LUCAS

An Alternative Plan

This Corporate Plan was prepared by the Lucas Aerospace Combine Shop Stewards' Committee for that section of Joseph Lucas Industries which is known as Lucas Aerospace.

If a brief description of Lucas Industries is provided this gives an economic, technical and company background against which the performance and potential of its wholly owned subsidiary, Lucas Aerospace, can be viewed. It was also felt desirable to do so as some of the alternative products proposed elsewhere in this report, although emanating from aerospace technology, could more appropriately be handled, at the manufacturing stage, by production techniques and facilities available elsewhere in the Lucas organisations.

Lucas Industries Ltd.

Lucas Industries is a vast and complex organisation with design, development, manufacturing, sales and services activities in the automotive, aerospace and industrial sectors of the economy.

The Company which was formed in 1877 now has some 80,000 employees and an annual turnover of approximately £300,000,000 and capital investment of £110,000,000.

A discernable feature of the Company's mode of operation during the past few years has been to shift large quantities of capital, resources and technological know-how into overseas activities. This raises a whole host of fundamental, political, economic and industrial questions, as is the case with the operation of any Multi-National Corporation. It is not the purpose of the Corporate Plan to analyse these. Suffice to say that this tendency is causing deep rooted concern amongst large sections of Lucas employees and they will clearly have to consider appropriate means of defending themselves from the likely repercussions of these developments. These views and anxieties are reflected in the Aerospace division.

Lucas Industries hold a monopoly, or near monopoly position, in respect of a number of product ranges both in the United Kingdom and in Europe. However the present economic crisis, itself a reflection of the inherent contradictions of the market economy, is having serious repercussions within Lucas Industries. At the time of preparing this report the Company is attempting to shed large sections of labour in some of its plants. There has also been a serious cut in the living standards of all Lucas workers both by hand and brain since 1972. The attitude of the Company to its employees and society at large is however no worse than that of its international competitors and it is certainly better than some of them. However, a sophisticated industrial relations set up and a relatively elaborate network of consultative devices simply provide a thin veneer of concern, beneath which is concealed all the inevitable ruthlessness of a large corporation involved in the frantic international competition of the 1970s.

Lucas Aerospace Ltd.

Lucas has been in the aircraft equipment field since 1926 when it acquired a subsidiary Rotax. Prior to World War II Lucas set up a parallel aircraft equipment company known as Lucas Gas Turbine Ltd. This was formed initially to design, develop and manufacture the fuel system and combustion chamber for the Whittle gas turbine engine. Through this Company close collaboration was established with Rolls Royce and that continues to this day. Thus, since the end of the War and up to the late 60s Lucas had, in practice, two distinct aircraft component operations. Rotax, which supplied electrical generating systems, starting systems and small gas turbine driven auxiliary power units, whilst Lucas Gas Turbine Equipment supplied engine fuel systems and larger fabricated components.

During the 1960s Lucas had three major competitors in the electrical aircraft field namely, Plessey, English Electric and AEI. Lucas Gas Turbine Equipment division did not have a competitor and Lucas, at that stage, was not engaged in the design of flying control and actuating systems. Paradoxically the turmoil in the UK aircraft industry of 1965, when the Labour Government cut back a number of major products, provided the objective circumstances in which Lucas could establish itself as the dominant force in these fields.

In 1968, through Rotax, it took over the AEI interests at Coventry and then the Special Products Division of English Electric at Luton, Bradford and Netherton in 1969. Lucas further extended its influence in the aircraft equipment field by moving into the flying control and actuation systems side by acquiring Hobsons of Wolverhampton in 1969.

The 'Internationalisation' of Lucas Aerospace followed closely the pattern of Lucas Industries described above. Through its acquisition of English Electric it acquired a 40% stake in Auxilec of France and 34% stake in PLU of Germany – a joint company set with Bosch (15%) and Pierburg (51%) to produce hydro-mechanical fuel systems particularly for the MRCA. The result is a Lucas Company achieving the same dominance in the field of aircraft compo nents as other sections of Lucas have achieved in the automotive industry. Lucas Aerospace is now the only company in the world with the capability of producing, within a single organisation, a complete range of aircraft electrical generating systems and switchgear, engine starting, de-icing, flying control, fuel management, thrust reverse and combustion systems, instrument lighting and cockpit transparencies.[1]

Lucas Aerospace also produce a range of equipment for defence applications on both land and sea. The current major commitments include extensive systems work on the RB.211, Concorde, the TU144 supersonic airliner, the Lockheed Tri-star, the A300B Airbus, the European Multi Role Combat Aircraft (MRCA) and the Anglo French Jaguar.

Approximately 20% of Lucas Industries resources are now devoted to the Aerospace industry. Lucas Aerospace now has just over 13,000 employees. This is a highly skilled and talented workforce, comprising a very wide spectrum of technological ability both in the manual and intellectual field. With a high design and development content it is inevitable that there is a large proportion of technical staff and there are 2,200 engineers, designers and draughtsmen of various kinds. Aerospace deploys some 5,000 machine tools and approximately 250 of these are advanced machine tools which are numerically, automatically or digital display controlled. This is supported by extensive research and development facilities and laboratories.

In consequence of this, Lucas Aerospace is now Europe's largest designer and manufacturer of aircraft systems and equipment.

The Combine Committee

The five years from 1964 to 1969 saw a very rapid monopolisation of large sections of British Industry and the emer-

gence of massive corporations such as British Leyland and GEC. This process was actively supported by the government, which, in many instances, was providing the tax payers money to lubricate this process. Within Mr Wilson's philosophical framework of 'the white heat of technological change' many thousands of highly skilled workers found that the consequence of the 'White Heat' market economy was that it simply burned up their jobs and gave rise to large scale structural unemployment. The 'logic' of the market economies and rationalisation programmes in these vast corporations resulted in the illogical growth of the dole queue with all the degradation and suffering and loss of economic activity of hundreds of thousands of highly skilled men and women.

The Weinstock empire, that is GEC, was the pacemaker in this development. The work force was reduced from 260,000 to 200,000 whilst during the same period the profits went up from £75,000,000 to £108,000,000 per annum. Thus whilst it was profitable for Weinstock to cut his work force, society at large had to pay the price, firstly in social security payments for those involved and secondly in the loss of productive capacity which these people could have made available to the economy of the nation as a whole. Weinstocks's attitude to the work force, summed up by one of his managers in a statement to the *Sunday Times* "he takes people and squeezes them until the pips squeak" was seen as some kind of virtue. Indeed it is a measure of the deep rooted economic and political sickness of our society that a person like Weinstock was then, and is still, held up as the pinnacle of managerial competence.

When Lucas acquired parts of English Electric in the process described above, the lessons of the Weinstock escapade were not lost on Lucas workers. It was clear that Lucas Aerospace, if it were permitted, would embark on a similar rationalisation programme. Strangely enough it was recognition that this attack would be made upon the work force that provided the objective circumstances in which the Combine Committee was formed.

Its formation resulted in the first instance from fear of redundancy, and the recognition of the need to provide an organisation which could fight and protect the right to work. It was realised from the onset that the Combine Committee could itself become another bureaucracy and that there were real dangers in centralising activities of all factories through one body. Accordingly a constitution was carefully worked out and widely discussed at all sites which provided adequate safeguards.

Development of the Combine Committee, now known as the Lucas Aerospace and Defence Systems Combine Shop Stewards Committee, took approximately 4½ years. In its early stages it lacked cohesion and strength. The Company was, as a result of this, able to embark on a rationalisation programme in which the work force was reduced from 18,000 to the present 13,000. However, at the last attempted sacking of 800 workers in January/ February 1974 the Combine Committee was well enough organised to resist this. The Combine however has no illusions that the right to work can ever be guaranteed in a market economy.

Gradually the Combine Committee set up a series of advisory services for its members. These include a pensions advisory service which has recently negotiated a complex pension structure for manual workers[2] and the campaign for the election of trustees for the staff pension fund in order that information could be available as to where this pension fund money is being invested. The importance of this development may be judged by the fact that the staff pension fund has a market value of something like £80,000,000 and the works one £40,000,000 at a time when the capitalisation value of Lucas as a whole on the stock market has been as low as £36,000,000.

Other services included a Science and Technology Advisory Service which provided technical information on the safeguards to be campaigned for when new equipment was being introduced[3] or when health hazards were possibly involved.[4]

The Combine Committee is also a reflection of the growing awareness, of those who work at the point of production, that the traditional trade union structures based on geographical divisions and organised on a craft basis are incapable of coping with the new and complex problems of these large monopolies. However the Combine Committee should not be seen as an alternative to the traditional trade union movement rather it is a logical development from it, and complementary to its aims.

The Combine Committee produces its own four page illustrated newspaper approximately bi-monthly, 10,000 copies of this are circulated amongst the 13,000 manual and staff workers.

In practice the Combine Committee has become the voice on a number of subjects for the 13,000 manual and staff workers who now work throughout Lucas Aerospace in the United Kingdom. It has also taken a series of steps to establish close links with those employed by Lucas Aerospace abroad. The significance of its developmen has been included in lectures at the TUC[5] on the training courses for shop stewards and for full time TU education officers.

Corporate Plan

The object of the Corporate Plan is two-fold. Firstly to protect our members right to work by proposing a range of alternative products on which they could become engaged in the event of further cut backs in the aerospace industry. Secondly to ensure that among the alternative products proposed are a number which would be socially useful to the community at large.

The idea of proposing alternative products on which the work force could be engaged as an alternative to the redundancy arising from cut backs in the aerospace industry is not new in Lucas Aerospace; as far back as 1970 when the Company was attempting to close the Willesden site a number of projects were put forward at the negotiations which took place on that occasion. However the idea of preparing an overall Corporate Plan for Lucas Aerospace arose in the first instance at a meeting in November 1974 with Tony Benn, the then Minister of Industry. That meeting took place at the request of the Combine Committee to discuss the nationalisation of Lucas Aerospace. In the course of the meeting Mr Benn suggested that there was the distinct possibility of further cut backs in certain aerospace and military projects. Even if this did not occur the rate at which new projects would be started was likely to be reduced. Accordingly he felt that the Combine Committee would be well advised to consider alternative products, not excluding intermediate technology on which our members could become engaged in the event of a recession.

The problems of the aerospace industry have of course been further compounded by the 'energy crisis' . . .

It is also likely that in order to make its austerity measures somewhat acceptable, the government will at least make a gesture towards cuts in defence expenditure. As the Defence Secretary, Mr Roy Mason, stated in the House of Commons 'even before the Defence Review it was clear that with few new projects coming along there

would be a marked reduction over the next decade in the level of activity in military aerospace projects, particularly on the design side'.[6]

These reductions we regard as both inevitable and desirable. Indeed it is the national policy of almost all of the unions the Combine Committee represents that there should be cuts in defence expenditure. However when these cuts are made our members are placed in the position of being made redundant or fighting for their continuation. We ourselves have done this in the past and will support our colleagues in the rest of the aerospace industry in doing so in future. Indeed, recently when the campaign to protect the HS146 was at its height our members at the Wolverhampton plant seized drawings in support of their colleagues at Hawker Siddeley's.

It has to be recognised however that the traditional method of fighting for the right to work has not been particularly successful. Between 1960 and 1975 the total number in the aerospace industry has been reduced from 283,000 to 195,000 workers. Apart from this internal problem in the aerospace industry there is the more general problem in which all industries are tending to become capital intensive rather than labour intensive with structural unemployment in consequence.

Over the past eight or nine years there has been some 5,000,000 people permanently unemployed in the United States. The same sort of structural difficulties are now manifesting themselves even in West Germany where there are 1,000,000 people out of work and some 700,000 on short time working. These structural problems are likely to be further compounded by the rationalisation of the European Aerospace Industry within the Common Market. Finally it is to be anticipated that Lucas Aerospace will attempt a rationalisation programme with its associated companies in Europe.

It is not suggested in this report that Lucas Aerospace is suddenly going to cease to be deeply involved in the aerospace industry. We recognise, whether we like it or not, that the aerospace industry is going to remain a major part of the economic and technological activity of the so-called 'technologically advanced nations'.

The intention is rather to suggest that alternative products should be introduced in a phased manner such that the tendency of the industry to contract would firstly be halted and then gradually reversed as Lucas Aerospace diversified into these new fields.

It is also evident to us that when the three sectors of the aerospace industry are nationalised the relationship between them and Lucas Aerospace may well change. We have clear indications from our fellow trade unionists in those bodies that they will not be prepared to see the lucrative parts of the industry hived off by the component manufacturers; in this we fully understand their motives and support them.

As trade unionists we do not wish to see a relationship between the aerospace component firms and the nationalised sector of the industry which would be similar to the relationship of the equipment manufacturers to the National Coal Board. Such a relationship would provide the opportunity for those forces in society hostile to nationalisation to point out that nationalised industries were economically unsuccessful, whilst in practice they would cream off the research and development which was paid for by the tax payer into component companies. It has already been stated to us therefore, that our colleagues in the nationalised sectors of the aerospace industry will be demanding that these industries diversify such that any potential contraction is at least in part countered by those industries engaging in the manufacture of some of the components which they now buy from outside.

The desire to work on socially useful products is one which is now widespread through large sectors of industry. The aerospace industry is a particularly glaring example of the gap which exists between that which technology could provide, and that which it actually does provide to meet the wide range of human problems we see about us. There is something seriously wrong about a society which can produce a level of technology to design and build Concorde but cannot provide enough simple urban heating systems to protect the old age pensioners who are dying each winter of hypothermia (it is estimated that 980 died of hypothermia in London alone last winter, which was a particularly mild one).

Further it is clear that there is now deep rooted cynicism amongst wide sections of the public about the idea, carefully nurtured by the media, that advanced science and technology will solve all our material problems.

As Professor Jung recently said to an international trade union gathering "the deterioration in the quality of life is already noticeable in the highly industrialised areas of the world, and this, presumably still accelerating trend, makes it increasingly difficult for scientific and technological thought and planning to enjoy the blind trust it received in the past decades".[7]

Of particular significance in this connection is the much publicised rejection by capable sixth formers of the places that are available for science and technology at British Universities. Science and technology is perceived by them to be de-humanised and even brutal and the source of a whole range of problems, not only for those who work in the industries themselves but also for society at large.

It is our view that these problems arise, not because of the behaviour of scientists and technologists in isolation, but because of the manner in which society misues this skill and ability. We believe however, that scientists, engineers and the workers in those industries have a profound responsibilit to challenge the underlying assumptions of large scale industry; seek to assert their right to use their skill and ability in the interest of the community at large. *In saying that, we recognise that this is a fundamental challenge to many of the economic and ideological assumptions of our society.*

It is certainly not the assumption of this Corporate Plan that Lucas Aerospace can be transformed into a trail blazer to transform this situation in isolation. There can be no islands of responsibility and concern in the sea of irresponsibility and depravity. Our intentions are much more modest, namely to make a humble start to question these assumptions and to make a small contribution to demonstrating that workers are prepared to press for the right to work on products which actually help to solve human problems rather than create them.

It remains our view that no matter how many sections of workers in other industries take up these demands the progress can only be minimal so long as our society is based on the assumption that profits come first and people come last.

Thus the question is a political one, whether we like it or not. Perhaps the most significant feature of the Corporate Plan is that we trade unionists are attempting to transcend the narrow economism which has characterised trade union activity in the past and are extending our demands to the extent of questioning the products on which we work and the way in which we work upon them. This questioning of basic assumptions about what should be produced and how it should be produced in one that is likely to grow in momentum.

In July 1970 the United Automobile Workers of America (UAW) issued a statement to General Motors Corporation asserting that UAW members had a direct legitimate concern in pollution caused by the automobile industry and claim-

ing the right to raise the issue in collective bargaining. The union asked to know about future programmes of General Motors 'designed to eliminate pollution, both from within the plants and outside the plants caused by waste emitted by the Corporation's factories and by internal combustion engines'.

In September 1972 Douglas Fraser, the head of UAW Chrysler Dept., announced that the union had asked Chrysler Corporation to begin talks on how to 'humanise' jobs on the assembly line. He said that if the Corporation refused the request, the issue of workers boredom and dissatisfaction would be one of the unions most important bargaining goals.[8]

Activities of this kind will, in our view, be far more significant in the long term than campaigns for worker participation or worker directors. This Combine Committee is opposed to such concepts and is not prepared to share in the management of means of production and the production of products which they find abhorrent. Indeed at times of Company crisis the real role of the so-called directors becomes self evident. Thus in spite of one third of the seats on the Volkswagen board being filled by union representatives and these voting with socialist politicians on the board, which in practice is said to give a 50:50 say in the running of the plant, this in no way helped the workers during the massive redundancies which took place in Volkswagen recently.[9]

There cannot be 'industrial democracy' until there is a real shift in power to the workers themselves.

Trade Unionists at the point of production through their contact with the real world of manufacturing and making things are conscious of the great economic power which workers have. This growing sense of confidence by working people to cope with the technological and social problems we see about us is in glaring contrast to the confusion and disarray of management, particularly in the highest echelons of industry.

Corporate Social Responsibility

It is clear that even amongst the supporters of private industry there is a growing recognition that things will have to change. Issues such as the 'quality of life' and the harnessing of the productive forces to meet human needs are likely to be issues of major political importance during the coming years. Even those whose policies have given rise to the present economic and social crisis now admit that change is inevitable. Fifty per cent of the key policy makers in Europe agreed "the 1970s will see an economic crisis provoking a re-examination of economic aims, the pursuit of growth will give way to a search for 'quality of life' for social justice and solidarity".[11]

The motives of the "large scale corporations are quite correctly perceived to be anti social". The growth of large scale corporate industries during the past century appears to furnish additional evidence of businessmen's anti-social behaviour, first in the trust problem and the treatment of labour and more recently in racial discrimination, pollution of the environment, contribution towards low levels of public taste, inability to achieve stability in the economy and inadequate consumer service and protection. The rosta of accusations viewed over the past decade seems to be lengthening and the intensity of antagonism appears to be rising.[12]

The rosta could indeed be lengthened to include the dehumanised forms of work in the plants of these corporations and even the interesting contradiction for them that they are unable to provide the right to work for our members in order that they can exploit them! All of this, it seems to us, arises because the motive force behind industries of this kind is the maximisation of profit.

In order to retain some kind of public credibility the large corporations are even denying that profit is now the main motive. The manager of the French subsidiary of the American corporation Singer is quoted as saying "profit remains vital to our survival but it cannot any longer be our sole aim. Human related goals must be advanced, the satisfaction of wage earners and consumers and the protection and upgrading of the environment".[13]

Peter Parker, Chairman of Rockware Group, told a conference of the British Institute of Management "the social dimension is for me the most demanding and decisive of the decade. Its scope includes relationships with government and institutions, organisational adjustments to the ages, social priorities of classlessness and of establishing consent to the exercise of industrial power, of a decent environment and of personal and moral attitudes towards the question of efficiency to what purpose and at what price".

He went on to state "with social responsibility we are dealing with an idea whose moment has come at last".[14]

Social responsibility has been defined as 'the commitment of a business or business in general to an active role in the solution of broad social problems such as racial discrimination, pollution, transport or urban decay".[15] Some Companies are even putting forward social responsibility audit check lists.

It remains our view that businesses will look at social responsibility purely in terms of profits, indeed as Maguire has pointed out, social auditing represents "a crude blend of long term profit making and ultruism".[16]

We believe this Corporate Plan will provide an opportunity for Lucas Aerospace to demonstrate whether it is really prepared to take its social responsibility seriously or not.

Job Redesign

The past 70 years have seen systematic efforts to de-skill jobs, to fragment them into small narrow functions and to have them carried out at an increased tempo. This process which oddly is known as 'Scientific Management', attempts to reduce the worker to a blind unthinking appendage to the machine or process in which he or she is working.

In Scientific Management as its founder, Fredrick Winslow Taylor tells us "the workman is told minutely just what he is to do and how he is to do it and any improvement he makes upon the orders given to him is fatal to success".[17] Taylor was not unaware of the implications of what he was doing and once said "that the requirements of a man for a manual job is that he shall be so stupid and so phlegmatic that he more nearly resembles in his mental make up the ox than any other type".[18]

The tendency to destroy skill and job interest is now evident in all fields of manufacturing including in Lucas

Aerospace; but human beings are not oxen and are rebelling against such a system in many ways. In Volvo in Sweden, the labour turnover in 1969 was 52% and absentee rate reached 30% in some plants. In the United States the reaction has been even more dramatic; in General Motors Lordstown's plant the computer-controlled production line and the products on it have been directly sabotaged by workers who felt completely oppressed by their working environment.[20]

This is of course inevitable in a society which views workers merely as units of production and tries to treat them accordingly. Moral arguments will certainly not change the situation, in fact Griener – a leading academic in this field – suggests that successful change does not begin until strong environmental and internal pressures "shake the power structure at its very foundation. Until the ground under the top managers begins to shift it seems unlikely that they will be sufficiently aroused to feel the need for change, both in themselves and in the rest of the organisation."[21]

Nor are these problems confined to the shop floor. The past ten years have seen the extension of various forms of 'Taylorism' into the fields of white collar and mental work.[22]

Behavioural scientists and others are now making vast fortunes advising management of job enrichment schemes and group technology. *These of course are simply devised to get more out of each worker.* In fact workers have always known that is far better if people work in teams and know what each other are doing. They know that if they are engaged on work which is challenging to them this results in better products of higher quality.

However modern industry continues to move in the opposite direction: a gradual replacement of human beings by machines, a change in the organic composition of capital in which industry is made capital intensive rather than labour intensive. Not only does this give rise to serious problems of structural unemployment but it also causes serious problems as far as quality of products is concerned, and more importantly 'quality of life'.

It is clearly evident from some of the Lucas Aerospace plants that attempts to replace human intelligence by machine intelligence (e.g. over emphasising the importance of numerical controlled machine tools as against human skill) have had quite disastrous results. It is intended to campaign for quite radical job re-design which will protect our members from this.

The idea of a Corporate Plan of this kind is an entirely new initiative by industrial workers. It is, to our knowledge, the first time that such a plan has been proposed in the United Kingdom. There has, of course, been some developments of this kind abroad, notably in Italy where at Fiat the work force put forward a series of social demands in addition to the straight forward economic ones (such as wages).

Whilst the Combine Committee is unanimous in its desire to have the Corporate Plan produced, there is by no means universal agreement on the tactics for its introduction. This is because of the industrial dangers which arise in a project of this kind. There is obviously the danger that the discussions with the Management about the implementation of the plan, (if it were agreed that such discussion should take place), could gradually degenerate into a form of collaboration. There is also the danger that, even if collaboration were carefully avoided, the Company might simply take parts of the Corporate Plan and have all this technology on the free. The plan has taken a very considerable length of time to prepare and involved many evenings and weekends of work. It has also meant that outside experts have been prepared to give generously of their detailed knowledge in order to help the development of the Corporate Plan.

In these circumstances the greatest care will have to be taken to ensure that the Company does not succeed in drawing off the 'money spinners' from the plan, and perhaps even having these produced abroad, whilst declining those products which would be socially useful. It is even conceivable that whilst the Company would take sections of the Plan, our members may still be confronted with the perennial problem of redundancy. Because of these dangers it is suggested that the correct tactic would be to present only part of the plan to the Company, and then to test out in practice the manner in which the Company will attempt to deal with it.

Approximately 150 products were proposed for the Corporate Plan. Twelve of these were selected for presentation at this stage and are suitable for use in the following six major areas of technological activity.

1. Oceanics
2. Telechiric Machines
3. Transport Systems
4. Braking Systems
5. Alternative Energy sources
6. Medical Equipment

Each of these major areas is supported by a file of some 250 pages of detailed technical and economic supporting information. Only that on alternative energy sources is provided at this stage. A summary of the products chosen is included at the end of this section of the Corporate Plan.

While the Corporate Plan was being prepared, unemployment problems arose at the Hemel Hempstead and Marston Green plants. Separate mini corporate reports were prepared for these plants and they are being handled by the local shop stewards committees.

Employee Development Programme

The prosperity of Britain as a manufacturing nation depends to a very large extent upon the skill and ability of its people and the opportunity to use that skill and ability to produce commodities.

During the past five years the Lucas Aerospace work force has been reduced approximately 25%. This has come about either by direct sackings or by a deliberate policy of so-called natural wastage, i.e. not replacing those who leave, or encouraging early retirement. The net result has been that highly skilled teams of manual workers and design staff have been seriously diminished and disrupted; we cannot accept that such a development is in the long term national interest.

Coupled with this development has been one inside the Company in which attempts have been made to replace human intelligence by machine intelligence, in particular the introduction of numerically controlled machine tools. This has, in a number of cases, proved to have been quite disastrous and the quality of the products have suffered in consequence.

In many instances the Company has fallen victim of the high pressure salesmanship of those who would have us believe that all our problems can be solved by high capital equipment. We have allowed our regard for human talents

to be bludgeoned into silence by the mystique of advanced equipment and technology, and so forget that our most precious asset is the creative and productive power of our people.

When we reviewed the work force we now have, our concern centres on four points. Firstly, very little is being done to extend and develop the very considerable skills and ability still to be found within the work force. Secondly, the age group in some of the factories is very high, typically around 46-50 years average. Thirdly, there is little indication that the Company is embarking on any real programme of apprenticeships and the intake of young people. (It is in fact sacking apprentices as they finish their time.) Fourthly, the Company is making no attempt to employ women in technical jobs, and apart from recruitment of these from outside, there are many women doing routine jobs well below their existing capabilities. Quite apart from the desirability of countering these discriminatory practices, the employment of women in the male dominated areas would have an important 'humanising' effect on science and technology.

In that section of the report dealing with specific recommendations we propose a number of steps which should be taken in this direction. The section of this report is concerned with development and retraining facilities for the existing workforce, this we regard as important at two levels, firstly retraining and re-education would mean that we were developing the capabilities of our people to meet the technological and sociological challenges which will come during the next few years. Secondly, in the event of work shortage occurring before alternative products have been introduced the potential redundancy could be transformed into a positive breathing space during which re-education could act as a form of enlightened work sharing.

During the past ten years a number of social, political and economic factors have become clearly discernible which suggests that the traditional pattern of education/work/retirement will grow increasingly inappropriate in the fourth quarter of the 20th century. For the purpose of the Corporate Plan the most important of these factors are:

1. The exponential nature of technological change[23/24]
2. The rate of knowledge obsolescence and break up of skills associated with 1 above.[25]
3. Structural changes in manpower requirements.[26/27]
4. The movement towards equal employment and education opportunities for women.[28]
5. The political and social unacceptability of structural unemployment as a feature of advanced industrial society.[29/30]

There are some indications that the trade union movement, educational institutes, and even some managements are beginning to respond to this new situation. The growing interest in adult and recurrent education and retraining is an indication of this.[31] It is also encouraging to see international bodies, such as the OECDs Centre of Educational Research and Innovation, proposed recurrent education which permits 'educational opportunities to spread out over the individual's life time'.[32]

Some countries have already well established and co-ordinated retraining and educational programmes. In Sweden for example, apart from all training within industry, and the individuals own initiative, the state recognises an annual training need of 1% of the total work force.[33] Even in the United States, where the short sightedness of private enterprise is at its worst, some large corporations now include training and education as part of the corporate social responsibility activities.[34]

In general, however, the tendency is to discard older employees and engage younger ones 'with new knowledge'. This, unfortunately, is likely to remain the predominant business attitude for some time to come. It is an attitude which we cannot and will not accept. In our view there is a need for a blending of the dynamism and drive of the young people, to be counterbalanced by the experience and knowledge of older workers, who should also have the opportunity of having their knowledge updated.

More attention is now being given to the importance of 'human assets', although the terminology used reveals the real motives of many of the companies, for example reference is made to 'human capital'.[35/36/37] However, there are some indications that the value of retraining employees 'who know the company system' is beginning to be recognised. The growing pressure from the international trade union movement for retraining and re-education of older workers (which can frequently mean a little over 40 in some fields) is likely to be a significant factor during the next decade.[38/39/40]

It is to be anticipated that these international tendencies will be reflected in the United Kingdom, although to date the emphasis has been on compensation and unemployment payments rather than re-education as an occupational form of 'work-sharing'.

Unemployment is a social evil which need not occur in advanced industrial society and should not be tolerated. It represents a tragic wastage of the nations greatest asset, its people's creative and productive power. Whilst it may seem feasible from an accountant's viewpoint to balance his books by sacking a few hundred workers the loss to the nation as a whole can be very considerable. This loss arises firstly because the individuals involved are denied the right to produce, hence the commodities that they would have created are no longer available. Secondly, the state is involved in vast sums of money which are paid as earnings-related unemployment benefit and in compensation to the individuals who lost their jobs.

For the individuals involved there is the indignity and degradation of the dole queue; for the tax payer there is the expenditure on these social benefits. It is our view, therefore, that even in a narrow economic sense it would be feasible to propose that part of the money that would have been available had these people been redundant, should be provided as a basis for part time education, thereby protecting the individual from the dole queue whilst at the same time investing in the nation's future manpower . . .

It should be emphasised that we are not, in this context, talking about retraining for white collar and technical staff only. It is our view that the entire work force including semi-skilled and skilled workers are capable of retraining for jobs which would greatly extend the range of work they could undertake. This would provide opportunities which they may have been denied, for a number of reasons, at an earlier stage in their lives.

Such courses could best be organised in local technical colleges and polytechnics. It is our view that universities are too rigid in both their entrance requirements and teaching methods. The courses would have to take into account that many of those involved would not have had traditional forms of education and paper qualifications, but could bring to the course a wealth of experience through actual work in industry.

It would further mean that those teaching on these courses would have to develop new teaching methods and have a real respect for people who had industrial experience. Such an arrangement would not be without its advantages for the

polytechnic and technical colleges involved, as such trainees could bring to these institutions a much more mature and balanced view about productive processes in general, but also about wider political, social and economic matters.

Oceanics- A Brief Review

The ocean beds cover over 70% of the earth's surface. It is clear that during the coming years there will be an ever increasing use made of this vast area. Judging by the irresponsible manner in which human beings have used the first 30% of the earth's surface the prospect is one which we view with considerable trepidation.

The exploitation of the ocean bed is likely to take at least three forms:

1. Exploration and extraction of oil and natural gas.
2. Collection of mineral bearing nodules.
3. Submarine agriculture.

Oil

It has been estimated that 15% of the world's oil is already drawn from coastal waters and this figure will be increased to 33% by 1980. The significance of this in the United Kingdom has of course been underlined by the work on North Sea Oil.[41] The scale of this activity may be judged by the fact that the total capital expenditure on process industries is forecast to amount to £8.6 billion pounds in the three years up to the end of 1977. Of this some 40% is likely to go on North Sea Oil production development.[42]

Five years ago, efforts to interest Mr Rivett and Mr Clifton-Mogg in the possibility of using existing Lucas Aerospace valve technology, and the manufacturing facilities of the ballscrews to provide a complete valve operating and controlled system were ignored. It is perhaps not surprising therefore that Sir Fredrick Warner, Chairman of the NEDC process plant working committee maintains that process plant and equipment manufacturers are missing out to overseas companies on much of the North Sea Oil work. He stated in presenting the NEDC report on the 9 June 1975 'I wish we were getting half the business'.[43]

Although such valve work would represent only a minor part of the capital investment in such installations it would have been of major significance to Lucas Aerospace. However the real growth area would be in a whole range of automatic and electronically controlled remote equipment. 'It is easy to envisage a time when all facilities now used in processing and distributing oil are put in the sea bed in vast plants manned by men living in atmospheric conditions, or handled by robots and automatic systems electronically controlled from the shore."[44]

It is significant that Westinghouse and Lockheed are both actively engaged in these fields, and Lockheed are concentrating their efforts on developing sub sea working chambers which can be approached by diving bells.[45]

These activities will require a wide range of submersible vehicles which in turn will need generating and actuating systems on board. Lucas Aerospace should be entering into working agreements with the manufacturers of these in particular with Vickers Oceanics. In fact they should consider entering into an agreement with Vickers which would establish the same relationship which they have in the aerospace field with Hawker Siddeley or BAC.

Metal Bearing Nodules

One of the richest sources of mineral resources is the metal bearing nodules to be found on the sea bed. They exist virtually everywhere and are usually 20mm to 40mm in size and average 17% manganese and 11% iron. They also contain considerable quantities of trace elements of nickel, copper, cobalt and zinc, together with lead and phosphates. By the year 2000 the land sources of some of these metals will have been exhausted, whilst the marine reserves are enormous. The quantity of copper in nodule form for example is 150 times greater than the terrestial reserves.[46]

Although this field of activity is only in its infancy three large companies in the United States, including Hughes Tool, has already put $100 million into the project to exploit the seas off California. In Europe both France and Germany have carried out initial experiments of deep sea retrievers. The initial investment of projects of this kind is likely to be enormous and as a consequence international co-operation is likely to be the pattern. In fact a spokesman for the German company said 'the technical development is so expensive that exploitation of these metal bearing nodules is out of the question for one firm alone, or even a national group of companies. It can only be done by international co-operation as through cross frontier consortia'.

Marine Agriculture

During the coming ten years there is likely to be a growing interest in marine agriculture. Products of the sub acqua farms are likely to range from directly consumable vegetables to those producing by products which can be processed on land. This type of farming will require a whole range of special purpose small vehicles to take the 'farmers' down to the work areas. There are also likely to be requirements for a range of submersible vehicles and telechiric machines which could carry out both the sowing and reaping by remote control. It is our view that oceanics provides very important long term outlet for Lucas Aerospace as manufacturers of complete aircraft systems. We are in a unique position to provide total systems for the vehicles and equipment which will be required in this field. It would also be a logical point of entry for Lucas Aerospace into the wider and developing field of control systems as a whole. This is likely to be one of the leading growth areas during the coming years and a very considerable use of mini computers and micro-processors are likely to be involved. The predictions are that this will have a profound effect upon the whole nature of our technology during the coming years.[47] This field would also provide a logical framework in which Lucas Aerospace could get involved in microprocessing systems. It is significant that some of Lucas' leading competitors such as Plessey are already making considerable advances in the micro-processor field.

Braking Systems

The increased speed of both road and rail vehicles and the larger payloads which they will carry, both of passengers and goods, will give rise to stringent braking regulations

during the coming years. This tendency will be further increased by Britain's membership of the EEC. The EEC is now introducing a range of new braking regulations. These specify, not only stopping distances, but calls for minimum standards of braking endurance over a continuous period. In addition, the regulations lay down conditions for 'braking balance' between axles in order to prevent a dangerous sequence of wheel locking.

Many individual EEC countries have, in addition, their own national braking requirements. In France for example, since the mid 1950s auxiliary braking systems have been compulsory for coaches operating in mountainous terrain.

A fundamental weakness of normal mechanical brakes is that when subjected to long braking periods they overheat and the braking linings, at elevated temperatures, tend to temporarily lose their 'gripping qualities'. This problem can be greatly reduced, if not totally overcome, by using a retarder. A retarder is basically an electro magnetic dynamometer which is fitted usually to the prop shaft between the engine and the back axle. To reduce speed its coils are excited by an electrical supply direct for the vehicle battery, thereby inducing a braking force as the disc rotates in the magnetic field.

At the Willesden plant some 25 years design experience exists in this field of dynamometry. Attempts by the design staff some 10 years ago to get the Company to develop and simplify these eddycurrent dynamometers for mass production as retarders failed. It is felt, however, that the time is now opportune to reconsider this whole project.

In Britain public attention has been dramatically focused on the weaknesses of existing braking systems by the Yorkshire Coach disaster which claimed 32 lives in May 1976. The *Sunday Times* (1.6.75) stated "last week's crash might have been avoided if the coach had been equipped with an extra braking device, such as an electro-magnetic retarder which is being fitted to an increasing number of coaches in this country". In fact it would appear that only 10% of Britain's 75,000 buses and coaches actually have retarders fitted to them. There is, therefore, clearly a vast market available to Lucas if it adopts an imaginative approach to this problem. It is not suggested that Lucas should simply produce dynamometers, rather what is proposed is that they should analyse the whole nature of braking systems through a wide range of vehicles, including buses, coaches, articulated lorries, underground and overhead trains as used by British Rail.

It is proposed that a braking system analysis and development team should be set up to take an overview of this problem. The team should make an analysis of the actual requirements for the different applications, and at the same should analyse any patent problems which might arise with respect of the French Labinal retarder which is marketed in this country as 'Telma'. Simultaneously a development team should develop an existing Lucas Aerospace dynamometer, using a unit capable of being fitted in the conventional position, i.e. in the prop shaft between the engine and the back axle, capable of absorbing 600 brake horse power and the weight approx. 200 kgs. Once this unit has been designed and developed, discussions should take place with Girlings to arrange for its mass production under a licensing arrangement from Lucas Aerospace. Although a vast potential market exists for dynamometers of this kind this unit should be seen only as the first step in evolving a total braking system capability.

The second stage would be a combined electro magnetic braking system coupled directly to a traditional mechanical brake based on a Girling disc. The control system would have to be designed such that by moving the brake pedal the dynamometer would initially operate and the further depression of the pedal will gradually increase the current and hence the braking load until finally the mechanical brake could be applied if necessary. Use of the dynamometer between the prop shaft and the back axle clearly limits its range of application. To overcome this, discussion should take place with manufacturers of gear boxes to arrange to have them fitted on the output side of the gearbox such that they could be used on the tractors of articulated vehicles.

A further development would be to design and produce units which could be fitted to each individual axle. Work in this field is already being carried out in France, but based on traditional dynamometer units.

An elaborate control system would be necessary to ensure that as each of the individual axles is braked it still meets the new EEC requirements concerning the sequence and the effects on individual axles and their proper synchronisation to remove the risk of unstable skidding or 'jack knifing'. This work would dove tail in conveniently with existing work being undertaken by Girlings on anti-skid systems. It is important that this programme should not be carried out in the usual piece-meal short term manner. A long term overall plan should be worked out, and each stage of the development programme should be a tactical step towards a long term strategy.

Part of that long term strategy should be the provision of radar applied braking systems. All the necessary components should be designed to produce a flexible range of system options. Dynamometers lend themselves ideally to this as the load is applied electrically. The 1975 Society of Automotive Engineers Congress held in Detroit, reported that the National Highway Safety Association's 71 statistics showed that 8% of the vehicles on the road were involved in rear end accidents. They represented 25% of accidents or 8½ million vehicles. The medium to long term aim should be to provide radar applied braking systems particularly for use on motorways.

The *Financial Times* (7.5.1975) stated

> "in the longer run electronic station keeping devices which use a form of radar to apply brakes automatically to cars travelling along motorways when they approach too close to a slowly moving vehicle ahead may be adopted. If they were introduced compulsorily for traffic they would certainly lead to a substantial reduction in the number of lives lost through motorway accidents in fog."

R.A. Chandler and L.E. Woods of the US Department of Commerce Institute for Telecommunication Sciences have said at the conference quoted above "while significant problems exist in the development of generally acceptable radar sensors for automobile braking, no insurmountable difficulties are evident". Applications more complex than mere station keeping should also be considered, but these give rise to a series of technological problems which, although they could be overcome, may only be soluble with very expensive equipment. However both Chandler and Woods had the following to say "both pedestrians and the cyclists are detectable, radiation hazards are minimal, small radius corners give a problem in false alarms, inter-system blinding is a problem and that the effect of rain scattering are serious". Spokesmen for the National Highway Traffic Safety Association have stated that research in radar braking fields warrants continuation, but the decision to implement such devices should be made only after cost benefit studies and acceptable hardware performance had been verified. It is clear that now is the stage for Lucas to become involved in these developments.

It is proposed that a similar long term overview should be

taken of braking requirements for rolling stock railways and underground. Already British Rail has introduced, on an experimental basis, velocity monitoring systems, which indicate to the driver if he is travelling at a velocity considered to be dangerous for an oncoming curve, junction or other impediment. With these velocity sensing devices already installed, it would be a logical step to use this information to feed into braking systems such that the train was automatically slowed down to meet the travelling requirements already determined for other sections of the track if the driver fails to respond due to illness or whatever. Such overall braking systems would require many computers and micro processors. The use of these would fit in with suggestions made elsewhere in the Corporate Plan.

Transport Systems

Road Vehicles

There will be an increasing requirement for battery powered vehicles during the next 20 years. However the numbers involved are not likely to be substantial until alternative forms of battery power storage and battery production have been developed, and until means of charging these, other than using conventionally produced electricity have been developed.

In the meantime there is likely to be a growing interest in hybrid systems which make the best use of battery storage and couple that with the optimum performance of internal combustion engines. It is therefore proposed that a hybrid system be evolved utilising the IC engine running at a permanent and optimum power setting and connected to a generator. The generator would charge the batteries which in turn supply the power to the electric motor driving the vehicle. Viewed in the wider company context it may be desirable to use the diesel engine with its inherent advantages of better fuel consumption characteristics. Initial calculations suggest a 50% fuel saving in such a hybrid.

The Gound Support Equipment Group of the Aerospace division already has considerable experience in the packaging of coupled prime movers and generators. In addition it has developed considerable expertise in the silencing of units of this kind without greatly impairing the efficiency of the engine. This would mean, not only could atmospheric pollution be greatly reduced, in that the toxic emissions would be reduced by some 70 to 80% by the permanent power setting, but the noise pollution could be greatly reduced as an added advantage.

The existing Lucas battery powered vehicles could be used as a test bed for this generator package. It is therefore proposed that designers from the Ground Support Equipment Group liaise with their colleagues in the Lucas Electrical Co. and CAV, so that a specification can be drawn up for the 'hybrid package'.

A prototype should then be built by the Ground Support Equipment Group and tests carried out in the vehicles already in existence.

Air Transport

In Western Europe the pressure of urbanisation and the density of population will mean that transport systems, other than rail and road, will increasingly be sought. There is a growing and understandable public hostility to conventional air traffic systems with the problems of air and noise pollution in the immediate vicinities of airports. These considerations and ones of economy are likely to give rise to a growing interest in airships. Explosion hazards associated with hydrogen are likely to continue to make that an unsuitable lifting source, helium is extremely expensive. Docking, loading and unloading problems are considerable. To release a load of 250 tons would require a release of nearly 9 million cubic feet of helium and cost something in the order of £100,000.

In addition there is growing concern as to the availability of helium in the future. The present rate of consumption of the resources of crude helium can only be expected to last for a few more decades. In these circumstances a system such as 'Air-float' is highly desirable. However to allow for fine control over its load/unload position, complex vertical and horizontal vectoring power units will be required.

It is suggested that Lucas could make a major contribution in this. It is proposed that direct contact should be made with Dr Edwin Mowforth of the University of Surrey in order that Lucas' contribution to this development could be explored in detail.

The Combine has already been in contact with Dr Mowforth on this issue.

Railway Systems

The structure of railway coaches is based on a design philosophy which is about 100 years out of date. Strength and weight of railway coach structures depends essentially on the characteristics of rigid wheel on the track and its power transmissions through that. R. Fletcher of the North East London Polytechnic pointed out for a number of years that these problems could be overcome if pneumatic wheels were used. The entire suspension system of the vehicle could then be much lighter as could the overall payload bearing structure. This work is currently supported by a Science Research Council grant. If Lucas were to accept the proposal for braking systems made elsewhere in this Corporate Plan they could extend that idea by providing a complete wheel and axle unit which would embody a pneumatic wheel, a retarder and disc brake. Aerospace would provide the automatic braking system and the microprocessors to operate the unit.

With the overcrowding on roads such a light weight train could be used to great advantage on suburban lines and migh even be used on some of the lines now closed by the Beeching Plan. It is therefore proposed that contact should be made with R. Fletcher to establish in which way the braking systems could be incorporated into an overall design philosophy for these lightweight railway vehicles.

Approximately 10 years ago Lucas Aerospace spent vast sums of money on developing a railway actuator. Basically the idea was that a vehicle could be taken directly from a railway and run on wheels suitable for conventional road surfaces. These wheels to be actuated into position by a system provided by the then Rotax Division. It is suggested that the system should now be re-examined in light of current transport requirements. It should be particularly re-examined in light of the proposals above for a light weight vehicle.

The (Scottish) Highland and Islands Development Board has already shown considerable interest in such a hybrid road/rail system. A section of track has been located where the tests can be carried out. The hybrid prime mover proposed above and the 'Braking System' should be incorporated into the final design.

Summary of Proposals

This is a summary of proposals made specifically in sections of the Corporate Plan or those arising from a review of alternatives.

1. *Components for low energy housing*

a. Solar heating, in particular switching circuits and pumping components. The provision of materials and prototype components for research and development in the Essex County Council experimental house. The appointment or seconding of a research fellow to the Group working on this research project at North East London Polytechnic for the Sussex County Council.
b. An examination of the feasibility of the Luton site producing solar heating panels for such housing.
c. An investigation of the feasibility of applying advanced aerospace technology to wind power sources in particular 'windmills', with special emphasis upon rotor speed regulation systems.
d. The building of a prototype and the testing of it at the test house at Sibton Green, Sussex.

2. *Fuel Cells Technology*

A research and development programme to keep Lucas abreast of the technology in this field. Specifically, consideration to be given to the feasibility of building a prototype 30kW fuel cell power plant, using gaseous hydrogen and oxygen.

3. *Braking Systems*

Set up analysis and development team to adapt eddycurrent dynamometer technology to the requirements of retarders for coaches.

Analyse markets for such retarders and investigate patent complications in connection with the 'Telma' retarder. Establish relationship with British Leyland and with Girlings to produce an overall system for Leyland buses and coaches.

Initial staff required 2 R&D personnel, 1 prototype fitter over a 3-month period expand the team to cater for the following work:

a. The design of a 600 brake horse power unit weighing approximately 200 kgs.
b. An integrated braking system incorporating both mechanical disc brakes and dynamometers.
c. Anti-skid systems.
d. Automatic braking systems incorporating station keeping capabilities.
e. Complete braking systems for railways.

4. *Transport Systems*

a. The design and development of a prototype hybrid power package incorporating internal combustion engine, generator, batteries electric motor.
b. Airship vectoring systems.
Arrange meetings with Dr Edward Mowforth of the University of Surrey.
c. Combined road/rail vehicle. Establish transport systems design and development team.
Establish working relationship with R. Fletcher of the North East London Polytechnic whose work in this area is supported by the Science Research Council.
Examine feasibility of providing integrated braking system for this vehicle together with micro-processors, suspension systems using Girling know-how and the hybrid power package outlined above. Contact Scottish Development Board, and Derbyshire County Council through R. Fletcher with a view to establishing a test section of existing track.
Re-examine the Rotax railway van actuator in light of current requirements.

5. *Oceanics*

Establish working relationship with Vickers Oceanics.
Consider feasibility of providing complete systems for submersibles.
Examine the feasibility of designing, developing and manufacturing, either independently or with Vickers, telecheiric devices for metal bearing nodule collection and marine agriculture.

6. *Micro-processors*

Marston Green Electronic Group to consider the provision of micro-processors for the systems outlined above.
Particular attention to be paid to the development at Plesseys.

7. *Medical*

Establish a medical division at G&E Bradleys, initially increasing the production of kidney machines thereby approximately 40%.
In conjunction with Ministry of Health build up a 'design for the disabled' unit.
Investigate the feasibility of applying aerospace technology to provide 'sight' to the blind.

8. *Power Units*

Examine the requirements of the computer industry for standby power units using automatic sensing and starting systems, to be developed by Marston Green.
Carry out market survey of requirements of Middle East Oil producing countries and newly emergent nations for power packs built on a module basis to meet alternatively the requirement for pumping facilities, hydraulic power pack facilities, electricity generation and compressed air.

9. *Industrial Ball Screws*

Analyse the application of ballscrews to valve control systems, machine tool control systems, telecheiric machines and submersible vehicles.

10. *Telecheiric Machines*

Augument existing systems and actuator know-how with

specialists in remote control field.
Examine application for fire fighting telecheiric devices, mining machines and underwater devices.

11. *Employee Development Programme*

Arrange Union/Management negotiations on employee re-training.
In the event of immediate redundancies negotiate full time education as a form of work sharing backed by government grants.
Unions to have discussions with the Department of Employment and Manpower Services commission.

12. *Integrated Product Teams*

Union/Management negotiations on the establishment of integrated product teams incorporating design, development production engineering and manufacturing in one group.
Negotiations on the redesign of jobs.
Union to meet Dr Gilbert Jessop of the Work Research Unit of the Department of Employment to discuss job satisfaction schemes.

13. *Other Products Under Consideration for Enlarged Corporate Plan*

a. Linear motors operating pumps and compressors.
b. Range of applications for the '60 and 90 Gas Turbine'
c. Robot helicopter using Lucas gas turbine for crop spraying.
d. High speed motors.

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