellow men—and he thought that, on reflection, Mr Lennox-Napier would not think so either. Many experiments had been conducted into the question, “What makes the workers like work?” It was not a question, “What makes them work?” but, “What makes them like to work?” Time after time the same list was given as an answer, no matter where the experiments were done or who did them—and the factor which most made people work was love, not fear.

In this context, love meant the sense of belonging and knowing that they meant something in the organisation, that whilst they were only cogs in the machine, the machine would not work without its cogs, and that they were part and parcel of an important job. People worked for a man, rather than for an organisation, they worked for a foreman they loved or hated, or something in between. If they liked working for a certain foreman, production was higher under that foreman than under another.

The Author had proved this personally at a factory where shift work was in operation and where teams of workers moved forward on shifts—mornings, afternoons, nights—and the foremen moved backwards—nights, afternoons, mornings. Teams were therefore constantly meeting new foremen. It was not necessary to know which team was on a shift to discover where production was highest, it was necessary simply to know who was the foreman. One foreman was a born leader—a good-looking, brute of a man, who was idolised by his team. Their increased work was not reflected in their pay packets, the men were certainly not influenced by fear and they were not compelled to produce as much as they did, in fact, produce. They did it because they liked doing it.

He doubted whether those present at the meeting would gain money through having attended, they had attended because they wanted to improve their knowledge of their job. The result would be that they did their job more effectively, not that they got a better job for themselves.

Nor had the Author come to the meeting through fear. He was afraid of his audience, but that was not his reason for attending. Nor was it because of his love of them. It was because he loved his work. It was not fear which drove 16 stalwarts from Putney to Mortlake in a cockleshell craft in April. It was a sense of belonging or of competition or of team spirit.

If we made those who worked for us feel that we cared about what they were doing and how they were getting on, that was an important step forward. This need not be done in a mealy-mouthed fashion. People could be made to feel that we cared in a masculine and industrial way, and then we should get more work out of them than by standing over them with a whip. Everybody in the country surely now believed this. Certainly every good manager believed it, for if he did not believe it he was not a good manager.

People were not basically lazy. Once they were employed in a job, and once they had clocked in during the morning and knew they were there until clocking-out time, they knew that it was harder work doing nothing than doing the job the right way. If we had good management we need not worry about people being basically lazy. If we looked for the lazy man we should probably find that he was doing the job in the easiest way—in other words, that he was doing our work study for us. We should never be afraid of people avoiding work for the sake of avoiding it. When they avoided work they usually did so in order to get back at management for certain things which management were doing to them—and that was worth investigating. All this was not a pipe dream, he had seen it time after time.

He agreed that there were a variety of methods to overcome management resistance. What bigger shock for management than to prove that last year they had lost over £100,000 through not doing something? Work study advocates should use that sort of shock and any other method to help management to believe that work study was worth having.

In dealing with quality, he said that when we designed a job we should design the quality required. That was done by finding out what was the purpose and how much quality was required in the job. Next, we must ask what was the method by which the job would be carried out—within the safety regulations, because quality and quantity were all very well but not if they left a trail of torn limbs in their wake.

Fatigue problems were introduced, too, and problems of group relationship, the factory book of rules and so on. The job was designed to hit the quality and other specifications which were right. He agreed that we should make things which were just good enough.

We should not make them over-good, because they would be scrapped just as easily.

The trouble was that normally, in our factories, we did not specify what the quality requirements were. We simply said, "Make this, and make a good job of it," and we got a good job. Pieces which he used for demonstration purposes for one term came back from the workshops with a wonderful finish, even though they would be thrown away in three weeks' time. When he complained that he did not need such high quality, the producer replied, "But I do, because I am training the boy who did the work to produce high quality." Thus the consumer might not always know best!

The **Chairman** said that one of the difficulties in an industry such as the helicopter industry, where they were breaking new ground, was that they did not know exactly how much quality to design for and where it needed to be. Looking back over past experience they saw several examples where quality was not good enough and disaster ensued. There was therefore an inevitable tendency at the outset to ask for too high a quality until the results of experience and measurement of the loads encountered made it clear that the initial standard was too high and enabled the quality to be lowered. But that could not be done at the outset. May be when the production run was well established it was safe to say that quality could be lowered, but even in these cases there had been recent examples where fatigue failure had not appeared until after many thousands of hours of operations. For certain parts of an aircraft, designers would be very bold if they deliberately took the risk of lowering quality when they were venturing in an unknown or even a partly known field.

He thought the Author had been scarcely fair to the Government in his reference to the introduction of improved office methods, for the Treasury Organisation and Methods Division was in being several years ago and had had a very good shot at overhauling Government procedure. Their methods had spread to local government with very good effect. Some local authorities had saved many thousands of pounds by inviting the Treasury O & M Division to make inquiries into their work or by accepting their guidance. There was a great field for improvement. It had started in Government offices and local authorities had followed suit, but he was quite sure that this work had not been started in many industries and firms.

The Author had commented on the amount of paper needed in production. But American factories, which were noted for high production, seemed to use even more lbs of paper per person per year than we did. Was the answer not less "bumf" but more "bumf"?

The **Author** (in reply), agreed that the Treasury Organisation and Methods Division had done a great deal of work and had been running for a number of years.

One of the troubles about work study in offices was that there was a tendency to say, "We have done it all once. Now let us forget about it. Everything must be right." There was perhaps more need of continuous inquiry in the office than in any other part of the factory because things changed much more freely and easily on paper than in production. Although much work had been done in many Government Departments, he did not think they had yet gone far enough. A colleague had recently thrown away 13½ tons of paper out of which he had previously made a big storage job. When he stopped to ask himself why he wanted all these documents, he realised that he did not want them at all, and threw them away—after he had laid out all the storage area!

The Author was prepared to copy the Americans where that was right and proper and to let them copy us where it was right and proper that they should do so. People often said that work study was recently brought to this country from America, but in fact the Americans got it from this side of the Atlantic to some extent, partly from France. In any event, work study had been going on ever since man first made the wheel. There had always been someone thinking of better ways of doing the job. It was certainly not one-way traffic with America.

It was probable that the Americans used more paper for a particular job than we did. Furthermore, in the slide he had shown of a non-continuous production job where £14,000 was saved, the amount of paper used was considerably increased. As more techniques were introduced, there was a tendency to use more paper, but when work study was introduced at that level it afforded control over factory production and gave a great deal of information so that, throughout the rest of the organisation, there ought to be an appreciable reduction in the amount of paper. There was proper labour control on the shop floor and information was available for use over and over again instead of constantly being transferred from one piece of paper to another.

Work study could even help in the case where 90 per cent of the cost of the product was based on the raw material—as in the case of the tobacco factories. That figure could be reduced, perhaps, to 80 per cent. This would mean that the proportion of labour in the cost had risen, and the next work study man might then tackle the labour problem because labour represented a much higher proportion of cost than 10 years earlier.

All the while this was going on the work study department and its overheads were getting bigger, until sooner or later somebody tackled them. *Status quo* would never be reached until there was complete automation, with helicopters being extruded out of the end of a pipe line. The Author had never flown in a helicopter, and when they were produced in that way he would certainly not fly in one!

As we improved on the consumption of raw materials and introduced more and more work study, we were likely to use more paper until we carried out a methods study on the work study department itself.

The **Chairman** said they owed the Author a debt for his interesting Paper, which was different from the type of Paper to which they were accustomed. He had dealt with the subject on broad lines and helicopters had scarcely been mentioned. They were none the worse for that, they had been invited to sit back and see what they looked like from the point of view of someone whose job it was to persuade people to stop and look at themselves. They were grateful for the opportunity, and the Association owed the Author a debt.

The vote of thanks to the Author was carried by acclamation.

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#### WRITTEN CONTRIBUTION

RECEIVED FROM MR F W BUGLASS (*Hunting Percival Aircraft Ltd*)

When first asked to contribute to the lecture by Mr L J HARPER, I was merely given the title and I have busied myself thinking around improved production and design for manufacture as being the proper subject to be discussed. I was, prior to the lecture, privileged to read the Paper to be presented, this being, as we had all heard, a talk on Work Study.

I have no quarrel with Work Study, as I think this has an essential contribution to make to efficient production, but this does not in any way apply only to Helicopters. Whenever I see a quotation stating that an authority on something has quoted something as being fact, I always feel an urgent desire to know who the authority is. We are given some figures for the cost of caretaking of material which I find it difficult to accept. In our own case, at any time during the past twelve months our actual material stock figure was approximately half of our purchase for the year, showing that we were holding at any one time roughly six months stock, which under the present difficult delivery position regarding steel, I do not think is excessive. The cost of maintaining this, taking into account Cost Office staff, Accounts Department staff, Stores staff, Buildings, Light, etc., is just over 10% of the value of the material.



in stock. In this material we include proprietary items, in fact all items not fabricated by ourselves but not items supplied on a "free issue" basis.

Work Study can contribute very much at present to the Industry in the saving of unnecessary paper and in ensuring maximum output is obtained for the minimum effort expended, but I feel that before Work Study is applied, a more decisive contribution to the economic production of Helicopters should be arrived at by a more concentrated effort towards design for the achievement of this.

There must be considerably more co-operation between Design staffs and Production Staffs and each must contribute its highest degree of efficiency when considering design and its application to economic production. To achieve this co-operation it is essential that both Design and Production staffs realise that the other side is doing its utmost to obtain a more economic result and not merely poking its nose into someone else's business. Another point which must be taken into consideration when dealing with this particular aspect of production is that we must not be tied to the apron strings of what has been done in the past.

With our own Helicopter project we decided to use an unusual scheme for propulsion and this forced us out of the rut and compelled us to look for new methods of manufacture for rotor blades, hub, and various other items. If this went into production, we would expect to have a Design/Production Meeting at which all concerned would be asked for their opinions on the changes in design necessary to achieve an economic result and it is only at this juncture, I think, that we can afford to look at Work Study.

I would agree that Work Study applied to present products would possibly not be other than advantageous. With regard to our "fancy" specifications, we are, I am sure, all capable of expressing our concern over some of them, but I think the important point to be borne in mind is that in the aircraft industry one requires to have the lightest possible material for the maximum strength and safety and this requirement not only contributes to vast improvement in helicopter performance, it is contributing to other industries as well and whilst it may be possible to reduce the gauge of a tin to contain peas or some other commodity, the process is more complicated when applied to aircraft production.

In closing I would say that we have listened to this Paper with considerable interest and I would agree that Work Study can contribute very much to the economic production required, but I would suggest that the reason why managements are stated to be disinterested in Work Study is not because they actually are disinterested but because there is a feeling that there are so many other aspects which can contribute more directly to economic production than Work Study.

#### MR HARPER'S REPLY TO MR BUGLASS

The authority for the statement that the cost of storing materials is about 25% per annum of the initial cost of the materials is the firm of Brisch & Partners, of Victoria Street, London, who are consultants concerned very largely with classification and rationalisation of stocks. As a result of many hundreds of assignments they have concluded that this figure, as an average, holds true. Whilst not doubting the veracity of Mr Buglass's calculation, I wonder whether in fact he will have made his assessment on exactly the same basis as the consultant would have used. Has he, for instance, included the loss of interest or earning power of the capital tied up? It is perhaps unimportant if in a particular example the figure of 25% is not completely justified but I do congratulate Mr Buglass on carrying out the investigation which I am sure was necessary to arrive at his figure of 10%. It would surprise me if the investigation had not uncovered something which could lead to an economy and this would help justify the time spent in collecting facts as well as, I hope, triggering off a chain reaction towards further fact finding and economy.

With regard to the other points raised, in principle I am sure we are not at variance. It is our constant cry that Work Study is not a substitute for good management. By all means let us have much more co-operation between the various functions of management and particularly a better appreciation of the economic problems.

Further, we must have a means whereby this co-operation and understanding is kept virile and dynamic, else it will atrophy again to the present condition. Work Study does not go against this ideal, on the contrary, the data which is made available as a result of full application of Work Study proves an invaluable adjunct to the management that wants to see how it is doing, where the economies might be made and even how to set about achieving them.

As I have said repeatedly, Work Study is not a panacea for industry's ailments. It is, however, an extremely effective technique for helping with the diagnosis of the ailments and this is perhaps more valuable than a soothing balm.

Certainly let us improve communications amongst Designers and Production staffs. Let us embrace any tried and proved means of doing our job better so that we can again challenge the rest of the industrial world. But, if we know the source of some of our deficiencies and have been unable to correct our shortcomings by traditional methods, would it not be more in keeping with our national character to investigate methods which have proved themselves in every other industry? Could I suggest that a positive contribution would be to run a short course for senior Design and Production people together, to teach Method Study techniques. I can assure Mr. Buglass that his economies would begin to manifest, just where he wants them, before the course was completed.

As for specifications of metals, I appreciate very well how right is the comment and I hope that none of us are going to commit the sin of throwing the baby out with the bathwater. Nevertheless, I feel we are agreed that there is scope for investigation in certain places.

With regard to the last point, again I am in agreement. I know the feeling well. Although I am not a member of the Association, I should be honoured to be invited to attend on the occasion when you are able to put on a lecture on more immediately practicable means of achieving economic production. Please do not misunderstand this. I am genuinely interested for we at the Work Study School are intent on serving industry in the best way we can and need to know your problems and how you think you can best tackle them.