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Evaluating collaborative R&D programmes in information technology: the case of the U.K. Alvey programme

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ABSTRACT

Increasing attention is being paid to the evaluation of the economic and technological impact of large, government-sponsored, collaborative research and development (R&D) programmes in information technology. However, the practice of evaluation is still in its infancy and, as yet, there exist few guidelines as to how *to evaluate major information technology (IT) programmes with multiple objectives. This paper describes the evaluation of the U.K. Alvey programme, focusing on how the technological and economic impact of the programme on the U.K. economy is being evaluated. The various methods adopted to evaluate the programme are described and related to the multiplicity of goals contained within the Alvey programme. Also, a concrete example is provided of 'real-time' evaluation. It is argued that ongoing, or real-time, evaluation has a range of advantages over the conventional* ex-post *(after-the-event) evaluation, including the ability to feed back evaluation results to those responsible for directing the programme. Although IT programme evaluations will inevitably differ according to the aims, strategies, and rationale of each specific programme, by demonstrating the range of methods and techniques used to evaluate Alvey, the paper hopes to contribute to the general field of IT programme evaluation.*

INTRODUCTION

The 1980s have witnessed a proliferation of national and international, government sponsored, R&D (research and development) programmes in the area of information technology (hereafter IT programmes). Partly in reaction to the Japanese fifth generation project launched by MITI (the Japanese Ministry for Trade and Industry) in 1981, the U.S.A. and several European countries have set up government support programmes for IT.[1] Single-country initiatives include: the U.K. Alvey programme begun in 1983; the Finnish programme for

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R&D in IT (FINPRIT) begun in 1984; the German Informationstechnik programme implemented in 1984; the U.S. Sematech programme, approved in 1988. Within France La filière électronique, established in 1983, includes a collaborative R&D programme for IT. European Community programmes include ESPRIT (European strategic programme for R&D in IT), ESPRIT 2, and RACE (R&D in advanced communications for Europe)[2]. Increasingly, European countries view international collaboration in IT as a means of rationalizing industrial R&D activities, and countering competition from Japan and other Far Eastern economies such as Korea and Taiwan.[3]

Despite the enthusiasm for collaboration, strategies of government support for R&D in IT have yet to be proven as an effective means of improving research performance and promoting the competitiveness of IT, at the level of the firm, the sector, or the nation. Huge sums of investment have been allocated to support IT programmes but the economic results have, on the whole, yet to be seen.[4] Indeed, it is not inconceivable that these modern schemes of collaboration and government subsidy will fail to generate the improved industrial competitiveness expected of them, upon which most of these programmes are justified.[5]

Probably as a consequence of the strategic importance of IT programmes, and the large investments both from governments and industry, increasing attention is being paid to programme *evaluation*. One of the main promises of effective evaluation is to monitor the performance of such programmes and to demonstrate their economic and technological effectiveness. Nevertheless, as two recent studies of evaluation practices in the OECD show, as yet there exists a "lack of maturity" in the development of evaluation [1, p. 70] and "few systematic and objective evaluations of the effectiveness of innovation policies" [2, p. 2].[6]

Part of the difficulty in establishing a systematic framework for programme evaluation, particularly in the IT field, is that programmes differ considerably in terms of aims, scope, scale, cost, participant groups, and organizational structure. Also, most programmes in this area include a multiplicity of economic and technological objectives—they are not solely R&D programmes. Economic objectives towards trade, balance of payments in IT, domestic industrial performance, and so on, are frequently cited as the rationale for IT programmes. Also frequently included are aims towards academic research orientation, IT research 'community building', the orientation of academic and government R&D activities, and industrial exploitation of R&D.

Given the importance attached to R&D programmes in IT and the dearth of useful guidelines in this area, the purpose of this paper is to provide a case study of the aims and methods of the official evaluation of the U.K. Alvey programme for R&D in advanced IT.[7] This evaluation was set in motion in 1984 with a broad mandate, covering not only issues of bureaucratic and administrative efficiency but also the vital question of the economic and technological impact of the Alvey programme on U.K. firms and the U.K. economy as a whole. The evaluation is unusual in that it is conducted by outside organizations rather than the Alvey programme itself. It is also unusual in that the evaluation is carried out in 'real

time' (which means that it is conducted during the operation of the programme rather than after the programme has actually finished, as is often the case).

The present paper concentrates on the evaluation of the technological and economic impact of the Alvey programme on the U.K. economy carried out by the Science Policy Research Unit of the University of Sussex. Part 1 assesses the objectives and rationale of Alvey, arguing that a clear statement of programme aims and methods is crucial to effective evaluation. Part 2 analyses the notion of real-time evaluation, arguing that it has certain advantages over conventional *ex-ante* (beforehand) and *ex-post* (after the event) evaluations. Part 3 discusses the main aims and methods of the evaluation focusing on two related sets of questions: first, is Alvey an appropriate strategy for the U.K. (and does it remain so through time)? Second, is Alvey achieving its technological and economic goals? In order to relate evaluation methods to programme objectives, Part 3 presents a simple classification scheme for the main goals and sub-goals of Alvey and describes the variety of different methods being utilized to carry out the evaluation. For illustrative purposes, Part 4 offers one example of real-time evaluation in practice, analysing the impact of Alvey on the R&D activities of the academic sector in the U.K.

Throughout the paper reference is made to the various studies, completed and underway, which together will form the basis of the final evaluation of Alvey's economic and technological impact. Given the wide diversity of national and international IT programmes the present case study cannot, and does not, intend to provide a blueprint for evaluation which can be readily transplanted to other programmes. Nevertheless, the discussion does hope to provide useful practical examples of evaluation research methods and outputs in order to make a contribution to the emerging field of IT policy evaluation.

PART 1. THE RATIONALE, OBJECTIVES AND STRATEGY OF THE ALVEY PROGRAMME

In order to carry out an evaluation it is first necessary to establish the criteria against which the programme is to be judged. This involves a clear statement of the rationale, objectives and strategies adopted. In practice this task is often very difficult. Alvey, for instance, contained a wide range of objectives ranging from extremely broad economic aims, to detailed, highly specified technical aims.[8] In addition, large programmes can contain a large number of sub-objectives and utilize different strategies to achieve those sub-aims. Furthermore aims and strategies are not static but dynamic: to some extent they will change over time. Within reason, this is to be expected as external market and technological circumstances are constantly changing, and there will be an inevitable process of learning-by-doing as a programme proceeds. Nevertheless, despite these complexities, the first step in effective evaluation is a clear understanding of: (a) the rationale for the programme, (b) a statement of the initial aims and strategies of the programme, and (c) a record of any changes as the programme proceeds.

Turning first to Alvey's rationale, the initiation of the Alvey Programme has to be seen against the background of the U.K.'s deteriorating international economic performance in the electronics and IT industries. Throughout the 1970s and into the 1980s the U.K. had lost national and international market share to competitors. Declining competitive performance had led to consistent worsening of the balance of trade in IT products and services.[9] Japan, and the newly industrializing countries (NICs) of the Pacific Basin, had steadily increased their market shares of relatively simple electronic equipment such as consumer goods and office equipment. The U.S.A. continued to strengthen its own domination of large sectors of the computer and informatics industries. In response to competition from the U.S.A. and the NICs, Japan had taken measures to improve its innovative performance in the more sophisticated areas of IT such as computing and semiconductor technology. Also Japan's performance in telecommunications, an area of relative strength for the U.K., showed significant signs of improvement.[10]

The Japanese announcement of the fifth generation computing programme, for many, drove home the need for a concerted national U.K. response in advanced IT. High capacity, extremely fast, fifth generation computers based on parallel processing with friendly, intelligent software, could well lead to a new era of growth in electronics and IT in the future. Without the capabilities needed to absorb, develop and market the new technologies, countries such as the U.K. could well experience a further widening of the technology gap in IT, and a further deterioration of the IT trade balance. This prospect applies not only to the information-intensive industries (such as computing and telecommunications), but also to more 'traditional' industries (such as aerospace and automotive) which are increasingly utilizing IT to improve products, process technologies, and organizational efficiency to enhance productivity and competitiveness.

The U.K. Alvey programme can be viewed as a direct response to the Japanese fifth generation programme, and also as a response to the continuing relative international decline of the U.K. IT industry. Although Alvey had been preceded by various smaller IT schemes such as the microelectronics application project (MAP) and the microelectronics industry support scheme (MISP), in many respects Alvey represented a radical departure from previous U.K. policy in the IT area.[11] Indeed, Alvey probably represented the first large-scale, government coordinated, nationwide strategy for recovering the U.K.'s international position in IT. Unlike previous initiatives, Alvey could be seen as a national technology strategy for the U.K. In terms of organization, objectives, and strategy, Alvey has no historical counterpart in the U.K. The unusual nature of the programme naturally influenced the evaluation of the programme itself. Before discussing the evaluation it is therefore useful to briefly describe some of the novel features of the Alvey programme.

The overriding aim of the Alvey programme is to promote R&D in advanced IT, in order to assist U.K. industry to catch up with overseas competitors and ultimately to reverse the deteriorating national trend in IT balance of payments.

The objective of Alvey is to promote R&D in four areas of so-called 'enabling' technology.[12] These are the basic, generic, technologies which, it is believed, will underpin industrial innovation in IT in the future. Alvey is by far the largest U.K. IT programme, costing a total of £350m over a five-year period with funding shared by government and industry. There are three central features of the Alvey strategy: (1) the promotion of collaboration between firms and between firms and academic institutions, (2) government support for, and direction of, national R&D in IT, and (3) the concentration on pre-competitive stages of research, rather than support for production and marketing activities.

Collaboration occurs between government departments, academic institutions, government research institutes, and between firms applying for R&D support through Alvey. In order to qualify for support a firm must usually present a project jointly with one or more firms, as well as an academic institution, to a special directorate set up within the Department of Trade and Industry (DTI) charged with directing and administering the Programme. If a project is accepted Alvey provides one half of the funding while industry contributes the other half. In addition to full collaborative projects Alvey also sponsors so-called uncle projects. These are academic-only research projects which do not require a full industrial partner. Instead, an 'industrial uncle' is allocated to oversee the project and to ensure the research is relevant to Alvey's overall goals.

The rationale for coordinating research under the direction of Alvey is: first, to identify and strengthen existing technological resources within the economy; second, to enable U.K. research in advanced IT to be coordinated and directed at the national level; third, to promote and accelerate the transfer of technology between the academic institutions and firms collaborating in the projects. The funding and administrative system is designed to provide the directorate of the programme with a means of steering and coordinating a large proportion of national research in advanced IT. However, the responsibility of defining and proposing research projects is undertaken by those most qualified to do so in industry and academia, rather than government.

Together with the published, explicit, aims of Alvey there also exist implicit goals, and by-products of the programme, which although not necessarily highlighted in strategy documents, are important and require evaluation. For example, one implicit goal of Alvey is to promote longer-term technology strategies in the participating firms consistent with the national goals expressed in the Alvey strategy. By involving industry in the formulation of goals, and the execution of the projects themselves, it is hoped that the programme will introduce longer term strategic technological horizons to U.K. IT corporations.

As noted earlier, one of the prime strategic mechanisms of Alvey is collaboration. Alvey is the first U.K. government programme in IT which involves such extensive collaboration. Collaboration is built into the organization and functioning of Alvey at almost every level. Three government agencies, the MoD (Ministry of Defence), the DTI (Department of Trade and Industry), and the DES (Department of Education and Science) worked together with leading

industrialists in the formulation of individual programme aims. The MoD and DTI together provide the government funding for the research, while academic funding is administered jointly through the SERC (a part of the DES), and the Alvey administration. The cooperation of three U.K. government ministries in the programme demonstrated, for the first time, government recognition of the need for a national strategy for IT.

Most importantly, the individual projects and technology programmes involve collaboration. Collaboration is seen as the means to rationalize and accelerate the research activities of firms, universities, polytechnics and other R&D establishments operating in the U.K. By June 1987 the programme as a whole consisted of 311 interrelated projects, of which 198 were full industrial projects, and 113 academic only. On average there were 3.9 partners per project (usually 2 to 3 firms, and 1 to 2 academic institutions). Overall, there were approximately 2500 researchers working on Alvey projects in the U.K. at that time.[13] The rationale behind a large-scale collaboration of this type is to ensure that the benefits of the programme as a whole exceed the benefits of the sum of the individual projects. Again, this 'programme' concept is a new type of government initiative in the U.K. IT sector.

As well as collaboration between firms and universities at the level of project development, a wide variety of other means of collaboration are instituted within the programme. These include a range of formal 'clubs' centred around specific technology areas, together with individual technical progress meetings, and regular annual conferences reporting on progress to date and future planning. A programme of large scale demonstrators links up several of the major projects in order to demonstrate working prototypes resulting from Alvey research. Equally important is the development of informal networks of technical specialists and key individuals. This 'community building' among the IT research community is seen as an important mechanism for bringing about the effective development and transfer of technology. The performance of Alvey in creating a coherent IT research community in the U.K. through collaboration is itself an issue for evaluation.

At the outset Alvey identified and targeted four areas of enabling technology for development: (1) very large scale integration (VLSI); (2) software engineering (SE); (3) intelligent knowledge-based systems (IKBS); and (4) man–machine interface (MMI). Research into each of the four main technical areas is carried out within four major sub-programmes. Two further programmes were established to demonstrate prototype results (the programme of large-scale demonstrators), and to facilitate communications and technology transfer between the projects (the infrastructure and communications programme).

The four technology areas targeted by Alvey differ in their nature, their degree of maturity, and extent of industrial diffusion. As a result, the individual sub-programmes have established their own detailed sets of objectives and strategy plans.[14] In evaluating Alvey, close attention has to be payed both to the novel characteristics of the overall programme, and to the differing goals and strategies of the six individual sub-programmes.

PART 2. REAL-TIME EVALUATION

Like the Alvey programme itself, the evaluation of Alvey is also a radical departure from most programme evaluations carried out in the U.K. and overseas.[15] Most government evaluations are carried out internally according to a brief decided upon internally. In contrast, Alvey commissioned an independent evaluation to be carried out by outside groups from the academic sector in collaboration with each other. Initially, three groups were involved in the evaluation: the Centre for Business Strategy (CBS) of the London Business School, the Programme of Research on Engineering Science and Technology (PREST) of the University of Manchester, and the Science Policy Research Unit (SPRU) of the University of Sussex. During the course of the programme the number of groups involved was reduced to two, SPRU and PREST.[16] The evaluation is carried out according to a research strategy established by the evaluators, and agreed upon with the directorate of the programme.

A second unusual feature of the evaluation is that it is being carried out in 'real time' or 'on line'. Essentially, this means that the evaluation research is conducted *during* the running of the programme. Most research evaluations occur before a programme starts (*ex-ante* evaluation), and/or after a programme has finished (*ex-post* evaluation). *Ex-ante* evaluations are usually conducted to help select the projects and decide upon resource allocation, objectives, and programme strategy.[17] *Ex-post* evaluations are normally carried out to assess the results of a programme, and to gain some idea of 'value for money' or costs and benefits.[18]

In contrast, real-time evaluation is undertaken during the life cycle of the programme itself. The Alvey evaluation proceeds alongside the programme and is scheduled to end one year after Alvey has finished. There are three main reasons for considering real-time evaluation for large-scale, complex, long-term research programmes such as Alvey. First, real-time evaluation enables the collection of data and expert opinions that may not be available after a programme has finished. As Gibbons and Georghiou [1] point out, opinions tend to be "distorted by hindsight" with the passage of time. Expert views and various types of data gathered during a programme can then be used to generate the final, *ex-post* programme evaluation.

A second reason for considering real-time evaluation is that it allows the findings of the evaluation research to feed back to the directors charged with running a programme. In this sense, real-time evaluation is not 'neutral' with respect to the programme. If recommendations for change are made by the evaluators, and acted upon by programme directors, then the evaluation activity to some extent plays a role in the performance and direction of the programme itself. It would be very difficult to envisage an on-line evaluation which did not take positions on particular aspects of a major programme, and did not attempt to improve the performance of the programme it is involved with. Findings and recommendations can also be channelled to other individuals and organizations planning other research programmes during the life cycle of the programme

under review. On the whole, these types of interactive activities could not be carried out with an *ex-post* evaluation carried out after a programme has finished.

A third advantage stemming from real-time evaluation is that it permits the *active* generation of data that are relevant to the evaluation needs throughout the duration of a programme. It also permits information to be gathered at the most appropriate points during the various stages of a programme. This active and 'targeted' type of evaluation can investigate issues in depth, with the participation of those most closely involved in the many projects and activities which constitute the programme.

For a wide-ranging, independent, evaluation such as the one commissioned by Alvey this final point is critical. Real-time evaluation allows data to be obtained through methods such as questionnaires and structured interviews, which probably would not be feasible after a programme has finished. In turn, this permits the evaluators to plan an overall research strategy, and to focus attention on issues of most relevance to specific phases of the programme life cycle. For instance, in the early stages, the Alvey programme was heavily involved in project selection, forward planning, and setting up the machinery to administer and finance a large number of complex, collaborative projects. As the programme progressed activities naturally shifted to the issues of technological progress, the transfer of technology from academia to industry, and the industrial exploitation of research results. In the latter stages of the programme, and beyond, the emphasis of the evaluation will shift to measurement of the technological and economic outputs of the programme.

From a programme's point of view, one of the possible disadvantages of opting for real-time evaluation is that it may cost more than a short, *ex-post* evaluation. This is because evaluators have to be involved to a varying degree throughout the life cycle of the programme. A second possible disadvantage is that in taking positions on various issues and feeding back recommendations to a directorate, the evaluation group or groups may tend to lose 'objectivity', and become too closely involved with a programme to maintain a clear and impartial view. In addition, there may be subtle 'pressures' placed on evaluators by various interest groups within a large programme, to support a particular action or perspective. To some extent this is always a potential problem if professional outside evaluators are hired in. However, it is possibly less of a problem then if a programme is evaluated internally, as is usually the case. One of the tasks of professional evaluators is to recognize these potential problems and minimize them.

Despite the possible drawbacks of real-time evaluation, for large complex programmes it may well be that the benefits, in terms of access to data and expert opinions, analytical depth, the ability to feed back findings and recommendations through the course of the programme, outweigh the costs. To be aware of the potential pitfalls also goes some way to avoiding them.

Real-time evaluation allows the evaluators to plan an overall research strategy which targets problems, issues, and outputs as they arise during a programme's

cycle, as well as to prepare and set in motion studies to meet future needs. In principle, this also facilitates the generation of information when it is most readily accessible—i.e. when particular activities are being carried out. This information, in turn, can be used to provide a sound basis for the final *ex-post* evaluation. In fact, real-time study is probably a necessary condition to conduct a wide-ranging and intensive evaluation, such as the one commissioned by Alvey.

PART 3. THE AIMS AND METHODS OF THE EVALUATION

The two groups involved in the evaluation of Alvey, PREST and SPRU, undertake two distinct, but interrelated, research tasks. PREST is concerned with examining the structure and organization of the programme. The main concern of PREST is to evaluate managerial structure, organizational efficiency and other important issues of programme effectiveness such as the speed of processing proposals and methods of achieving intellectual property right (IPR) agreements.[19] As noted earlier, the task of SPRU is to assess the overall technological and economic impact of the Programme on the U.K. economy. The following focuses on SPRU's component of the evaluation.

SPRU is attempting to answer two sets of questions concerning the economic and technological impact of the programme. First, was Alvey the 'right' strategy for the U.K. economy? This raises the question of the *strategic appropriateness* of Alvey in the U.K. and international context. Second, is Alvey meeting its economic and technological objectives? These two sets of questions have helped define the detailed evaluation strategy which is presented in the SPRU evaluation workplan.[20] To give some idea of the various methods adopted, it is helpful to look at the analytical issues raised by the two questions, and to point to some of the evaluation activities and reports produced by SPRU.

3.1. Is Alvey an appropriate strategy?

I will turn first to the question of whether Alvey is an appropriate strategy for the U.K. This question cannot be examined in isolation, but has to be addressed within the context of the national and international economic and technological environment within which Alvey is situated. Also, given the rate of technological advance the question of whether Alvey *continues* to be the right strategy through time has to be continually addressed.

There are three main aspects of the international context which are of particular relevance to the strategic appropriateness of Alvey; first, similar government-support programmes in other countries; second, international technological trends in Alvey-related areas; third, the strategies of international firms in each technology area. The types of questions which SPRU is attempting to answer in this component of the evaluation are: has Alvey struck the right balance between the different technological areas? Did Alvey adopt a viable

strategy for ensuring technological development? Did Alvey set realistic but challenging technological goals in the various technical areas? Were sufficient funds set aside to achieve the goals set? (and so on). In evaluating the appropriateness of Alvey, evidence is gathered on the activities and performance of similar programmes abroad, as well as the behaviour of major corporations with respect to advanced IT.

On the issue of how other governments have approached the problem of policy making in advanced IT, it is clear that strategies adopted by other countries cannot be transported wholesale to the U.K. Nevertheless, there are important 'lessons' to be learned from the successes and failures of other national programmes. Various studies have been produced by SPRU on the theme of international policy comparison, including three reports and a book that review government policies in IT and attempt to distill the institutional, cultural, technological, and economic factors that have produced successful national strategies in other countries.[21] At this level of analysis the principal means of evaluation is therefore comparison.

The question of 'appropriateness' should also be seen within the *national* economic and government policy context. What is appropriate for the U.K. must take into account the existing policy-making mechanisms within government, as well as the technological and economic capabilities of the firms and academic institutions involved. On this issue SPRU has begun to examine the recent history of government policy making in IT, comparing the experiences of policy making across the major government departments—the MoD, the DTI, and the telecommunications administration, British Telecom (formerly the British Post Office).[22] The principal means of evaluation is again comparison, allied to historical analysis.

As noted above, the *continuing* economic and technological appropriateness of the Alvey strategy also comes within SPRU's remit. By analysing international market and technological trends in Alvey technology areas it is possible to gain a broad appreciation of whether events have overtaken the original strategy. For instance, the Alvey sub-programme closest to the market is the VLSI programme which includes a strong element of technology development. Here, SPRU has begun an analysis of technological and market trends both in the U.K. and internationally.[23] By examining the technological direction of the market and the strategies of the leading international firms it is possible to gain a broad appreciation of: (a) whether the aims of the VLSI programme continue to be appropriate; (b) whether the strategy adopted is best equipped to meet the objectives; and (c) which major technological changes impinge on the ability of the programme to achieve its long-term objectives. During the course of the evaluation, SPRU intends to conduct similar studies for the other technological areas of the programme.

Many other factors impinge on the issue of the appropriateness through time of a major innovative programme such as Alvey. Fundamental questions are raised. These include: is collaboration in R&D a viable strategy to promote competitiveness? Are Alvey's national goals consistent with the U.K.'s European objectives?

Is firm subsidization consistent with increasing industrial dynamism and competitiveness? Can military aims in IT be reconciled with civilian objectives? The priorities of the evaluation, and the depth in which these issues can be tackled, are determined by the resources available to the evaluation, and other research that can be drawn upon to complement the evaluation.[24] Not every issue can be tackled in depth, and broad agreement on priorities has to be established with the directorate of the programme and built into the evaluation workplan and timetable. SPRU's research into the appropriateness of the Alvey strategy must also be balanced against the other main SPRU question: is Alvey meeting its goals?

3.2. Is Alvey meeting its goals?

The second major task of the evaluation is to devise methods to assess whether, and to what extent, the goals and sub-goals of Alvey are being met. In contrast to the first area of SPRU's evaluation, this research task does not question whether the goals were correct or appropriate, but focuses entirely on evaluating the performance of Alvey in meeting its internal targets.

As a programme directed mainly at pre-competitive research, the impact of Alvey is likely to be most strongly felt at the following stages and 'locations': (1) universities and other institutions involved in basic research (especially where Alvey funding represents a large proportion of total IT research being conducted); (2) at the interface between academia and industry where new collaboration has begun; (3) prototype development of Alvey technologies (mainly by firms); (4) early indications of technological outputs such as citations and patents; (5) changes in firms' technological investment strategies; and (6) economic impacts at firm, sectoral, and national levels[25].

One of the advantages of real-time evaluation is the ability to target evaluation study at the most opportune phase of a programme's operational cycle. SPRU's evaluation group has therefore set in motion studies to monitor and assess these various expected effects of Alvey, more or less in line with the programme's actual impact in real time. For instance, Alvey's impact on academic research, and the contribution of university research to Alvey's aims, was the subject of four in-depth evaluation studies that investigated and compared the effects of Alvey across the four main technical areas during 1986 and 1987 (see Part 4 below for an illustration). Over the period 1987 and 1988, Alvey's impact on individual firms' research behaviour, business strategies and exploitation of Alvey innovations is the subject of further in depth analysis. After this research more detailed investigation is planned into the overall economic impact of Alvey at the firm and national level, utilizing various indicator schemes which were established at earlier stages of the programme.

However, before it is possible to analyse whether Alvey's goals are being met, it is first necessary to establish exactly what the goals of the programme were. A detailed analysis by Guy published in 1985 [3] shows that the Alvey programme contains a multiplicity of goals that can be classified under four major headings:

economic, technological, structural, and military. To provide an overview of the evaluation's methodologies, it is helpful briefly to describe these objectives, and how the evaluation is attempting to assess progress towards them.

3.2.1. Economic objectives

Alvey has prescribed various macro-economic objectives relating to IT trade performance and competitiveness of the U.K. economy. As discussed earlier, these objectives include improving the U.K.'s economic position with respect to other countries, increasing exports, and reducing the balance of trade deficit in IT. Micro-economic objectives are also expressed, relating to industrial development and performance, and improving the competitiveness of firms within the U.K. IT sector. To investigate the initial impact of Alvey on U.K. firms a preliminary report has been produced by Guy [4]. By means of structured interviews with a representative sample of U.K. electronics firms, Guy explores the impact thus far of Alvey on 'strategic thinking' at the managing director/research director level of U.K. firms. This initial study explores the importance of Alvey's influence within the wider range of external factors that impinge upon firms' behaviour. It also provides a 'statement of intent' from firms' directors with respect to exploitation of Alvey research. This particular study is being followed by a more detailed investigation of Alvey's impact on the research activities of individual firms, and the progress of firms in meeting Alvey's research objectives and exploiting R&D innovations (underway at the time of writing).

To complement these on-line studies, data are being gathered on firms participating in Alvey in order to be able more clearly to identify significant changes in behaviour that can reasonably be ascribed to the Alvey programme. The types of information currently being assessed include historical data on investment, military/civil orientation, patterns of joint ventures, behaviour in response to market opportunities in IT, and previous participation in government programmes. While it is extremely difficult to ascribe behaviour to particular events, the building up of historical information on companies participating in the programme plays a vital part in analysing the current and future impact of Alvey.

It is intended that these studies shall present a coherent picture of current R&D practices at the firm level in IT, the organization of R&D and its exploitation, and the influence of Alvey on the organization and exploitation of IT R&D by U.K. firms. Evidence is also being collected on investment and marketing activities with respect to Alvey technologies in order to track the extent to which research is commercially exploited by firms. By tracking Alvey technologies through in this detailed manner, the final stage of the evaluation hopes to be able to provide an assessment of Alvey's effect on production investment and output, exports, and other economic indicators of performance[26].

3.2.2. Technological goals

Alvey's technological goals are complex, and differ according to the particular sub-programme in each technical area (see ref. 3, pp. 9–13). Alvey's overall

objective was to strengthen the U.K.'s innovative capability in key strategic areas of enabling technology. In technical areas identified as close to the market (e.g. VLSI) specific prototype and product-development aims were also specified. In order to assess Alvey's technological impact, SPRU is planning to assess changes in trends in firms' patent behaviour as a result of Alvey, and to monitor Alvey related product outputs throughout the course of the programme.

In general, one would expect to see the technological results of the programme occur before the economic results, especially in the more basic areas of research. Furthermore, it is natural to expect that the impact of Alvey will be felt, initially, most strongly at the level of university and other academic research. This is the case for two reasons: (1) the proportion funded by Alvey of research and development in IT is far higher for academic institutions than for industry; and (2) in the technological and industrial 'chain of events' it is likely that Alvey's impact will first be felt most strongly in the areas of basic research and the interface between academic R&D and industry.

In real-time evaluation it is possible to focus direct attention on the achievement of goals at early stages during a programme. For example, one of the stated aims of Alvey is to promote and accelerate university IT research, and to increase the transfer of technology from academic institutions to firms. A study by SPRU on the role of academic institutions in the Alvey VLSI sub-programme is described below (see ref. 5). Investigation by structured interviews and questionnaires targeted at the experts carrying out the research is also being conducted in the SE, IKBS, and MMI areas.

Some of the research in the technological area involves developing new methodologies to try and measure technological progress. This includes attempting to establish *indicators* of technological and economic output, in order to measure these against the inputs to the programme. By its very nature this task is imprecise and extremely complex, and much of the initial effort has concentrated on methodological studies, designed to assess the value of existing techno-metric methods for the Alvey evaluation, and to try and build new methods where feasible.

One such methodological study involved investigating the use of patents to assess the performance of the U.K. electronics industry [6]. By assessing the patent trends in U.K. electronics firms it may be possible to see what impact, if any, Alvey has had. Another draft report explored the possibility of using the concept of technological families, and technological leads and lags, in the VLSI area; this study attempted to provide a methodology for tracking the technological progress of firms in Alvey against their stated targets, over the course of the programme [7]. Other indicators of financial and manpower inputs, as well as technological, bibliometric and other output indicators are described by Guy [8].

3.2.3. Structural change and military objectives

In addition to the economic and technological aims of Alvey, other objectives, often implicit, are embodied in the programme. Some of these relate directly to

military/defence requirements. The MoD (Ministry of Defence) is a major partner in the funding of the Alvey programme, and some of the technologies developed under Alvey follow on from previous MoD programmes. Part of the long-term evaluation aim is to assess to what extent military requirements are involved in shaping the programme, and whether these requirements are compatible with the civilian aims of Alvey.

Indirect aims related to defence technology are also recognized in the programme. For instance, Alvey hopes to encourage the use of defence technology for civilian purposes, and wishes to steer U.K. firms into commercial markets as far as possible. Often these types of aims are implicit and general. However, SPRU's part of the evaluation intends to analyse in detail the impact of Alvey in the military/commercial interface, at the level of technology, market, and firm behaviour.

This goal of encouraging U.K. firms to develop greater technological capacity in civilian areas can be considered a structural goal of Alvey—i.e. an attempt to alter the existing structure of the U.K. IT industry. Other structural goals which are the subject of SPRU evaluation include: (1) Alvey's attempt to build a community among IT researchers and industrialists; (2) Alvey's role in promoting U.K. firms' participation in European IT ventures; (3) Alvey's performance in increasing the supply of trained personnel in the IT field; and (4) the implications of re-orienting academic research towards the needs of U.K. industry. These types of structural goals are being addressed within longer term 'thematic' research into Alvey's impact on the U.K. economy.

PART 4. AN EXAMPLE OF REAL-TIME EVALUATION: ACADEMIC INSTITUTIONS IN THE ALVEY VLSI PROGRAMME

The purpose of this final section is to provide one specific example of real-time evaluation to help 'make concrete' some of the foregoing discussion on methodology. One of the early tasks of the evaluation was to examine the impact of Alvey on the IT research activities of the academic sector in the U.K. During 1986 and 1987, four studies were carried out covering the main Alvey technology areas, VLSI, SE, IKBS and MMI.[27] What follows is a sample of the main results from one of the studies, the VLSI programme.

The aim of the VLSI academic study was twofold: first, to gain an appreciation of the initial impact of Alvey on academic institutions in the VLSI area; second, to examine the contribution of the academic community to the VLSI programme objectives. In addition, the opportunity was taken to canvass academic opinion on the progress of collaboration under Alvey, on the programme's overall structure and goals, and on several other issues of interest.

The study was carried out by means of a detailed questionnaire which was sent to all academic research workers involved in the programme. In effect, the questionnaire amounted to a 'census' rather than a sample survey, as the whole population received questionnaires and the majority (78%) replied. In order to

develop and pilot a detailed questionnaire, and to address issues of importance both to Alvey and to the academic community, a series of in-depth, structured, interviews were carried out with a representative sample of academic research scientists, a sample of industrial collaborators on specific projects, and other important, associated organizations such as the Science and Engineering Research Council and the Alvey Directorate.

The questionnaire was designed to gather factual information, as well as behavioural and attitudinal data, on a wide range of issues. For the VLSI sub-programme, questionnaire sets were circulated in June 1986 to 73 academic departments covering a total of 104 'project entries'.[28] The questionnaire covered 31 U.K. universities, polytechnics and research establishments. Seventy-eight percent of the project entries responded to the questionnaire. Of those not replying, there was no systematic bias identifiable; given the high level of response, the results can therefore be taken as representative of the VLSI academic community as a whole.

Figure 1 presents replies to questions concerning the effect of Alvey on the

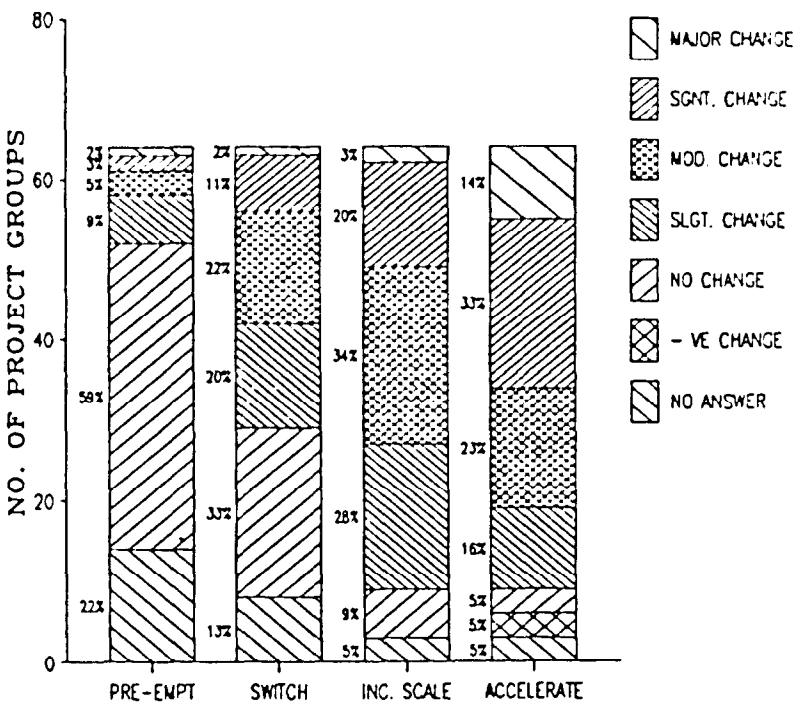

Fig. 1. Influence of Alvey on dept. R&D. Changes in the scale, pace and direction of R&D. Key: Pre-empt, Alvey has pre-empted work on other R&D; Switch, Alvey has caused departments to switch into major new R&D areas; Inc. Scale, Alvey has increased the scale of R&D carried out; Accelerate, Alvey has accelerated existing R&D activities.

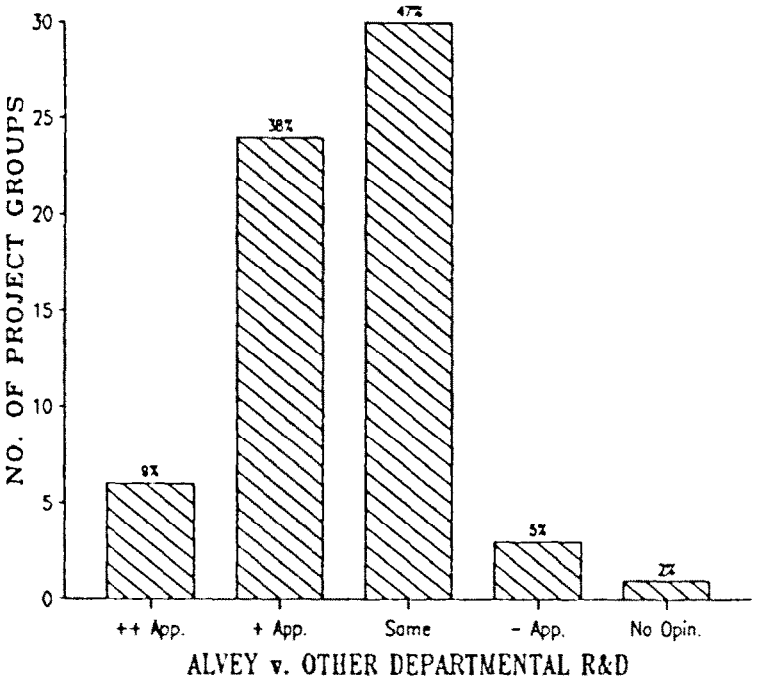

Fig. 2. Influence of Alvey on dept. R&D. The shift to more applied R&D. Key: ++App., much more applied; +App., more applied; Same, same; −App., less applied; No Opin. no opinion.

R&D activities of the academic groups involved in VLSI research. The most significant impact reported was an *acceleration* of existing research activities. Seventy-nine per cent of academic groups reported a 'moderate to major' acceleration of R&D activities. The second major effect of Alvey was to increase the *scale* of R&D carried out by the academic community, with 57% of academic groups experiencing a 'moderate to major' increase in the scale of their R&D activities. When asked if Alvey had caused departments to *switch* to major new areas of research, some 35% thought that Alvey had produced an effect of this kind. In contrast, only 10% indicated that Alvey had *pre-empted* work on other R&D projects to a 'moderate to major' extent.

The results shown in Fig. 2 complement those from Fig. 1: they seek to ascertain whether Alvey research was more applied or less applied than the majority of work carried out within the academic departments of Alvey researchers. Nearly half (47%) of the groups reported that the work carried out under Alvey was more applied (38%), or much more applied (9%) than the majority of departmental research. Only 5% indicated that Alvey research was less applied than other departmental work.

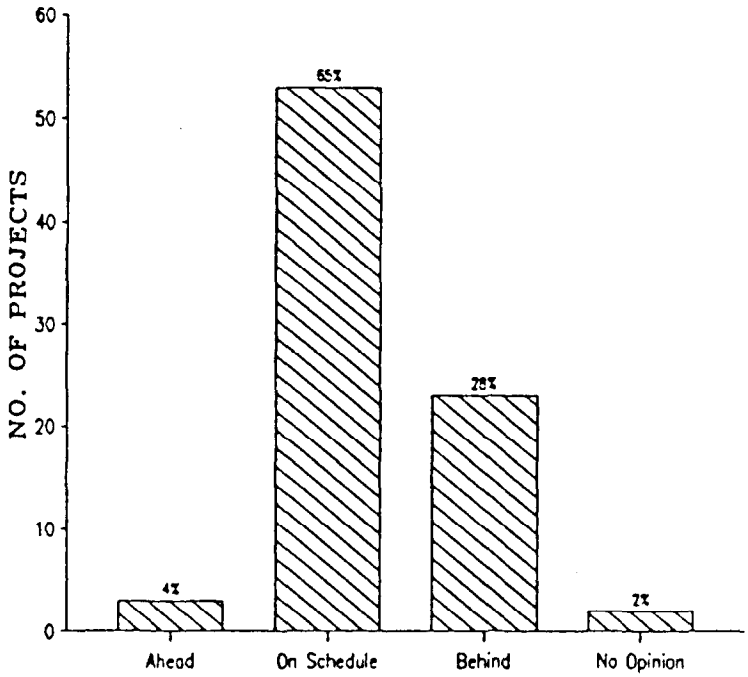

Fig. 3. Status of Alvey research. Alvey project progress.

Taken together, the responses to these two sets of questions indicate that Alvey has accelerated and expanded VLSI research in the U.K. In line with the stated aims of Alvey, research had also been steered into more-applied areas. The results also indicated that more-applied research has not been at the expense of basic research, as only a tiny proportion of such research had been pre-empted. By expanding the overall base of research, Alvey had brought about a shift to applied research whilst allowing basic research to continue.

Figure 3 shows the progress of research projects. At the time of the study (1986), the majority (65%) were on schedule, and a small number (4%) ahead of schedule. However, an appreciable number (28%) were reported as being behind schedule. To identify the sources and scales of the problems, a series of questions asked researchers facing problems to rank the obstacles that they had encountered to research. Figure 4 shows that the most serious problem facing project teams was the shortage of human resources (HUM). Here, 90% of the groups identified human resources as a 'moderate to major' problem. The second major problem identified was the Alvey/SERC administration of the projects (ALV). Here, 81% of the projects facing obstacles, experienced 'moderate to major' problems. Other problems such as capital resource shortages (CAP), intrinsic technological difficulties (TEC), collaboration (COL) and internal administration

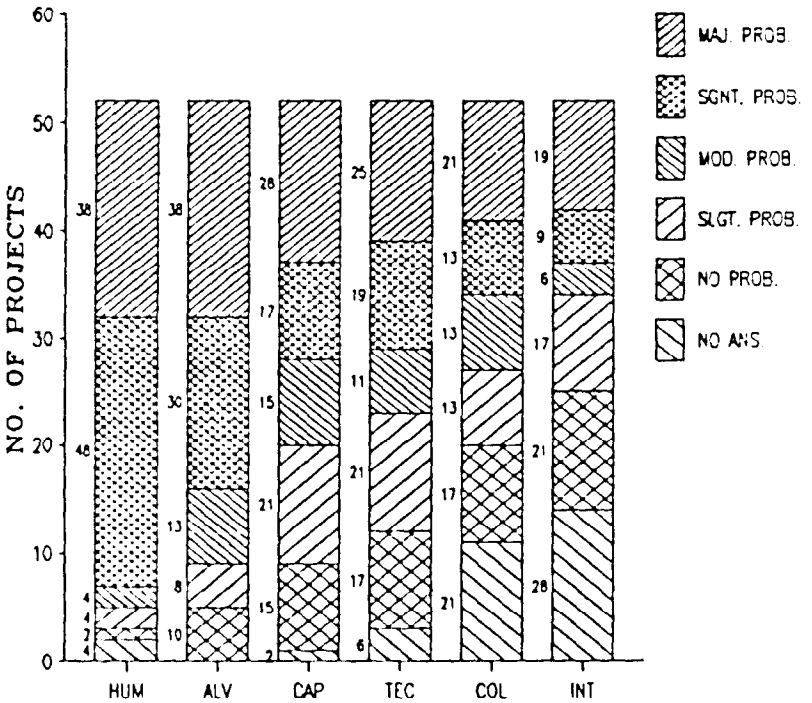

Fig. 4. Status of Alvey research. Source and scale of obstacles to research. Key: HUM, human resource shortages; ALV, Alvey/SERC administration; CAP, capital resource shortages; TEC, technological obstacles; COL, collaboration difficulties; INT, internal administration.

of projects (INT) were ranked progressively less important compared with human resource shortages and the Alvey/SERC administration of the programme.

The results from Fig. 4 emphasize the serious shortage of skilled people in the VLSI research area in the U.K. In addition, they point to major difficulties faced in the administration of the programme. In-depth interviews revealed that one of the main administrative problems was the sheer logistics of processing and assessing large numbers of project applications at the outset of the programme. By identifying such problems, and feeding the findings back into the directorate, real-time evaluation is potentially capable of influencing directors' decisions with respect to such problems, and able to provide advice and information for new IT programmes to help avoid such difficulties. Of course, some problems (such as human resource shortages) are not easily solved. However, problems such as administration could potentially be lessened by an appropriately organized administrative structure, with sufficient resources, established at the outset of the programme.

One of Alvey's main purposes was to increase collaboration between firms and

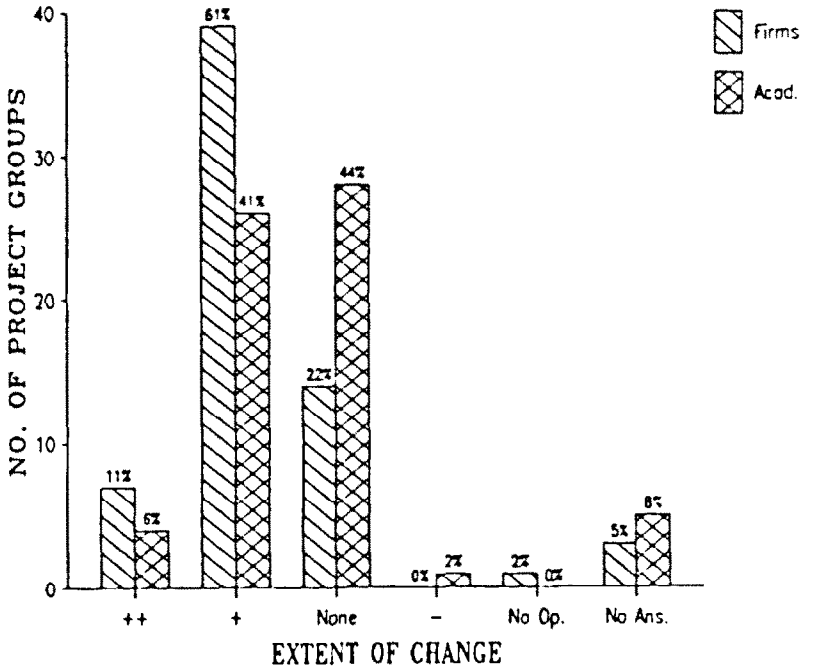

Fig. 5. Collaboration. Post-Alvey increase in collaboration with firms and Academe. Key: ++, large increase; +, moderate increase; None, not at all; −, moderate decrease; No Op., no opinion; No Ans., no answer.

academic institutions. Figure 5 shows the extent to which Alvey increased collaboration between academia and industry. Seventy-two percent of academic groups reported a 'moderate to large' increase in collaboration with firms, while 47% reported a 'moderate to large' increase in collaboration with other universities. Figure 6 shows that the overwhelming majority of academic groups found collaboration with firms and universities 'moderately to very beneficial' to their own research activities. Ninety-four percent found collaboration with firms beneficial, and 82% found collaboration with other academic groups of benefit to their own research activities.

The results from Figs. 5 and 6 show that despite the problems encountered, collaboration had increased broadly in line with Alvey's aims. The results also illustrate that academics have a positive approach towards industrial collaboration, and suggest that the academic community welcomed the increase in collaboration brought about by Alvey.

Finally, Fig. 7 examines academic opinions on the goals of the VLSI programme. Here, 55% agreed that Alvey's goals were sufficient to *accelerate* VLSI developments in the U.K., against 14% who thought they were not.

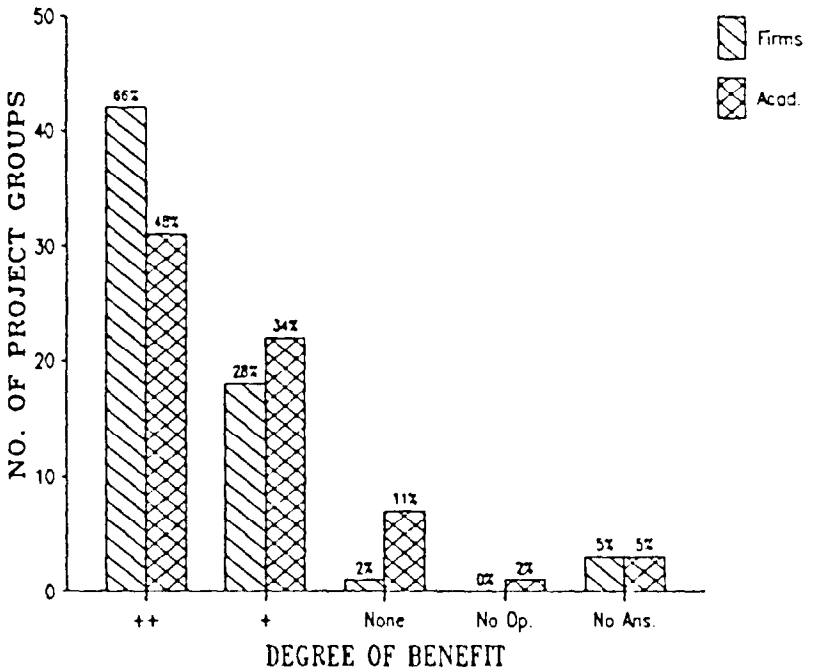

Fig. 6. Collaboration. How beneficial is collaboration with firms and academe? Key: ++, very beneficial; +, moderately beneficial; None, of little or no benefit; No Op., no opinion; No Ans., no answer.

However, 58% considered the technological objectives of Alvey insufficient to allow the U.K. to *catch-up* with VLSI developments elsewhere, and only 22% thought the programme's goals would be achieved during the lifetime of Alvey. Results from other questions showed that the main reason for the pessimism surrounding Alvey's ability to catch-up with overseas competitors was due to the scale of the current programme. Many researchers thought that the scale of Alvey was too small to achieve its research objectives in VLSI and that a larger follow-on programme would be needed to continue the work of Alvey.

One of the main limitations of the research method used, as illustrated here (structured interview and questionnaire techniques), is that non-factual questions can be subject to bias (particularly when future funding may depend on a 'favourable' presentation of results). This is always the case in such studies, but a range of techniques can be used to identify where bias may exist, and to minimize the natural bias in responses to questions. One mechanism, utilized in the above example, is to canvass opinions from outside the target population, especially from potentially hostile groups (for example, those who have failed to gain funding from a project, or members of potentially antagonistic groups such

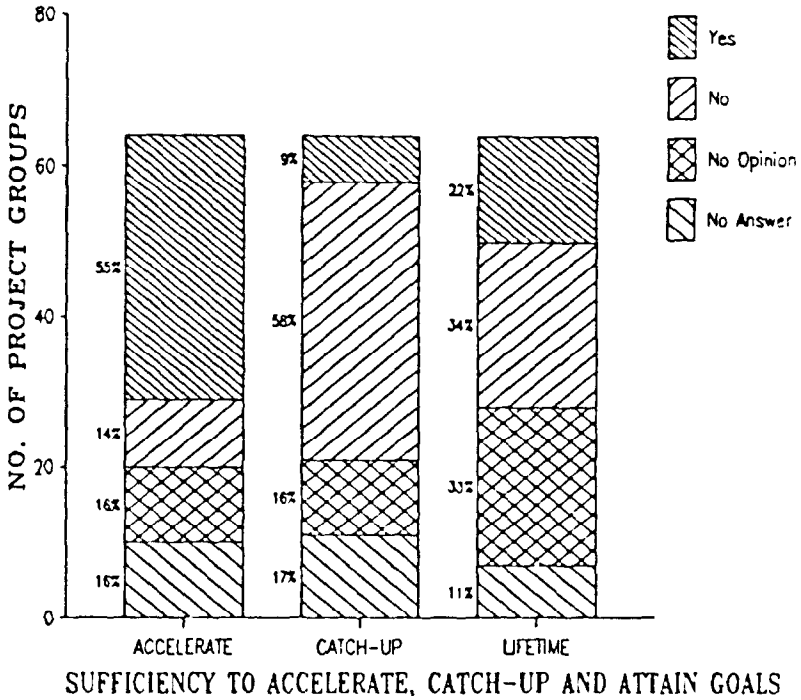

Fig. 7. Opinions on the Alvey VLSI programme. Sufficiency of programme goals. Key: ACCELERATE, sufficient to accelerate U.K. VLSI developments; CATCH-UP, Sufficient to allow the U.K. to catch up; LIFETIME, attainable within the lifetime of the programme.

as industrialists involved in joint academic/industry projects). A second technique is to compare results across sub-programmes, and neutralize bias by producing relative results across sub-programme areas[29]. Also, it is often possible to place special questions within a questionnaire to cross-check particular answers where subjective bias is likely. In most instances, though, bias is unlikely because of the nature of the questions. Usually, awareness of the bias problem can enable an evaluation to take account of it where it may exist.

To sum up, this sample of results from one of the studies conducted within the evaluation illustrates the type of results which can be fed back to the directorate of a large programme. In certain cases action can be taken to remedy problems. In other cases it may be too late to resolve problems within the current programme. However, in most cases a careful and quantified assessment can help inform decision makers in the future, and provide the feedback information to enable future activities to 'learn' systematically from past ones.

CONCLUSION

One of the major innovative features of the U.K. Alvey programme is the extent to which the programme has submitted itself to outside evaluation. Unlike most programme evaluations conducted in the U.K. and abroad, the evaluation of Alvey is conducted in real time by groups independent of the programme itself. This paper has described some aspects of the Science Policy Research Unit's component of the evaluation, focusing on the economic and technological impact of Alvey on the U.K. economy.

Although it is not possible to generalize from one IT programme evaluation to another, given the many differences between programmes, there are certain issues of general importance that arise from this case study of Alvey's evaluation. In order to evaluate large, complex programmes such as Alvey a wide range of methodologies and techniques is required. There is no *single* evaluation methodology which can be utilized for programme evaluation. In addition, a particular set of evaluation methods suitable for one programme cannot readily be transported to another programme. Evaluation methods are inevitably determined by a range of factors, some of which are specific to individual programmes. These factors include the aims and sub-goals of the programme, the strategies for achieving programme goals, the range of data available, the types of data which can realistically be generated, the specific mandate of the evaluation itself, and the resources allocated to the evaluation.

In order to provide a systematic evaluation of the economic and technological impact of Alvey, a wide range of methods is utilized including questionnaire surveys, structured interviews, patent and bibliometric analysis, case studies, historical analysis, and international comparisons. Although evaluation 'models' cannot be readily transplanted, once the overall aim of an evaluation is agreed upon in relation to a programme, then it is feasible to decide systematically which evaluation methods are most appropriate and most likely to deliver the necessary evaluation results. In all cases, this process will require a clear and unequivocal analysis of the programme's rationale, objectives, and strategies.

The evaluation described here was not concerned with initial decisions over objectives, resource allocation, and establishing an appropriate programme structure (*ex-ante* evaluation). The nature of the evaluation was an ongoing, or real-time evaluation, concerned with assessing the impact of the programme. It was argued that this type of evaluation has a range of very significant potential benefits over the more usual *ex-post* evaluations conducted after a programme has finished. Real-time evaluation, conducted during the lifetime of a programme, can permit the gathering of important factual information and opinions at appropriate stages of the programme cycle, and allow these data to be fed back to, and used by, programme directors. An example of this type of evaluation feedback was provided for the case of Alvey's impact on academic VLSI (very large scale integration) research in the U.K. A conventional *ex-post* evaluation would probably have found it impossible either to generate the necessary data to

evaluate impact in depth, or to feed back information to assist in executive decision making.

In addition to feeding back results, real-time evaluation enables the active generation of data and the in-depth research required to build up a portfolio of studies from which the bulk of the final *ex-post* programme evaluation can be drawn. In the case of Alvey the evaluation is scheduled to continue for one year after the programme has officially ended. This is to enable existing on-line studies to be completed and the final evaluation report to be constructed from all the evaluation research then available.

In the medium term it is more than likely that national and international IT programmes will continue as a major feature of innovation policy in Europe and elsewhere. Given the large investments in these programmes it is also realistic to expect that increasing attention will be focused on evaluating the economic and technological results of such programmes. Hopefully, the present case study will provide some useful insights into the practice of real-time programme evaluation.

NOTES

[1] An earlier MITI initiative (the VLSI programme, 1976 to 1979) is also partly credited for Japanese firms' subsequent success in the international semiconductor industry. See Sigurdson [9] for an analysis.

[2] The financial scale of many of these programmes is very large. For example, the Japanese fifth generation project has a total budget of $426m over a ten-year period. ESPRIT, began in 1983 with a budget of approximately ECU (European currency units) 1.5 billions, equivalent to roughly $1.25bn, over the duration of the programme. The U.S. Sematech programme, focusing on advanced semiconductor technology, has an annual budget of roughly $250m, and could spend in the region of $1.5bn overall. Within France, La filière électronique includes a collaborative R&D programme for IT with funding of approximately $5bn over a five-year period. The Eureka programme put forward by France covers 18 European countries and also includes a substantial element of R&D in IT. The European telecommunications programme, RACE, has a budget of approximately ECU 350m over the period 1985 to 1996. In most of the IT programmes, funding is shared roughly equally between government and industry [10–12].

[3] In 1975 the European Community had a trade surplus in IT products. By 1980 this surplus had been transformed to a deficit of roughly $5bn. By 1982 the deficit had doubled to $10bn, and showed no sign of improving [11, p. 112]. Europe and the U.S.A. have been losing competitive ground across many of the IT industries, most notably in electronic consumer goods, office automation, and semiconductors; other sectors under concerted attack by Japanese and Far Eastern producers include telecommunications, computers and factory automation technology.

[4] This is not surprising at this relatively early stage when many of the R&D innovations have yet to be fully exploited and commercialized by industry. Interim reports on ESPRIT's and Alvey's performance are provided by ESPRIT [13] and Georghiou et al. [14].

[5] Some of the general problems of collaboration in IT are discussed by Langlois [11,

chapter 7]. Hobday [15] discusses the rationale for, and possible problems with, the U.S. Sematech programme.

[6] Both of these reports are critical of the current 'state-of-art' of evaluation and include reviews of IT and non-IT evaluation efforts.

[7] Three academic groups were initially contracted to evaluate the Alvey programme: the CBS (Centre for Business Strategy) of the London Business School, PREST (Programme of Research in Engineering Science and Technology) of the University of Manchester, and SPRU (Science Policy Research Unit) of the University of Sussex. The present author is a member of the SPRU team.

[8] The broad aims are contained in the initial report of the Alvey Committee (Department of Industry, [16]) and subsequent strategy documents covering all the technical areas.

[9] Evidence of the U.K.'s general position in IT is provided by NEDO [17]. For an in depth assessment of the U.K. software industry see also ACARD [18].

[10] The steady advance of the Japanese in digital telecommunications technology is illustrated by Arthur D. Little [19] and Dang Nguyen [20]. Leading Japanese firms such as NEC, Hitachi, Oki, and Fujitsu have already captured significant market shares in Latin America and other Third World markets.

[11] See Guy [21] for a full discussion of U.K. policies and programmes in the IT industries.

[12] For reasons of length the detailed technical aims are not discussed here. See Alvey [22] and Alvey's individual strategy documents for full details of aims in each technical area.

[13] See Alvey [22].

[14] The broad technological goals of Alvey are discussed in Part 3. Full details of the strategies for the four main technical areas are presented in Alvey's published strategy documents.

[15] See Gibbons and Georghiou [1] for a review of evaluation practices among the OECD countries.

[16] CBS was to withdraw from the evaluation after an initial period. The broad separation and allocation of evaluation tasks is described in Part 3.

[17] Sometimes interim evaluation are undertaken to give an early idea as to progress and problems to date. See, for example, the mid term review of ESPRIT [13]. These types of evaluation are fairly rare.

[18] For the 'state of the art' in measuring the returns on investments in research see OTA [23].

[19] For details of PREST's activities see Georghiou [24].

[20] See Guy [8] for details.

[21] For the international comparisons mentioned here, see Arnold [25], and Arnold and Guy [10,26]. Also for an analysis of U.S. policy initiatives in IT see Guy and Arnold [27].

[22] See Guy [4].

[23] See Hoselitz [28] for a personal appraisal of the Alvey VLSI strategy in relation to the capabilities of firms in the U.K. Hobday [15] examines Alvey within the technological and market direction of the VLSI (semiconductor) industry.

[24] Complementary reports include Freeman [29, 30], and Evans [31].

[25] This is not to imply any rigid sequence of events either in the process of technological change, or in the impact of Alvey. The impact of Alvey will vary according to technological area, the specific objectives of the sub-programmes, the rate of technological change, and other variables.

[26] The Interim Evaluation of Alvey (Georghiou et al. [14]) contains a preliminary assessment of technological progress in each technical area. For the VLSI area a more detailed assessment of exploitation objectives is contained in Hobday [15].

[27] For full details see Hobday et al. [5] and Hobday and Evans [32] which deal with the VLSI and SE areas, Duncombe et al. [33] for the MMI area, and Guy and Arnold [34] for the IKBS area.

[28] Project entries represent that part of an overall project which is carried out by an individual academic department.

[29] This technique assumes that the bias in question is not dependent upon the specific technical area. A comparison of academic institutions in the four main Alvey technology areas is to be undertaken within the evaluation in 1988.

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L'évaluation de programmes de recherche et mise au point effectués en collaboration dans l'informatique: le cas du programme britannique Alvey.

RÉSUMÉ

On prête attention de plus en plus à l'évaluation de l'impact économique et technologique de grands programmes de recherche et mise au point (R&D) dans l'informatique effectués en collaboration et financés par le gouvernement. Cependant, la pratique de l'évaluation est encore à ses débuts, et jusqu'à ce jour, il y a très peu de lignes directrices pour dire *comment* évaluer de grands programmes dans l'informatique (IT) avec de multiples objectifs. Cet article décrit l'évaluation du programme britannique Alvey, et il concentre sur la manière dont on évalue l'impact technologique et économique du programme Alvey sur l'économie britannique. On décrit aussi les plusieurs méthodes utilisées pour évaluer le programme, et on établit un rapport entre ces méthodes et les multiples buts qui se trouvent dans le programme Alvey. En plus, on fournit un exemple concret de l'évaluation à 'temps réel'. On soutient que l'évaluation à temps continuel, ou réel, a beaucoup d'avantages sur l'évaluation conventionnelle ex post (après l'événement), y compris la capacité de donner en retour aux responsables de la direction du projet les resultats de l'évaluation. Quoique les évaluations de programmes IT soient inévitablement différentes selon les buts, les stratégies et le raisonnement de chaque programme spécifique, cet article espère, en démontrant la gamme de méthodes et de techniques utilisées pour évaluer Alvey, contribuer au domaine général de l'évaluation de programmes IT.

Die Einschätzung mitarbeitender Forschungs- und Entwicklungsprojekte in der Informatik: der Fall des britischen Alvey-Programms.

ABRISS

Man schenkt zunehmende Beachtung der Einschätzung der wirtschaftlichen und technischen Auswirkung von großen, mitarbeitenden Forschungs- und Entwicklungsprogrammen (R&D) in der Informatik, die staatlich unterstützt werden. Die Praxis der Einschätzung steckt jedoch noch in den Kinderschuhen und bis jetzt gibt es wenige Richtlinien darüber, *wie* man große Programme in der Informatik (IT) mit vielfältigen Objektiven einschätzt. Dieser Aufsatz beschreibt die Einschätzung des britischen Alvey-Programms, und konzentriert sich darauf, wie die technischen und ökonomischen Auswirkungen des

Programms auf die britische Wirtschaft eingeschätzt werden. Er beschreibt auch die verschiedenen Methoden, die angenommen werden, um das Programm einzuschätzen, und danach bringt er sie in Zusammenhang mit der Vielzahl von Zielen, die sich in dem Alvey-Programm befinden. Hier gibt es auch ein konkretes Beispiel der Einschätzung durch 'reelle Zeit'. Es wird behauptet, daß Einschätzung durch andauernde oder reelle Zeit bietet eine ganze Reihe von Vorteilen gegenüber traditioneller ex post (nach dem Ereignis) Einschätzung, darunter die Fähigkeit Einschätzungsresultate an denen zurückzuleiten, die verantwortlich für die Führung des Programms sind. Obwohl Einschätzungen von IT-Progammen zwangsläufig nach den Zielen, den Strategien und den Gründen jedes spezifischen Programms unterschiedlich sind, hoffen wir in diesem Aufsatz, durch eine Vorführung der in der Einschätzung Alveys angewandten Reihe von Methoden und Verfahren, etwas zum allgemeinen Feld der Einschätzung von IT-Programmen beizutragen.

La evaluación de programas colaborativos de investigación y desarollo en la tecnología informática: el caso concreto del programa británico Alvey.

Resumen

Tiene cada vez más importancia evaluar el impacto, tanto económico como tecnológico, de programas de la tecnología informática grandes, colaborativos y con aportación gubernamental. Sin embargo, la práctica de la evaluación es todavía muy nueva y, hasta el momento, pocas normas existen para saber como evaluar importantes programas de tecnología informática con sus múltiples objetivos. En este documento se describe la evaluación del programa británico Alvey, particularmente la forma en la que se evalúa el impacto tecnológico y económico del programa en la economía británica. Se exponen los distintos métodos empleados en la evaluación del programa, relacionándoles con los múltiples metas del Programa Alvey. Incluye, además, un ejemplo concreto de la evaluación del 'tiempo real'. Se argumenta que la evaluación contínua, o de tiempo real, tiene una serie de ventajas comparada con la evaluación tradicional ex post (posterior al acontecimiento), incluída la posibilidad de comunicar los resultados de la evaluación a los responsables de dirigir el programa. Aunque las evaluaciones de programas de tecnología informática (IT) siempre variarán de acuerdo con las metas, estratégias y el razonamiento de cada programa específico, la aportación de este documento al campo general de la evaluación de programas de IT es notable por demostrar la gama de métodos y técnicas empleados en la evaluación del programa Alvey.