10 DOWNING STREET

From the Private Secretary

A/F 21.11.79.

MR VILE

The Prime Minister has now had a chance to consider Sir Robert Armstrong's submission of 13 November, ref. A0638, about the Advisory Council for Applied Research and Development.

The Prime Minister is reluctant to disturb the existing hierarchy in ACARD if this is likely to cause trouble. I suggest, therefore, that Sir Kenneth Berrill should be invited to sound out Sir James Menter and Dr. Spinks about future arrangements for the chairmanship, and that Sir Robert Armstrong should report further to the Prime Minister on this before an appointment is confirmed.

The Prime Minister is content with the proposals to establish a regular rotation of members, although she sees no need for any excessive rigidity on this. She is also happy to see published the two further reports listed in paragraphs 5 and 6 of Sir Robert's minute. She agrees that the Secretary of State for Industry and the Chancellor of the Exchequer should take the lead in preparing the Government response to the two reports. I would be grateful if you could let me have draft Private Secretary letters commissioning the responses.

M. A. PATTISON

19 November 1979

VLE

Ref: A0638

APPOINTMENTS IN CONFIDENCE

PRIME MINISTER

Advisory Council for Applied Research and Development

You have agreed to Sir Leo Pliatsky's proposal that ACARD should continue in existence for a further two years and that I should report on its performance in the autumn of 1981. Since the Election the Council has been without a Chairman and I have now discussed with Sir Kenneth Berrill how this position should be filled.

2. I presume that you would not wish to chair ACARD yourself and you have not given any other Minister a co-ordinating role in scientific matters parallel to that of the Lord Privy Seal's in the last Administration. Sir Kenneth sees no great need for a Ministerial Chairman but tells me that the present Deputy Chairman, Sir James Menter, has not shown the leadership that was expected. The Second Deputy Chairman, Dr. A. Spinks (whom you met recently at a Chemical Society dinner), would be a much better Chairman, though the easing out of Sir James would require tactful handling. If you are content with this objective, I shall ask Sir Kenneth to see Sir James Menter and Dr. Spinks to see what he can achieve.

3. ACARD's membership also needs to be revised. The current members have in general served for three years and we would like to introduce some new blood. A regular rotation of members will, I am sure, do much to ensure the Council's continuing usefulness. We would aim at appointment from January next of one-third new members, one-third re-appointment for one year and one-third for two years. If you agree we will prepare a list of members on this basis, consult Departments and then submit this to you.

4. Meanwhile ACARD continues to be usefully productive. Their Robotics Report had a good Press: I attach copies of a centre page article from the Financial Times and of an article 'Britain needs to use more robots' from the Economist dated 10th November. I also enclose two further reports from the Council who have requested approval for their publication. I see no difficulty with either.

5. The first is on computer aided design and manufacture; it draws attention to the lack of coherence in our national effort in this subject and recommends some organisational changes to improve the effectiveness of publicly financed programmes. It also recommends a very modest programme to improve industry's awareness of computer aids. Chapter 7 (page 21) contains the report's conclusions and recommendations.

6. The second report deals with the implications for the United Kingdom of the rapid technological changes now taking place here and overseas. It contains little that is strikingly original but it firmly rejects arguments that the country can isolate itself from such changes and stresses the need for United Kingdom industry to adopt new technology in order to remain competitive in world markets. The report makes proposals for bringing more technological factors into policy-making machinery such as the NEDC. A summary of its conclusions and recommendations is on pages 1 - 6.

7. Publication of these reports, particularly the second, would lend support to your recent speeches on the need to improve productivity through new technology.

8. A Government response to the reports will be needed. The Secretary of State for Industry might take the lead on the first and the Chancellor on the second, given its close connection with the subjects to be discussed at the NEDC meeting that you are to chair in January.

Yes ok

RA

Robert Armstrong

13th November 1979

Britain needs to use more robots

After microprocessors, robots. The British cabinet office wants to stir up much the same sort of enthusiasm for robots (ie, programmable automation) as the government has begun to do in its campaign to get British industry to think about putting microprocessors into its latest products. A cabinet office report published this week suggests that £15m of public money spread over five years could give Britain a fair chance of catching up with countries like West Germany, America, Sweden and Italy in terms of the number of robots used by industry. Japan would still be streets ahead.

Why robots? Because they are not so stupid as they used to be. They can now help make many goods more cheaply than can conventional machines operated by human workers. They don't get bored, go on strike or indulge in high absenteeism. Result: they do a better job. And they will work happily under conditions humans would not tolerate (anyway without big bonuses).

Manufacturing consists mainly of making materials, forming them into various shapes, joining the bits together and then assembling the lot into finished products. Most of the value is added during the joining and assembly processes. These two processes also determine how successful a product will be in the marketplace. Because:

- Quality and reliability depend critically on the method of joining (ie, welding brazing, soldering, glueing or riveting) used and the skill with which it is applied. Robot joining machines do a far more consistent job than men.
- The cost of a manufactured item depends largely on the productivity of the assembly method adopted. Microprocessors and new electronic devices are giving robots a sense of sight and touch as well as a crude ability to make "intelligent" decisions. That looks like extending the range of jobs they can do. Robots are now expected to bring the cost and quality benefits of the mass production techniques used in big industry to small businesses based on batch production methods. (Remember: 40% of all engineering products made in Britain are made in batches of 50 or less.)

There are about 6,000-7,000 industrial robots in use around the world today. Half are in Japan, a quarter in the United States and the rest in Europe. Britain has only 60-70 robots, West Germany around 500 such devices.

The vast majority of today's robots are used for simple "pick-and-place" tasks—like feeding pieces to a lathe for machining. The rest do slightly more complex jobs—such as cutting metal, spraying paint or welding up parts. They do so by following optimum paths programmed into them. Few robots have yet been used commercially for assembling complicated products like car gearboxes or even washing machines. That is the next step, needing the second-generation robots that are at present being developed.

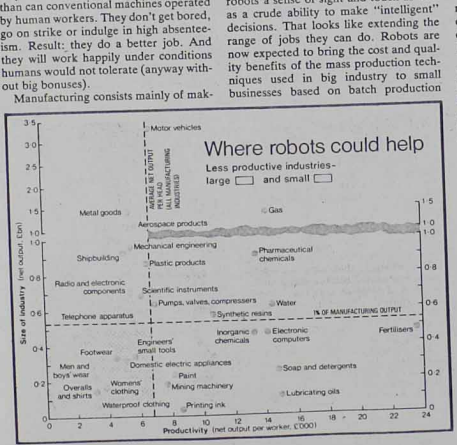
The British cabinet office report, prepared by the Advisory Council for Applied Research and Development, pinpoints where it thinks robots ought first to be applied in Britain to reap the maximum advantage. It has analysed 30 different industrial sectors in terms of net output and added value per employee in 1977 (see chart).

Two conclusions emerge immediately. Industries in the top left-hand corner of the chart make a big contribution to Britain's total industrial output; unfortunately, they have under average productivity. They include telephone manufacturing, aircraft assembly, shipbuilding and many sectors of electrical and mechanical engineering. These are the industries which would benefit most from wider use of intelligent automation.

A second group of industries, in the lower left-hand corner of the chart, would also benefit from adopting robots on a large scale. The garment industry is especially ripe for automating in this way.

Britain has not failed to keep abreast of the theory of robot development. Far from it. It has a number of research establishments inventing better ideas for robots which are the envy of the world. But, as in so many other areas of innovation, it has failed to apply its own ideas commercially. For this, the cabinet office report blames (correctly) the chronic shortage of engineers in British industry capable of adapting robots to manufacturing processes. It recommends:

- A major effort aimed at getting lots



Financial Times Wednesday November 7 1979

The robots are coming-but not to Britain

By DAVID FISHLOCK, Science Editor

THE public's perception of robots is conditioned at present by such anthropomorphical imitations as the Daleks of Dr. Who and the cackling creations which fall about at the idea of a housewife still peeling potatoes. The Cabinet Office, or rather its advisers on engineering and applied science, have a different perception; one we would all do well to heed.

For them, the robot is a versatile tool which will become as important to the manufacturing industries as, say, the machine tool is today. It is a tool destined to do many of the repetitive tasks at which human fingers fumble on assembly lines for seven or eight hours a day. It is a tool which will be programmed to perform its task of putting things together, oblivious of the clock which it anyway cannot see, of Monday morning, of tea-breaks, of heat, noise or fumes; oblivious, in fact, of any of the myriad of environmental aberrations which cause assembly-line output and product quality to fluctuate between wide extremes during a normal working day.

Britain today is ignoring this kind of robot—the "intelligent" robot—the Government's technical advisers say. The number at work in Britain's factories is minuscule compared with its big trading rivals—Japan, the U.S. and West Germany. Yet "failure to apply them will result in our industries being progressively less able to compete with either the high-productivity industrialised countries or the low-labour-cost developing countries," says a report published by the Government yesterday.*

This report is the third in a fascinating series of studies of technological change and how Britain is responding — or, rather, failing to respond. The source is the Government's Advisory Council on Applied Research and Development, which has already spawned stimulating reports—on silicon "chips," last autumn, and on industrial innovation early this year. They share a lucid exposition of the technological advance, and a bluntness about the consequences for Britain of continuing to ignore it.

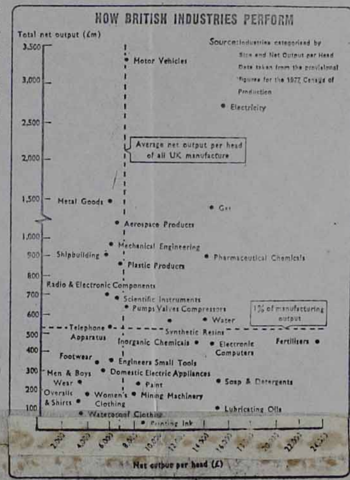
ACARD's latest report finds Britain "in great danger of being left a long way behind in the application of programmable automation and robotics." The evidence suggests that, properly used, automation both raises productivity and improves quality. Failure to use it is likely to leave the industry uncompetitive both in quality and cost—"greater threats to employment than the displacement of labour by machines," ACARD contends.

Contribution to total output

To establish a baseline for manufacturing performance in Britain, the study has drawn upon the statistics of the 1977 Census of Production, and compiled from these the accompanying chart. It shows the contribution that some major sections of industry make to total national output, and also their output expressed as added value per employee. The choice of industry shown here is governed partly by the purview of the report itself and partly by the need for clarity in its presentation. The utilities—electricity, gas, water—are included as benchmarks. (Coal and steel, on the other hand, are missing because it did not prove easy to interpret the figures in a comparable form.)

The industries which can expect to benefit most from automation in the shape of robots are clustered on the left-hand side of the chart, the area of less-than-average added value per employee. They include motor vehicles and shipbuilding, as one might well expect, but also aerospace products, scientific instruments, radio and electronic components and telephone apparatus.

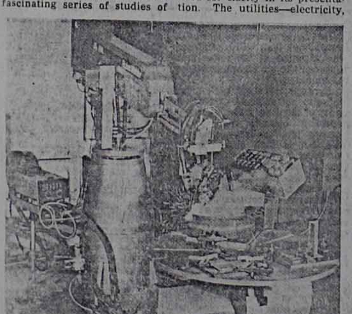
The relatively poor factory performance of these sectors is reflected in the way Britain's share of the world market has been falling, and in the way the value per ton—a crude measure of the technical sophistication of the product—has dropped below that of its imports. Failure to reverse this situation, says the study, would pose a serious and permanent threat to UK employment through the loss of Britain's competitive manufacturing ability. "The countries that now have the lowest levels of unemployment are those that have made the best use of available technology."



The technology considered by ACARD is not only the robot—the machine which, in this context, puts things together—but the joining techniques which will keep parts assembled. They include welding, brazing, soldering, adhesive bonding, fastening (bolts, rivets, spring fasteners, etc.) and stitching. The catalogue of possibilities is still expanding with the emergence from research of new techniques such as friction welding, "super-glues" and the use of lasers and electron beams.

Automatic assembly of mass-produced items such as motor-car sub-assemblies and the TV chassis has been a major goal of the production engineer for the past 20 years. Around 1960 the TV industry was beginning to use automatic machines to thread such electronic components as transistors and resistors into printed circuit panels, in preparation for automatic soldering of hundreds of joints simultaneously. A decade later one major British TV maker had abandoned his assembly machine and reverted to the idea of using rows of women again to thread the components by hand. His "robot" was simply too complicated. The slightest hiccup anywhere in a long sequence of workstations and the entire machine stopped assembling. It had no intelligence of its own and had to wait for a man to repair it. It spent more time stopped than assembling.

Today's robot tends to perform a single task, albeit often a complex one by the standards of the early machines. It costs about £30,000 — and a realistic view of charges for interest, depreciation, care and maintenance, etc., probably adds another £15,000 a year. Its counterpart at home is the washing machine or cooker which can be programmed to carry out a sequence of operations at predetermined temperatures, times, etc.—though without the robot's ability to sense, pick out, and place.



One of Britain's few ventures into robotics: an arc-welding robot being marketed by BOC Automated Welding Products from a base at Milton Keynes.

'Blind and not very clever'

Today's industrial robots are blind and not terribly clever. Manufacturers worldwide have bought far fewer than the robot-makers were forecasting in the early Seventies. But Britain, with almost none at work today, has no cause to congratulate itself, for it has accumulated none of the experience of tomorrow's approach to manufacture built up by other leading industrial nations. This experience will prove immensely valuable in introducing the new generation of robots now marching upon the factory gates.

Sir Henry Chilver, chairman of the ACARD working party which produced the report, said yesterday that robotics was potentially one of the world's biggest growth industries.

According to ACARD, some 6,000-7,000 first-generation industrial robots were at work worldwide last year. Half of them were working in Japan, one-quarter in the U.S., and one-quarter in Europe. Britain, however, could boast only 60-70 robots. The annual output of Britain's one manufacturer of industrial robots is derisory—fewer than 50 a year. The Department of Industry has commissioned a more detailed—and more technical—study of this disturbing situation from Ingersoll Engineers which is shortly to be published.

Still more to the point, however, the nations which are using robots today have national programmes which encourage their use and further development. Japan in the Sixties, acknowledging the lead the U.S. had built up in mainframe computers, set out to compete by developing robots. Currently it is engaged in a seven-year project, costing £25m, to demonstrate the principles of fully-automated manufacturing plant. One government-supported demonstration, at Kawasaki Heavy Industries, aims to assemble a small agricultural petrol engine almost entirely by robots. Another, at Toyota, includes robot welding of motor-cycle frames and axle housings.

West Germany has a Government-supported programme entitled "the humanisation of life at work." It aims to improve working conditions — for example, by keeping the worker away from hostile environments. The German Research Society also spends generously on engineering research, £20m a year, including the development of systems for factory automation. Sweden and Italy have also made much greater progress than Britain.

The U.S. Government is supporting manufacturing technology—including automated assembly—through the National Science Foundation. Its Automation Research Council has called for a joint government-industry programme on which $300m would be spent over seven years. It also has such powerful research centres in robotics as SRI International in California (formerly the Stanford Research Institute) and the Charles Stark Draper laboratory at MIT in Cambridge, responsible for some of the most advanced automation of the space programme.

Britain not only has no national programme on factory automation, it has almost no research and development on robots. Not even the Engineering Board of the Science Research Council, which has sponsored research into other neglected aspects of manufacture, has yet seen fit to support the development of the industrial robot. (This may be a legacy of the council's experience with the more controversial science of "artificial intelligence" in the early Seventies, when its investment bore little fruit.) University research relating to robots in Britain "contrasts starkly with that in West Germany," laments the ACARD report.

Yet for the production engineer, robotics offers the same kind of excitement and hope for the future as synthetic fuels and nuclear power in the energy sector, and supersonics and vertical take-off in aviation. What is more, ACARD believes that Britain has all the ingredients needed for a successful effort to exploit the coming of robots.

In welding technology it is second-to-none, with the Welding Institute and its [illegible] budget providing the bedrock. In adhesives technology it pioneered with the wartime production of the Mosquito bomber and has remained in the vanguard.

In the Sixties Mr. Theo Williamson, then technical director of Molins, attempted in the System 24 automated machine shop to implement what to this day is one of the most ambitious schemes for factory automation ever attempted anywhere. Other British technology highly relevant to robotics includes long experience of remote handling and repair techniques in the nuclear industry, involving major surgery deep inside reactors and other highly radio-active plant. In addition, Britain is skilled in "software" — programming. Cunningly-programmed microprocessors, together with miniature TV systems to provide the robots with vision, and other advanced sensors, will be the technological base of the new generation of robots of the Eighties.

The excitement of Concorde

ACARD is urging the Government to knit all this skill and experience into one programme, with the objective of revolutionising Britain's manufacturing methods. As a national objective, directed and managed by users—the leading manufacturing firms—such a venture could have all the excitement of a Concorde project and a far better chance of a national payoff.

We will know it has worked when we watch TV advertisements showing robots laughing at people who still try to assemble things by hand.

**Joining and assembly: the impact of robots and automation, pp 44, HMSO, £1.75.*