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Evaluation of Economic Effects: Relevance and Impacts of EC-Programmes promoting Industrial R & D with special emphasis on Small and Medium sized Enterprises

(Pilot methodological study)

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Evaluation of Economic Effects: Relevance and Impacts of EC-Programmes promoting Industrial R&D with special emphasis on Small and Medium sized Enterprises

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I. Summary and the Most Important Results of the Analysis

1. Fundamentals

The objectives of this study are twofold. The first objective is a methodological one, identification of appropriate methods to evaluate programmes relating to industrial R&D and testing the feasibility of one selected method. The second objective is to draw some (**preliminary**) lessons on the role of small and medium sized firms in EC-programmes, reasons for participation, expected effects, and the extent to which these firms take into account the economic effect of R&D.

The methods for the evaluation of promotion programmes are intended to be tested as a matter or priority with this pilot study. Hence, it is necessary on the outset to give an overview of current evaluation methods. The methods of analysis which are most suitable will then be chosen and tested on a concrete example in the second part of this study.

In order to preclude misunderstandings, it should be noted emphatically that though answers from the surveys are also to be commented on, nonetheless this served above all, the purpose of portrayal and examination of which prerequisites are needed so that concrete results can be achieved or not by the application of the selected methods. **An evaluation of the BRITE/EURAM Sub-programme was neither planned nor intended, because of the small sample of firms investigated.** Nevertheless, we want to underline, that a careful evaluation needs also a deep understanding of the structure and peculiarities of the industrial sector involved.

2. Concerning the Selection of the Aeronautic Industry

To test the method, we have chosen the Aeronautic Industry. The rationale for this decision is the fact that it concerns a small and thus a relatively easy, comprehensable branch. The hope we pinned on it is that **commendable results can be achieved despite the very low number of enterprises to be interviewed.**

A further aspect was that the Aeronautic Industry looks very suitable for the treatment of the formulation of the relevant question of European promotion programmes on technology transfer that involve a stronger participation of small and medium-sized enterprises from the "Small Member States". Different technology areas are being pushed up in this High-Tech-Sector. **Thus, this branch meets a prerequisite in this respect: technical know-how flows in other areas of the economy of the respective country through the participating enterprises.**

The general question about the division of labour in innovation between bigger and smaller enterprises is also relevant. Though in the analysed branch the bigger enterprises dominate, this does not mean that small and medium-sized enterprises were therefore meaningless. In contrast, it is to be expected that the enterprises will increasingly make use of the division of labour for the intensification of their competitiveness. This occurs through the expansion of their earnings on international markets and stronger usage of the services of small and medium-sized enterprises.

Objection to the choice of this branch could be that it portrays many peculiarities and is, to a certain degree, politically influenced. This is obviously a significant aspect On the other hand, it will be interesting to know, particularly in view of the further integration of Europe and European economic policy and promotion, how far national interests will be reduced in favour of European interest.

3. Concerning the Methods

It was the central duty of the study to test the most suitable methods for an evaluation of SME's promotion programmes. In Chapter III, the different methods in use will be portrayed:

- Control group approach;
- Econometric approach;
- Case study approach;
- Science and technology indicators approach;
- Before/After approach.

The weighing of the methods led to the conclusion **that a methods' mix consisting of the control group concept and the application of case studies should be thoroughly tested in this pilot phase.** In the course of this, it appears important to us to point out clearly that the sole application of such a concept is not enough, but **valid results can only be achieved when a corresponding work has been done in advance. Most importantly, an investigation of the environment in which the evaluation takes place is needed.**

If it is about a branch of industry, its characterizing feature is, at first, to be worked out. The branch is to be described in its national, European or international context. If a technology stands in the forefront, the expectations on the technology in view of its impacts on competitiveness and structure of the economy or enterprises as well as the diffusion breadth and velocity are to be described. Beyond the above, national and European promotion programmes are to be portrayed and - if previous analyses are already available - these are to be commented on. In general, the task is to process the available data (both qualitative and quantitative) in such a way that only the conception of the survey which is essential in determining the aspects of the subject of the analysis are known.

Generally in trans-national analyses, **there is a problem of compatibility of information.** Even more, the available statistical information for Europe is often not enough to produce detailed descriptions. This applies also to the relatively small branch of the Aeronautic industry. Although big enterprises and big projects are relatively well known, nevertheless the total structure of the branch and the activities, most especially of small enterprises can only be sketchily portrayed because of the missing information. This means that it is, as a rule, also necessary for evaluations of European promotion programmes to obtain original information about the respective existing national areas and the policies which are realized therein.

Despite such preparatory stages of the analysis, numerous and partly unremovable obstacles exist. In general, the results of surveys of enterprises are largely dependent on the individuals questioned in the enterprises themselves. This problem is not very significant in small enterprises, because there one is able to speak to the management. The division of labour increases with the size of the enterprise. Correspondingly, it will be more difficult to receive valid statements for the entire enterprise through surveys. This is less applicable for the quantitative questions than for qualitative ones.

The application of the control group which is so convincing as a theoretical concept is, however, difficult to realize in practice. Basically, control group means that these enterprises which are in the group have not taken advantage of the promotion programme but corresponds with the group of the promoted enterprises in other most important variables which determine the entrepreneurial behaviour. Just the very question - why an enterprise takes an advantage of promotion and the other does not - shows the already aforementioned problematic nature. In addition to the above is that, prior to the commencement of the analysis, the determining variables for the constitution of the groups are to be established without the existence of enough clarity about whether they are decisive for the action or not. Finally, of course, the success of the analysis depends on the willingness of the enterprises to participate in the survey.

Despite these objections, the control groups' concept has proved its usefulness in the analyses which the Institute for System Analysis and Innovation Research (ISI) and the German Institute for Economic Research (DIW) have executed using this method. Most especially in the evaluations of R&D-promotion programmes of the Federal Republic of Germany, the control group showed other behavioural pattern and development courses which are statistically significant. Of course, these analyses were based on a very large number of interviewed enterprises. Approximately 1,200 promoted and 800 non-promoted enterprises (in the control group) were questioned.

In the scope of the pilot study, such a clear result would not be expected. Rather, the goal of the examination is whether the control group concept is an adequate method of analysis by a larger number of surveyed enterprises. For the choice of the control group, the following criteria were thus taken into consideration:

- The size of the enterprises according to the number of the employees;
- "Nationality" of the enterprise;
- Non-participation on the BRITE/EURAM-programme;
- Performance of R&D in the aeronautics area.

The choice of a definite method of analysis or of a methods' mix is dependent on the formulation of the main underlying questions, the subject of the analysis, and finally, the statistical basis of the data or of the possibility to receive correspondingly statistical information.

The success to be achieved with a method of analysis is, on the other hand, dependent on the nature of the execution. What matters very much is that, most especially by the application of the preferred methods' mix in this context, the environment of the branch to be analyzed is correspondingly prepared and there should exist knowledge about the characteristics of the branch. Thus, the formulation of the exact objectives of the questions and the results of the survey can only then be interpreted accurately on the basis of sound information.

4. Written and Oral Surveys

The hypotheses are the first important stage towards the formulation of the questions to be asked in the written and oral interviews. Pretests are imperative before one is to begin with an intensive survey. This applies most especially to written surveys where a once wrongly placed question can no longer be corrected. The information lost can no longer be retrieved. The pretests served both the examination of the practicability of the questions (are the questions going to be understandable ?) as well as also the examination of the contents of the questions.

The advantage of written surveys is the possibility to be able to direct standardized questions to a large number of those to be questioned. Compared with interviews, they are - measured on the number of those questioned - clearly less personal and time intensive.

They offer the possibility of examining in advance the working hypotheses to be defined on a relatively broader basis. Important prerequisites for results which can be used are questions which are easy to answer and which must also convey an impression of goal orientation to the enterprises. The enterprises must be aware that problems which are relevant to them are being examined.

The Multiple-Choice-Method where applicable, is most appropriate for written surveys. An attempt should be made for written surveys to be answered according to the Multiple-choice-Method. While quantities are still, as a rule, to be indicated, questions which are open and provide qualitative answers are rarely utilized. In addition, they are very difficult to catalogue and correspondingly poor to interpret because of their dissimilarity. The more varied the questioned enterprises are, the more difficult will, of course, be the standardization. This is especially true in international studies where the preparedness to offer information and also the availability of data is often different from country to country.

Compared to the written survey, the case studies have advantages with respect to complexity and comprehensiveness. The enterprises are recorded in their totality and the relevant problem areas can be worked out. In addition, mistakes in the concept of the survey can at least be corrected partially during the analysis. These type of analyses are of course, very time consuming.

This particularly applies when they take place in an international context. Difficulties in the coordination of appointment, long travelling routes and high travel expenses demand a very careful preparation. Where possible, institutions close to the selected enterprises should be utilized in undertaking the interviews.
Those that come into question in this context are the European Community, Chambers of Commerce, National Economic Promotion Establishments and Associations. The analysis which is presented here had in itself the support of the European Community and the already existing contacts of the German Institute for Economic Research (DIW), which were very helpful.

5. The Sub-Programme Aeronautics - Summarized Results of the Analysis

Basis of Information

First of all, available statistical information and analyses for the characterization of the branch were evaluated. Together with the underlying assumptions of the promotion programme, they served the description and formulation of the working hypotheses. Original information about the bahavioural patterns of enterprises and possible effects of the programme were the basis for written and oral surveys.

In the scope of this pilot study, enterprises in **Ireland, Denmark and the Federal Republic of Germany** were questioned in a written and oral manner.

Twelve enterprises were sent a questionnaire after telephone contacts. From these enterprises, five were located in Ireland, two in Denmark and five in the Federal Republic of Germany.

The choice was, amongst others, influenced by the fact that, firstly, enterprises of a country that has its own aeronautic system industry at its disposal (Federal Republic of Germany) were questioned and secondly, enterprises of the Small Member States (Denmark, Ireland) were represented.

Our first idea by which only enterprises with less than 500 employees were supposed to be included in the inquiry was adapted to include some bigger enterprises of the equipment industry. This was most especially necessary for two case studies in the equipment enterprises in the Federal Republic of Germany. **Thus, it was also possible to receive information from bigger equipment enterprises about:**

- the division of labour between the equipment industry and the system industry;

- the necessary scale of an enterprise in order to be competitive in the branch;

- the dependence of the equipment industry on the national aviation programmes and the possibilities to gain a foothold on the international market;

- the cooperation possibilities and forms between bigger and smaller enterprises of the equipment industry - partly beyond the national boundaries;

- the importance of the BRITE/EURAM Sub-programme Aeronautics for these enterprises in view of their international competitive position.

The Aerospace Industry in Europe

The Aerospace is a small industry, measured in terms of number of employees and the shares of their real net output. However, importance is generally attached to this branch in the light of two significant functions it performs, namely:

- National autarchy: In the case of crises, the Aerospace industry is supposed to help secure the particular defence capability of the country. The agriculture or the energy economy has a similar function which, in such a situation, is supposed to sustain the independent supply of the country.

- Industrial, political and technological: the Aerospace industry is regarded as a technological key area. This, in itself, is already portrayed on a close examination of the research and development expenditures (R&D Expenditures): 15 % of the total turnover is allotted to R&D. No other industrial sector has a similar high relation.

The Aerospace production takes place primarily in four countries within the European Community: Great Britain, France, Germany and Italy. Other countries involved are the Netherlands, Belgium and Spain. Measured on the total production, activity in the remaining countries of the European Community is not significant.

The European Aerospace industry is considerably determined by sixteen big system enterprises (prime contractors). The system enterprises distinguished themselves through the fact that they developed and produced in their respective competencies aircrafts or the so-called sybsystems. Because the award of contracts **within the Aerospace industry is often traded on the principle of "buy national"**, a very central role for the entire European Aerospace industry will fall towards these enterprises.

Two exceptional features of the branch, amongst others, must, of course, be considered by an evaluation of the BRITE/EURAM Sub-programme Aeronautics:

- Enterprises below the system level have, in a very limited form, only the possibility to find markets with their respective product ideas. Instead, they are dependent on the system enterprises. This, of course, also opens production possibilities for the suppliers through the aircrafts and power plants produced by them, whereby the product to be developed or supplied must conform with the given technical requirements of the system manufacturer.

- The dependence of the equipment industry is still increased by the relatively respective low multiple variants of the produced aircrafts or power plants, the limited number of the system enterprises as well as the difficulty of the market entry. To be able to be active as a producer in the area of aerospace, an enterprise must not only acquire the confidence of the customer, but must also be licenced as a producer.

Working Hypothesis

A set of hypotheses about possible effects of promotion and suspected weak points by the enterprises must be placed in front of every evaluation of promotion programmes. The hypotheses arise from the goals of the programme itself, experiences from other parallel analyses as well as from the peculiarities of the branch.

First of all, a comprehensive description of the programme itself including the promotion conditions and its utilization were therefore given in the scope of this study. **Secondly,** a portrayal of the division of labour in innovation between big and small enterprises or the innovation behaviour of SMEs took place through evaluation of available literature. Finally, the description of the branch itself served this goal.

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Before one is to begin with an evaluation of an SME's relevant promotion programme, there must exist ideas about the division of roles between bigger and smaller enterprises. Results from analyses on innovation behaviour of SMEs show that they are, on the one hand, supplier of ideas and they play, on the other hand, an important role in the diffusion of technologies. Due to the longer period of the "return on investments" and because of the generally few possibilities to take great risks, small and medium-sized enterprises, in contrast, cannot perform extensive basic developments due to financial reasons.

In this connection, the (Neo-Schumpeterian) question is often being asked, who is more innovative - bigger or smaller enterprises ? If one considers that small enterprises utilize market niches and perform often more important functions as suppliers to big enterprises, then the conclusion suggests that the question of who is more innovative should be replaced by the thesis of a size-specific division of labour in innovation.

Within an economy, small and medium-sized enterprises have important functions. Usually, they are more flexible than bigger enterprises and serve smaller segments of the market. Because they appear as competitors to big enterprises, they increase the competitive intensity of the market. They mostly undertake important supplier functions for products which cannot be produced with the same profitability and flexibility for the customers. Due to their specilization in the divison of labour, they increase the flexibility and the efficiency of the total economic system.

Hence, **an efficient mixture of sizes is an important prerequisite for the improvement of the competitiveness of the branch or the economy.** Also, the Aeronautic industry appears to us to be a suitable branch for the examination of this hypothesis because there an increasing division of labour between the enterprises is to be expected.

Thus, the following hypotheses are, in general, developed:

- Funding of R&D is a central bottleneck area in the concerned enterprises.

- The enterprises are dependent on cooperations with enterprises and institutions which have their seats in other European countries.

- The financial support in the R&D area helps enterprises in the execution of the expensive R&D plans and creates therewith important prerequisites in order to be entrusted, as cooperation partner, with the solving of specific formulated questions in the scopes of bigger projects.

- The entry into a cooperation creates good prerequisites for the further engagement in the aviation area.

- Through the promotion programmes (subject to stronger engagement in technological superior areas of the aviation), the enterprises receive a supply of knowledge which will generally contribute to the improvement of the technological competitiveness of the enterprises.

- Through the promotion programme, the cooperation within Europe will be promoted beyond the boundaries and will enhance the fusing together of the national markets into a European domestic market.

- The market entry barriers are very high for small enterprises in the aviation industry. This is especially valid for enterprises of the "Small Member States".

Construction of the Questionnaire

The working hypotheses must be able to be converted into the conception of the survey. The Questionnaire is subdivided into the following topics:

- General situation of the firm with questions relating to turnover, employment, the most important customers, the importance of R&D, the expectation of the market according to production and market segments.

- A set of questions which are only directed to participants of the BRITE/EURAM-Programme with questions relating to the importance of the programme, knowledge of the programme, effects on the strategy of the enterprises, wishes regarding the administration and improvements of the programme.

- Main problems and proposals for improvement.
  In this part of the questionnaire, all enterprises were again questioned about their cooperation behaviours, the difficulties to cooperate internationally, the central R&D impediments and the necessary improvements in this connection.

- European Community tasks.
  In this question set, both surveyed groups, i.e., promoted and non-promoted enterprises were interviewed about their viewpoints concerning the most important duties of the European Community.

6. Summary of the Main Results of the Written Survey

In general, the questionnaire and the survey concept which was developed here **appeared to be suitable.** On the one hand, this was obviously due to special knowledge of the branches which stood at the disposal of the DIW in the area of Aeronautics. While on the other hand, the support through the European Community has also contributed significantly. Thus, **it was possible to be able to achieve relatively good interpretable results despite the very small sample of the survey.**

Compared to the Control group, the results were, however, ambiguous. Unambiguous structural differences could not be established by the findings of the survey. If this is due to the small number of the surveyed enterprises or if actually there is no difference, this can only then be answered by a broadening of the survey on a larger number of enterprises.

On the whole, the results of the written survey could be summarized as follows: The surveyed German enterprises were on average more technology-intensive than the enterprises of the Small Member States. They had obviously more leeway for individual developments in the cooperations and had also, in higher proportion, individual patents at their disposal.

The market entry was a great problem for all enterprises. Because the enterprises were more engaged in the military area, where, of course, they anticipate declining demand, they had to deviate forcefully to other fields. The problem of armament conversion is a topic which concerns many of the European Aeronautic enterprises. In view of the general higher market entry barriers, it is going to be difficult to deviate to the civil market. Obviously, the enterprises from countries without individual System industry have, especially in this context, a hard time.

The greatest number of enterprises welcomed the programme's information of the European Community and the programme maintenance even though, measured on the enterprises' strategy, they attached less importance to the promotion programme.

However, in the area of R&D strategy and for the development of cooperation relationships, the programme had more significance. Here, the statements corresponded to those of the executed analyses in the Federal Republic of Germany whereby the small and medium-sized enterprises prosecuting R&D sought increasing contact to research establishments and other cooperation partners.

Help was still expected by the enterprises for their problems and, **at earliest, from the national governments.** Support, above all, was expected from the European Community by the initiation of cooperations.

In the differentiation of programme participant and non-participant, the written survey brought no significant results. The structure of the answers were almost equal in both groups. The reasons for this could be:

- The aforementioned problems and behaviours are almost the same by the enterprises of both groups - promoted enterprises and control group. Hence, the utilization of promotion programmes cannot be inferred from the tested behavioural specimen.

- The case numbers of both groups are too small to enable significant divergences.

Results of the Case Studies

On balance, the results of the oral surveys could thus be characterized; the surveyed equipment enterprises had, through the BRITE/EURAM Sub-programme Aeronautics, opened for themselves new cooperation possibilities. Thus, **support by the initiation of cooperation was often more important than the financial assistance**. Hence, the support of the European Community was, above all, of importance because it concerned a branch which, in higher degree, was influenced by the government and in most cases cooperations were entered into on the basis of traditional business relationships.

The continuation of the programme was, of course, welcomed because the participants hope, on the one side, to be able to gain a stronger foothold on the civil area which is increasingly gaining importance. On the other side, there existed the possibility that **development works would be promoted in technologies for which there were no national programmes.**

In this way, a specific competitive disadvantage which the enterprises of the Small Member States had, in contrast to the big industrial countries, would be removed. To what extent technologies were also relevant to other areas of the enterprises was not answered through the case studies in the scope of this study.

The significant empirical results of the research could be summarized as follows:

The BRITE/EURAM Sub-programme Aeronautics supported the small and medium-sized enterprises in their efforts for trans-national cooperations. In view of the expected structural alteration in the demand coupled with the increasing importance of the civil area as well as the growing competitive pressure, such cooperations would increasingly be more important.

As a rule, **the small and medium-sized enterprises were not in a position to jump the higher barriers of the market entry.** In the Aeronautic industry, the direct governmental measures made possible the market entry of the enterprises.

In a market in which "buy national" was still the central motto, enterprises of the Small Member States were especially disadvantaged. This was more valid in countries which have no individual system industry at their disposal.

The relatively few final products were exclusively produced by enterprises of the system industry. Hence the Equipment enterprises had, only in a very small proportion, possibilities to open up markets with their own products. They were, in the rule, dependent on the cooperation with enterprises of the system industry. There was also the fact that the market newcomer, just because of the inadequate experience, could hardly be in the position to acquire price or qualitative competitive advantage which would enable them to be considered as an inevitable cooperation partner.

Thus, the market entry could, in general, only be achieved through a corresponding specialization in certain fields of responsibilities coupled with a simultaneous political support.

Enterprises of the equipment industry tried to create, through more system competence, more freedom within the cooperations. Here, enterprises in countries which have their own respective System industry had advantage.

The conditions of the programme on which enterprises from the Small Member States were to be admitted into the cooperations, had increased the chances of the enterprises of these countries to work in the area of aeronautics. The duration of this participation would, however, only be dependent on whether these enterprises were competitive and if they were really prepared for cooperation.

7. Assessment of the Pre-Test

In general, numerous clear statements about the effect of BRITE/EURAM Programmes in the area of Aeronautics were able to be made on the basis of a very small survey sample.
This was, of course, only possible because:

- the branch "Aeronautics" has been accurately analyzed already before the survey in view of its specific features;

- the Commission had supported the survey; and

- it concerns a relatively small branch which, despite its varied specifics, will become transparent under the aforementioned prerequisites about the collection of well-aimed original information.

The concept which is formed from written and oral surveys has, on the whole, portrayed itself to be very practicable: the questionnaire was, in most cases, well answered. This was, at least, the case because the questioned enterprises had been informed ahead about the goal and purpose of the survey. A broadly scattered, highly anonymous written survey would obviously require a questionnaire which would have to be tested in a pre-test. In the present case, this procedure is replaced partly by the short telephone conversations with the enterprises as well as the information from the Commission.

Experience from other interviews have confirmed that the multiple-choice questions are not always workable. This applies especially to the questions which are not directly related to the enterprises.

Because of the extensive willingness of the questioned persons to offer information, the interviews have contributed towards a better understanding of the branches. Interviews extended beyond the situation of the respective enterprise and included issues such as:

- the basic problems of the branch in Europe;
- the specific role of the SMEs;

- the possible effects of the promotion

of the programme to be evaluated, which were discussed with these persons, serving as a pre-test. Thus, they gave the necessary information in depth for a better interpretation of the written investigation.

From the preliminary analysis results which are presented here, **one can ascertain,** with regard to the established hypotheses, **that R&D for the SMEs in the area of Aeronautics has a high cost factor, but this cannot be seen as the central bottleneck.** In contrast, the hypotheses have extensively been confirmed in view of

- the importance of international cooperations for the development possibility of the SMEs in the area of Aeronautics;
- the higher market entry barriers;
- the significance of the system industries and the dependence of the SMEs on these enterprises;
- the, at least partly, still applied principle "buy national" which means an additional handicap for the enterprises of the Small Member States which have no system industry at their disposal.

The results of the analysis can be summarized as follows: Although the financial support of the enterprises in the area of R&D created an important prerequisite for the creation of better cooperation possibilities for the SMEs, nonetheless, the assistance from the Commission in the initiation of cooperation were, in general, still assessed as more important.

The hypotheses could still not be examined according to the real effects of the promotion programme in view of the:

- improved technological competitiveness of the promoted enterprises in the area of Aeronautics;
- technological spill-over effects on other production areas in the enterprises or on other industries of the respective countries;
- different development of the promoted and non-promoted enterprises;
- improved competitive situation of the branch and the effect on the total economy through the increasing division of labour, most especially, through the reinforced participation of SMEs.

In order to be able to achieve such results, the number of the enterprises to be interviewed would firstly have to be clearly expanded and secondly the analysis' concept about the before/after comparison would have to be widened.

8. Lessons to be Drawn

A convincing evaluation process which will extensively suit the theoretical requirements, and which is also empirically workable, is not available. Entrepreneurial decisions result from an interdependent operational network. Hence, the isolated registration of the effects of promotion measures is also a very difficult problem to solve empirically as well as theoretically.

The elimination of promotion effects, in fact, of both the intended as well as the non-intended effects can, at best, be made through a methods' mix in which qualitative and quantitative aspects are being taken into consideration.

The evaluation process has shown itself to be basically suitable with the methods' mix:

- before/after comparison;
- control group concept.

By these conceptions what has changed by the enterprises through the promotion measure is being compared respectively. First, in the promoted enterprises themselves (before/after comparison), and secondly, through the comparison of promoted and non-promoted enterprises. It is hereby being assumed from a theoretical viewpoint that all alterations are to be traced exclusively to the promotion, and the clause of ceteris paribus is applicable to other variables.

Nevertheless, because of the complexity of influencing variables and practical reasons, it can be concluded that the rigid concept of control group should be "weakened" by using a comparison group approach which controls only major variables such as size, subsector, country etc. This study shows that its empirical implementation is feasible.

For the evaluation, several innovation indicators are to be constructed. Hereby, we will be concentrating on innovation indicators at firm level with special emphasis on economic effects of R&D (see Table).

Innovation Indicators at Firm Level

Innovation Indicators	Quantitative	Qualitative
Input	R&D personnel R&D expenses	impulses for innovation
	contract research	level of organisation and planning of R&D
	innovation stages (costs, risks)	learning effects
		barriers of innovation
		competence for cooperation
Throughput	patents applied for and granted	
	revenues by selling patents, licenses and know-how	
Output	innovation intensity	new or improved products, processes and services
	productivity	aims of innovation
	profits	competitive position
	employment	new customers/ new business fields
	non-commercial benefits	

A clear empirical result of this study is, that one should not emphasize too much the economic effects of the promoted R&D projects. The SMEs investigated usually do not assess their participation in EC R&D projects in economic terms, such as expected rate of return or profit. The major benefit for these firms of an involvement in EC-programmes are qualitative ones, such as learning effects (knowledge, management, language), becoming a visible and competent partner for international cooperations, finding new customers and business fields. Therefore we conclude that - at a firm level - it is more valuable and appropriate to assess carefully these qualitative effects of EC-programmes than using a strong orientation to quantitative economic terms.

In practice, information about the determining variables of the considered behaviour of the actors which are to be connected with the measure to be evaluated, have to be collected. Hereto, the following steps are imperative:

- Analysis of the environment to which the promotion measure is directed;
- Analysis of the promotion measure itself according to objective and form;
- Construction of hypotheses in view of possible effects;
- Conception of written and oral surveys (theme of interview, questionnaire, selection process; construction of the control group);

- Execution of pre-tests;
- Feedback of pre-tests' results with developed concept;
- Written and oral surveys of promoted enterprises and enterprises of the control group;
- Evaluation of the results.

Furthermore, in view of rare practical experiences, the **following additional recommendations for future implementation can be raised:**

- starting evaluation in the early beginning phase of the programme to be investigated;
- intensive development of the theoretical base;
- careful selection of promoted and non-promoted groups of research teams or R&D performing firms;
- careful interpretation of quantitative effects with special emphasis on qualitative aspects (such as learning effects, reasons of participation in government programmes).

Basically, such evaluations are to be executed in two phases, or, if needed, three phases:

- Phase I: It extends up to the evaluation of pre-tests. This report is restricted only to phase I. The outputs of phase I are:

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- valid questionnaires and interview-guidelines for collecting necessary data for the before/after comparisons (Annex) and a practical procedure of selection and construction of groups of promoted and non-promoted firms;

- a preliminary analysis - on a small sample basis - on relevant effects of EC-programmes in promoting industrial R&D, especially within SMEs (Chap. 4 and 5).

- Phase II: Extensive written analyses according to the control groups concept.

- Phase III: This follows when a promotion measure is to be evaluated at the end. Executions hereto are to take into account the time-lags of the effects of the before/after comparison.

Experience shows that the quality of the entire evaluation is, in a special degree, dependent on the execution of phase I. Hence, the real preparatory analysis of this evaluation is given particular attention. Later corrections are hardly possible.

II Further Working Plans

For the execution of the first phase of the analysis of a feasible evaluation of the BRITE/EURAM programme, the choice of the Aeronautic industry has, on the whole, proved to be suitable. However, this industry is relatively unsuitable for a second phase of the analysis in which the control group concept is supposed to lead to significant results. Hereto, the number of the promoted projects and enterprises in the programme is rather too small.

For the effect of the BRITE/EURAM sub-programme Aeronautics, two questions are, above all, of interest from the viewpoint of this research:

- How the competitiveness of the European Equipment industry changes itself and its role within the cooperation;

- To what extent this programme contributes to uplift the technological standard of the enterprises of the Small Member States and extends the same to the rest of the economy.

Such investigations were supposed to be executed after the end of the promotion on the basis of the research approach utilised here on the written and oral survey. In this case, the inquiry about the end of the programme should be broadened by the horizon of the findings in a before/after comparison.

If the goal of the second phase is a general evaluation of BRITE/EURAM, then industries such as the **Mechanical Engineering or selected technologies such as "Materials" should be analyzed.** The population is larger in these areas and the concept of the Control groups can be better applied. **In any case and prior to the beginning of the study,** such as it is done here, **the actual inquiries, in which the necessary information for a goal orientated conception of the survey are being processed, should be analyzed first.**

The method of analysis in this context should be a methods' mix comprising written and oral inquiries as well as the Control group concept. However, the definition of the Control group should thereby be acted on very carefully because it, at least partly, serves as a yardstick for the measurement of the effects of the promotion. A conclusive assessment of the effect of the promotion can, however, only follow after the expiration of the promotion. The evaluation would, thus, have to be supplemented with a before/after comparison.

In this respect, there is also a very interesting question which should be acted upon in the scope of such further analyses. Bigger economies such as the Federal Republic of Germany, in general, have at their disposal a broad field of promotion programmes with which almost all significant technologies can be promoted in the enterprises. The pre-requisite for this, of course, is a corresponding size and differentiated industry. Smaller economies, due to the low number of industrial enterprises alone, cannot bring out similar differentiated promotion concepts.

This, however, means that enterprises with locations in bigger economies could have promotion conditioned competitive advantages in different technology areas since European Commission programmes, amongst other, encourage these contortia. The basis for this is supplied by the subsidiarity principle. Firstly, it legitimatized the State (government) to intervene in areas in which market failure exists; and secondly, it is the duty of the European Community to see that the European programmes are subsidiary to the national programmes. For example, it was clear from BRITE/EURAM that, enterprises in smaller countries would have, promotion-conditioned, been disadvantaged without such a Europe-wide promotion. To what extent promotion-conditioned competitive distortions exist in Europe and to what extent these biases could be reduced through a European promotion programme, should be examined more intensively. The enterprises in the Small Member States, above all, would profit from this suggested adjustment.

III The Analysis

1. Aims of the Study and Working Plan

This study has two purposes:

a. Analyzing the relevance and effects of EC R&D programmes especially for small and medium-sized enterprises. This contains reasons for (non-) participation in EC R&D programmes, type of firms and co-operations reached, the effects on firms which participate in the programmes and the identification of the existence of deficiencies in programme administration.

b. Implementation of new methods of evaluation of EC programmes promoting industrial R&D. The before/after approach and the control group approach are important methods in identifying the impacts of such policies, but both methods, especially the control group approach are difficult to implement.

Methods such as peer review and bibliometrics are appropriate evaluation methods for basic or long-term applied research. In the case of EC programmes promoting industrial R&D, especially if small and medium-sized firms (SME) are involved, other evaluation methods are needed such as the before/after comparison and the use of control groups. This will be discussed in Chapter 3.

Evaluation, as it is used within this project, means the examination and assessment of the effectiveness of EC programmes.

The key elements of such an evaluation are analysis of the firms reached (size, sector, innovational behaviour, their bottlenecks to co-operate, etc.), the level of technical and economic goal attainment of a programme and the actual effects achieved, both intended and unintended, as well as analyses of implementation and adminstration. In view of the thin empirical backing of impact hypotheses and the assumed bottlenecks of innovation in industry, analyses of the conditions underlying each programme are regarded as an important additional element of such impact analyses. Verifications of the theoretical considerations of governments and ministerial bureaucracies on which the conditions and administrative handling of promotional instruments are based, should also be included in impact analyses because they constitute the only way of ensuring that not only scientists, but also political administrators may learn from the results.

To analyze the participation of SMEs in EC R&D programmes and the effects caused by the promotion, the following questions are important:

- what are the reasons for the participation or non-particiaption of SMEs in EC programmes ?
- What are the effects on the SMEs which receive EC grants for their
  - o R&D patents,
  - o improved products, processes and services, royalties,
  - o competitiveness, sales and employment,
  - o exports and imports within EC countries,
  - o ability for cooperation ?

- What are the specific surplus effects of an EC promotion?
  - o Learning effects for the cooperating partners (technical knowledge, thinking and planning in international dimensions, language etc.),
  - o Initiation and enforcement of existing relations between the cooperating partners, establishment of scientific community and working relations (contacts, networks),
  - o Projects, which could only be realized on an EC level and are initiated mainly by the EC programme.
- Do SMEs of countries with a less developed industrial R&D base gain a significant part of EC R&D projects? Is there any decrease in the discrepancies of the industrial R&D levels in the different EC countries?
- To which extent does the promoted EC programme meet the main bottlenecks of innovation in the SMEs ?

Because of the difficulties to implement the above-mentioned methods, it seems useful to divide the project into two parts: a pilot phase (Phase I) and a phase of more intensive field research in terms of the numbers of SMEs and the countries investigated (Phase II). This report is restricted only to Phase I.

Within Phase I, it is necessary - on the basis of a small sample of enterprises - to carefully construct a group of firms promoted and a comparable control group of firms which are non-promoted. Comparable means that these firms are similar with regard to size, product mixture or branch, markets and technological potential.

Furthermore, a careful collection of data is needed to describe the situation of both groups of firms before the EC programme started and during its implementation.

To ensure homogenity, it is useful to restrict the analysis to one EC programme or sub-programme. Because of its high relevance for SMEs, the BRITE/EURAM II programme is an appropriate programme for analyzing the main questions underlying this project and for implementing the evaluation methods. To select an appropriate sub-programme the following criteria were used: an industry which covers relevant European perspectives and characteristics. The relation between large and small firms within this industrial branch are a crucial issue and because of methodological and pragmatic reasons, it should have a sufficient transparency and a low heterogenity. Therefore, Phase I was restricted to the sub-programme Aeronautics. About 20 firms (promoted as well as non-promoted SMEs) including national and EC bodies were interviewed.

Out of the selected countries one (FRG) was characterized by intensive R&D, and a high degree of participation within the selected sub-programme. The other selected countries are small (Ireland, Denmark) and/or represent the opposite case (Greece). The field research in Ireland, Denmark and Greece received substantial help by the national delegates of these countries.

Main questions that related to the promoted SMEs were:

- How did they learn of the existence of the programme and its context? What were the reasons which led them to participate in the programme ?
- How does the programme fit in with the objectives of the companies which have applied for it?
- What positive results do they expect from the research project to be promoted?
- Is the international cooperation which is a central point of the programme a goal in itself or merely a means of attaining their specific objectives?
- What progress will be made due to this activity: filling technological gaps, insuring competitive advantage, keeping up with the state of the art? What do they expect from this research (quality improvements, cost reductions, new applications, better production performance, substitution, etc)?
- What spill-over-effect do they expect from the research?
- How did they chose their research partners: from previous cooperation, meetings, because they were industrial partners, following EC suggestions?
- Have they encountered specific difficulties in dealing with their research partners due to the sharing of expertise, language, commmunication, research programming or coordination, and their anticipated sharing of the results?
- Do they want to continue the cooperation in this field? Or in other fields?
- What specific benefits do they expect from international cooperation?

2. The Contribution of Small and Medium Sized Firms to Innovation and Their Role in European Community Programmes - Theoretical Framework

Technological innovation processes comprise the development and introduction of process or product innovations. They differ from traditional used methods or products offered on the market because they exhibit new functional characteristics. Until the beginning of the 1970's, an overwhelming view was held that technological innovation processes were executed primarily by big enterprises, while the technological innovation capability of small and medium sized enterprises was neglected. This opinion is based on the formulated thesis of Schumpeter on the size-specific difference of innovation capability. His hypotheses relate to the interrelation between technical development and the size of enterprises. This, of course, was changed to the so-called Neo-Schumpeter-Hypotheses through the ensued discussion (see Tabbert, 1974). Thus, big enterprises and monopolies are frequently been placed on equal level. A whole host of literature has up to date dealt with the question - which influence the market structure has on innovation capability? (see as overview Stoneman 1983, Gahlen, Stadler 1986, Dosi 1988). In this discussion, the influence of the size of an enterprise as well as the role of the prevailing market structure is often mixed herein. Because both factors are only connected loosely with one another, it is, however, meaningful to analyse separately the connection of both factors with the technical change (see Meyer-Krahmer 1989).

In the last years, many empirical studies on innovational behaviour of small and medium sized enterprises have emerged. The importance of small and medium sized enterprises in the phase of invention is almost undisputable. Sahal (1983), for example, has shown in a comparative evaluation of different technical historical studies that a larger part of discoveries on whose foundation the development of so-called major innovations are based, were the result of research works of individual inventors or small and medium sized enterprises. All classes of enterprises participated obviously by the generation of the origin of major innovations. Up till now, big enterprises were, however, seen as dominant in the further development of fundamental inventions up to their commercialization (Freeman et al, 1982).

On the basis of many existing studies (see as overview: Dosi 1988, Meyer-Krahmer 1989), the following hypotheses on the specific roles of small and medium sized enterprises in the innovation process are been established here: A general superiority of big or small enterprises in the invention and innovation process is not ascertainable in the course of the discussion on the Neo-Schumpeter-Hypotheses. However, it appears more meaningful to proceed from a division of labour between big and small enterprises which are, most especially, related to the market potential, the novelty of innovations and their closeness to the available product programme, and the extent in which small and medium sized enterprises participated in inventions and incremental innovations, but not on "major innovations".

Innovations in small and medium sized enterprises are determined to a great extent by the market. Flexibility and swift reactions on demand are, at the same time, both compulsion and comparative advantage for these enterprises. They operate or act predominantly on market niches. Furthermore, they compete rather over quality than over price competition on markets in which they stand in competition with big enterprises. The priority area of R&D activities of small and medium sized enterprises is in the area of development, while research, in a closer sense, is almost exclusively executed by big enterprises. While all sizes of enterprises participated in the generation of origin of major innovations, big enterprises dominate, however, in the further development of fundamental inventions up to their commercialization.

Innovating small and medium sized enterprises play not only an important role in the invention phase, but also by the diffusion of complex basic technologies. The diffusion of such technologies portrays a permanent process of adaptation and further developments on different application areas and market segments in which small and medium sized enterprises play individual roles. Innovating small and medium sized enterprises depict, in this connection, an important target group when government policy wants not only the emergence but the increase of the speed of the spread of complex basic technologies.

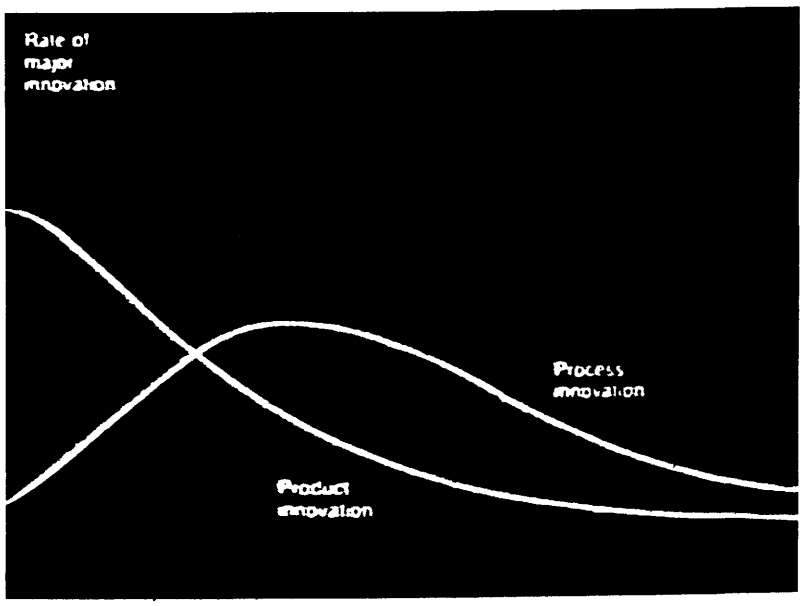
The innovation activity is not only determined through the sizes of the enterprises, but also through the phase of the life cycle of the products. In support of the product life cycle-Model, Abernathy, Utterback (1978, 1982) try to link the dynamics of product and process innovations with the development histories of enterprises and product lines. Product and process innovations take place in dependence on the respective stage of development and the course of the life cycle of a product line in periodical shift. In dependence on the increasing production volumes, Figure 2/1 depicts the typical ideal frequency of product and process innovations per time unit. The depicted cycle varied in duration according to the sector of the industry. It can last, for example, 70 years in automobile industry and 20 years in the electronics industry.

The approach of Abernathy and Utterback is easily compatible with our hypothesis of division of labour between big, small and medium sized enterprises in the innovation area. SME play a special role in the formation phase of a product line and they show a high innovation rate. They can either survive through niches strategies or can be displaced by bigger enterprises in the further course of the product life cycle. Solution strategies, therefore, remain the early change to other product lines or technologies. Enterprises with many product lines can compensate the fluctuations through a skilled product portfolio-management. If one introduces size-specific considerations in the product life cycle model, it can be shown that small and medium sized enterprises can choose between different strategies. Due to a niche and delivery strategy, a relatively stable position or a rather temporary state can be reached with a "First-Mover" or high technology strategy (see Thierstein 1987). As long as governmental technology policy restricts itself to an R&D-promotion, it will reach predominantly such small and medium sized enterprises which move themselves on market niches for technology intensive plants and investment goods or in new developed areas such as electronics, chemical, new processing techniques, material, energy and environmental technique. Such a policy will reach, to a less extent, small and medium sized enterprises in traditional industrial areas or the group of delivery companies.

Figure 2/1

Patterns of Industrial Innovation

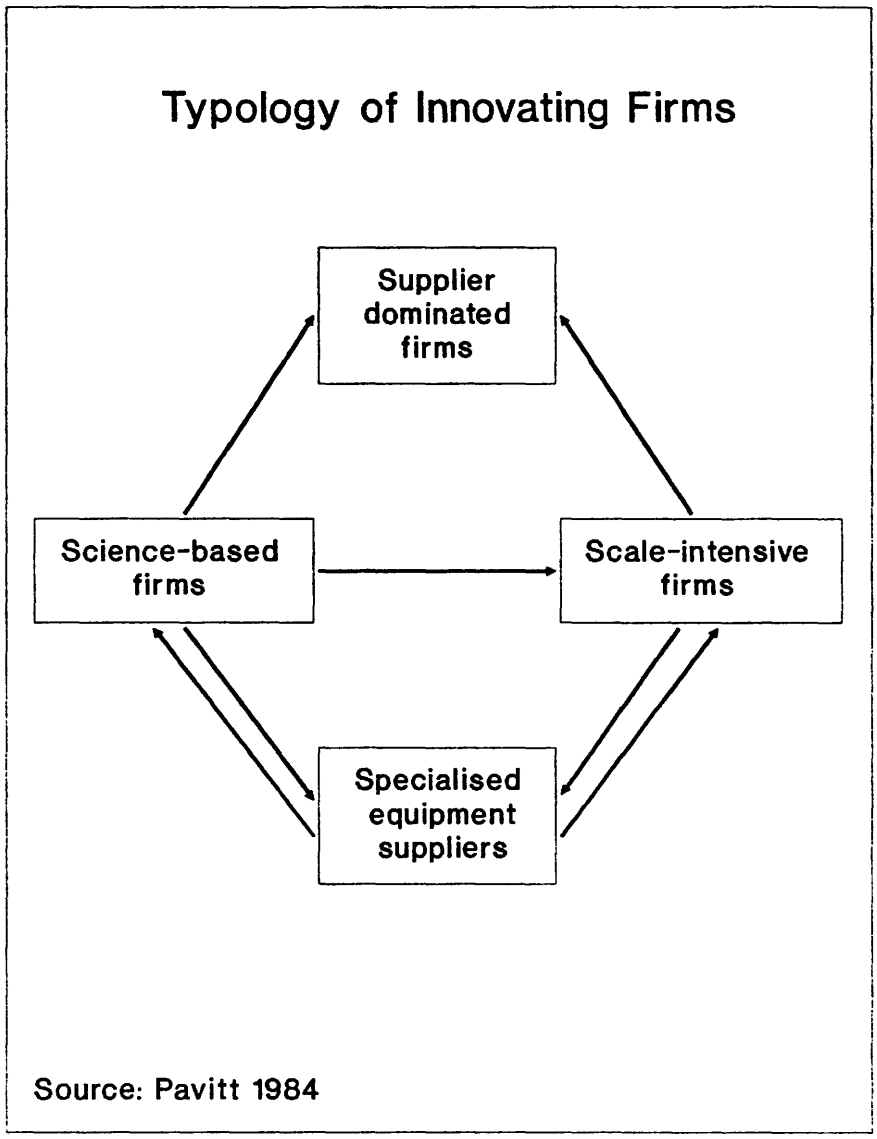
The changing character of innovation, and its changing role in corporate advance. Seeking to understand the variables that determine successful strategies for innovation, the authors focus on three stages in the evolution of a successful enterprise: its period of flexibility, in which the enterprise seeks to capitalize on its advantages where they offer greatest advantages; its intermediate years, in which major products are used more widely; and its full maturity, when prosperity is assured by leadership in several principal products and technologies.



	Fluid pattern	Transitional pattern	Specific pattern
Competitive emphasis on	Functional product performance	Product variation	Cost reduction
Innovation stimulated by	Information on users' needs and users' technical inputs	Opportunities created by expanding internal technical capability	Pressure to reduce cost and improve quality
Predominant type of innovation	Frequent major changes in products	Major process changes required by rising volume	Incremental for product and process, with cumulative improvement in productivity and quality
Product line	Diverse, often including custom designs	Includes at least one product design stable enough to have significant production volume	Mostly undifferentiated standard products
Production processes	Flexible and inefficient; major changes easily accommodated	Becoming more rigid, with changes occurring in major steps	Efficient, capital-intensive, and rigid; cost of change is high
Equipment	General-purpose, requiring highly skilled labor	Some subprocesses automated, creating "islands of automation"	Special-purpose; mostly automatic with labor tasks mainly monitoring and control
Materials	Inputs are limited to generally-available materials	Specialized materials may be demanded from some suppliers	Specialized materials will be demanded; if not available, vertical integration will be extensive
Plant	Small-scale, located near user or source of technology	General-purpose with specialized sectors	Large-scale, highly specific to particular products
Organizational control is	Informal and entrepreneurial	Through liaison relationships, project and task groups	Through emphasis on structure, goals, and rules

Source: Abernathy, Utterback (1978).

Figure 2/2


Typology of Innovating Firms
Supplier dominated firms
Science-based firms
Scale-intensive firms
Specialised equipment suppliers
Source: Pavitt 1984

It is clear from the investigations of Abernathy and Utterback that generalized hypothesis about the role of small and medium sized enterprises in the innovation process can mislead when one did not take into account the sectoral/product orientated dimension and also the changing role of these enterprises in the industrial development process. Hereto, small and medium sized enterprises are an heterogenous group consisting of enterprises from diverse activity fields and with very different strategies. In this context, multiple references and a lot of differentiations were developed (Pavitt 1984, Rothwell 1985, Thierstein 1987). Thereafter, the degree in which small and medium sized enterprises perform or use innovations can be classified as technology push or demand push (see Figure 2/2).

A typology of innovating enterprises can be established on a solid theoretical basis with the help of the further development of the cone theory of Majer (1978). The cone theory implies that the research results can be arranged in their basic application and the distance of the final product stage. The research scenery is structured on scientific areas. Findings of basic research about the result chains of the closeness of the final product are attained in ramified and non-linear succession, otherwise, they are not going to be further pursued in the course of these processes. The result chains have horizontal, vertical and feedbacked connection. The vertical result chains, the feedbacks and horizontal interrelation within a scientific area or immediate bordering areas lie on the surface of the cone. The connecting lines between different disciplines appear within the cone. The research cone exhibits therewith a vivid sketch of results. A more detailed description of the research cone can be found in Majer (1978).

Thus, this research cone can further be developed into an innovation cone in the following way for the interrelation which is of interest in this context (see figure 2/3). The cone is enlarged into an innovation or diffusion phase. In this phase, the research result is taken away as concrete product or process innovation, converted into technical production and introduced in the market or taken into production. If already the process begins earlier, it is of no further importance for the interrelation which is here of interest. At the latest, however, a technology core is, in itself, developed. Concerning the key words - technological trajectories, technological paradigms, architectural innovations - it

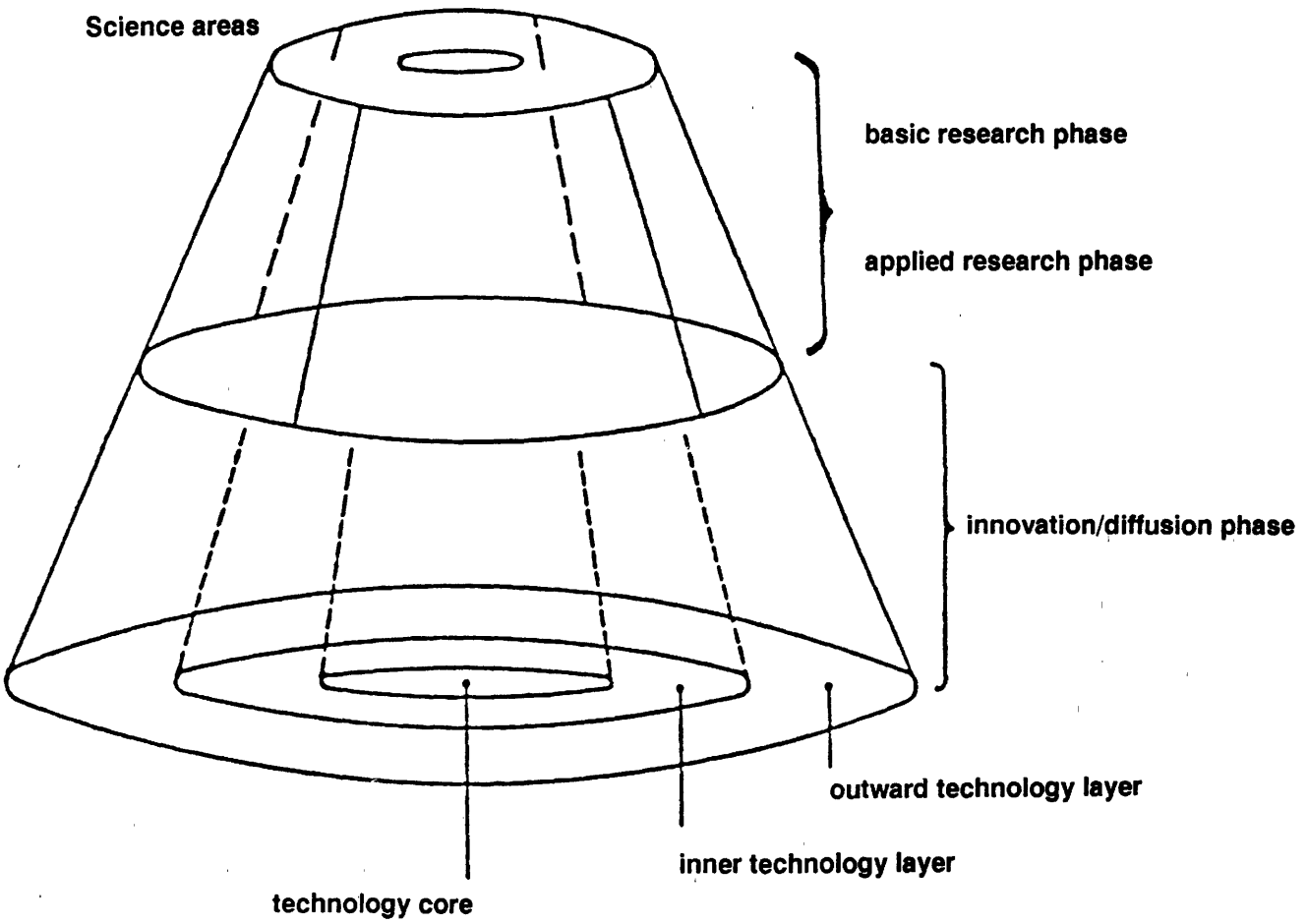
(4)

is already explained in the literature (eg Dosi 1988, Stoneman 1983, Abernathy, Utterback 1982). It concerns the central result chains of a technology flow matrix of science and innovation system in the categories of the cone theory. A layer wraps itself around this technology core (example: semiconductor technology) in which numerous further and adaptation developments of the basic technology on different application fields are located (example: diverse application possibilities of the micro-electronics). Here also industrial R&D activity still takes place, but the innovation level is lower and corresponds to the already above explained incremental innovation activities. The outward layer of the cone indicates, finally in this phase, the pure use and dissemination of the introduced technology in the market (adoption), for example, buying on the market available modern production plants as investment good or as intermediary goods (for example, new materials, software). Besides the (vertical) flow matrix between science and innovation system, there exists a close association between the technology core, the inner and the outward technology layer through the (horizontal) intersectoral connection.

Firstly, extending the cone theory through transformation of research into an innovation cone makes a possible theoretical derivation of the thesis of division of labour of innovation activity of big and small or medium sized enterprises which critically places an important branch of the innovation research in question and which, in connection with the shortened reception of the Schumpeterian thesis, has obviously concentrated on the question - "are big or small enterprises more innovative?". Bigger enterprises are predominantly going to determine the technology core of the cone, while small and medium sized enterprises, as far as they are innovating, are to be seen in the surrounding core of the layer. In the outward layer, small and medium sized enterprises are as well predominantly going to appear - this time as adoptors. Secondly, a typology which divides small and medium sized enterprises into three groups can be derived from here:

Figure 2/3

Innovation Cone



Source: Meyer-Krahmer, 1989.

1. Enterprises with a higher innovation level (technology core) prosecute mainly first-mover strategies and move themselves in high technology areas. They are Schumpeter-enterprises in the actual sense. To be expected is that only a small share of small and medium sized enterprises fall in this group.
2. Enterprises with incremental innovation activity which pursued predominantly niches strategies (inner technology layer) are mainly manufacturer of new materials and plants. It is to be expected that small and medium sized enterprises - if they are innovating - are to be seen in greater share, in this group.
3. Enterprises, which in itself adjust in this form to the technical change in which they buy new investment goods or intermediate goods which are available on the market and are herewith exclusive adoptors of new materials and plants (outward technology layer). It is to be expected that these enterprises belong predominantly to the traditional industrial sectors.

Such a typology is, nonetheless, of special importance for a technology policy for small and medium sized enterprises because an answer to the question is possible with its help - which enterprises are going to be reached and which type of innovation (or also diffusion) is to be promoted through such a policy. Furthermore, respective different concepts and instruments for the promotion of these types of enterprises must be adequate because different problem situations and effects are to be expected.

On the basis of such typology it is possible to identify *different specific roles of SME's within R&D projects promoted by the EC*:

a. SMEs performing R&D on the basis of a given specification (subcontractors);
b. SMEs acting as complementary partner for special problems;
c. SMEs contributing siginificantly to project design and specification;
d. SMEs as leading partners or coordinators.

3. Methods and Indicators

3.1 Methods of Evaluation with Special Emphasis to the Control Group Approach

Some of the recent evaluations have been performed with a mix of several approaches, which have been designed according to the specific characteristics of the programme. In general, the following methods of evaluation have been used so far (Rossi 1988, Meyer-Krahmer 1989):

Before/After Comparisons: In this approach, effects of programmes are identified by comparing the situations and the behaviour of the innovating companies before and after receiving public assistance. This approach employs either time series analyses and trend comparisons of the use of resources and the output achieved or a more qualitative comparison of the innovative behaviour and corresponding attitudes of firms. In a National Science Foundation (NSF)-analysis of a programme designed to promote cooperation between universities and industries, the extent of cooperation which occurred for the first time or the continuation of earlier co-operative relationships, the extent in which research findings were adopted before and after such cooperation was subsidized, whether there were personal contacts, and whether the use of pertinent information literature were investigated. In some cases, studies are limited to simple quantitative comparisons within the framework of the respective funding of programmes. For example, a German study investigated whether external R&D had increased or external consultants had been employed on a larger scale (see overview on relevant literature, Meyer-Krahmer 1988). Other studies seek to pinpoint changes in the development of R&D personnel or in R&D expenditures after the introduction of a programme to promote R&D. In such cases, periods of several years before and after the launching of the programme are compared. In yet another approach, a historical trend is extrapolated (for the case of the absence of a programme) and compared with actual developments.

The approach of before/after comparisons suffers from two fundamental problems; first it is based on data provided by the companies receiving support. Such data may be influenced by company interests. Secondly, since time-based comparisons are involved,

the impact of other factors has to be taken into account and, if possible, neutralized. This is very difficult and frequently it deals with ceteris paribus assumptions which are rather unsatisfactory. Thus, the more pronounced the structural changes are between points of data collections, the less useful this method becomes.

Control group approach: This approach concentrates on the comparison of behaviour of the companies promoted and the control group of a set of non-promoted companies. But it needs a theoretical base to justify the comparison between two groups as well as the structure which is necessary for the control group to guarantee the "ceteris paribus". This approach is theoretically very convincing. However, in its conversion, it still has, besides ceteris paribus, other problems: the significant characteristics must have to be identified in order to form a comparable group of the promoted enterprises. The usual characteristics are branches and sizes. These are statistically and empirically also understandable. The concept of the control group arises from the empirical conversion.

Econometric approach: This method has been used frequently especially in the USA and depends heavily on quantitative data and analytical estimates and tools. Usually this method employs a production function approach and it is used both at macroeconomic and microeconomic levels. As it is the case in almost every other research using the production function approach, its basic problems are inadequate assumptions (e.g. uncertainty) and the lack of reliable data. In addition, it is also necessary to consider possible influences of other factors.

Case study approach: The behavioural approach is used for qualitative analysis at micro-level. Even though there are other methods of evaluation, the case study method is most frequently used, mostly in the USA. The case study method is valuable for the analysis of the rapidity and complexity of innovative processes. But it raises some questions on the degree of validity, because it depends heavily on three categories of persons, that is, case researcher(s), informants, and reader(s) of the case. Most of all, it has difficulties in generalizing the results to other cases.

Science and technology indicators approach: Science and technology (S&T) indicators are successfully used in the realm of studies on the national structure of R&D. In particular, in the USA these have been intensively used by the National Science Foundation (NSF) since the seventies. Only during the past few years experimental use has been started on the microlevel to evaluate promotion programmes. It seems to be too early to judge the strengths and weakness; however, in combination with other approaches their use seems to be promising. This is true in particular for technometric indicators (the new concept, "technometrics" has been developed by the Fraunhofer-Institute for Systems and Innovation Research) which allows the measuring of technological achievements to complement the sales data with innovative products (innovation intensity) which are frequently distorted by pricing or fluctuating exchange rates. Also, the technometric method relies essentially on technology expert opinion and allows therefore the inclusion of qualitative aspects. EC presently tries out the use of indicators for an assessment of the utility of EC programmes.

Methods for impact analyses of governmental research and innovation policy, which have been used up till now, are mainly the peer-group approach, bibliometrics, technometrics, before/after comparisons, the control group concept, econometric models and case studies. These methods are strictly taken from different quality and different goals orientations: The before/after comparisons and the control group concept are the most valid methods to identify the influence of governmental promotion on research and innovation. These methods imply respectively a specific approach for the collection and registration of empirical data. In contrast, econometric models or the case studies approach are different methods with which the ascertained data could be analysed. Case studies, surveys or bibliometrics comprise also a third category of methods, namely a certain way of data collection. The transition between these different methods are flowing partly, most especially when many methods are being utilized simultaneously. In the works, available up to date, this strict difference between the various method categories is not carried out.

Methods such as peer review and bibliometrics are appropriate evaluation methods for basic or long-term applied research. In the case of EC-Programmes promoting industrial

R&D, other evaluation methods are needed such as the comparison of the before/after types and the use of control groups. Nevertheless, these methods are also relevant for evaluating basic or long-term applied research, because they help to identify causalities and impacts caused by public programmes.

Many studies use the case study technique which reflects the rather immature state of theory formation and the inadequate data base. However, an increasing number of studies attempt to supplement the historical, qualitatively descriptive case studies by applying additional methods. "Before/after" types of comparisons and the control group concepts have performed satisfactory particularly since they involve a combination of quantitative and qualitative approaches. Nevertheless, their empirical realization is difficult.

Because this study emphasizes especially on the control group approach, this concept will be discussed more in detail. The control group method is used mainly for evaluation of government programmes promoting industrial R&D and innovation. This method identifies the relation of causality between government programmes and direct or indirect technological and commercial outputs in industry. The type of outputs investigated depends on the concept of evaluation. Evaluation, as it is used here, means the examination and assessment of the effectiveness of programmes promoting industrial R&D and innovation. The key elements of such an evaluation are analysis of the firms reached (size, sector, innovation behaviour, their bottlenecks to cooperate etc.), the degree of technical and economic goal attainment of a programme and the actual effects achieved, both intended and unintended, as well as analyses of implementation and administration. In view of the thin empirical backing of impact hypothesis and the assumed bottlenecks of innovation in industry, analyses of the conditions underlying each programme are regarded as an important additional element of such impact analyses. Verifications of the theoretical considerations of governments and ministerial bureaucracies on which the conditions and administrative handling of promotional instruments are based, should also be included in impact analyses because they constitute the only way of ensuring that not only scientists, but also political administrator may learn from the results. This approach, developed for an evaluation of German programmes (Meyer-

Krahmer 1981), is similar to the evaluation concept underlying eg the Alvey programme evaluation.

The control group concept is based on comparisons of the behaviour of supported versus non-supported firms. The goal of the approach lies therein, ie, to have a possible comparison of both groups in order to show the experimental effect without interference. If this strict control cannot be executed, the methodological promotions must be withdrawn and a less sophisticated, quasi-experimental or non-experimental investigation plan has to be advanced. Its advantage is that there is no exclusive dependence on information provided by the firms concerned. On the other hand, the application of this method requires a theoretical base that can be used to identify which firms are truly "comparable" (which is particularly true in the "selection-for-purpose" case, for example, if "innovative" firms are compared).

This approach was used by McNutt and Rucker (1981) in their analysis of the impact of information programmes on car purchases. They found that the users of such information buy cars with better fuel economy than non-users do. A possibility for the formation of the control group is the random sample. The population of the non-promoted enterprises can (before the random sample is drawn) further be delimited through the standards of certain characteristics such as branches, sizes and R&D-intensity. However, it remained unclear whether that effect was produced by the pertinent information alone or was it due to the more positive attitude towards energy conservation that buyer exhibited, which had existed before they used the information programme. In this case the two groups cannot be regarded as comparable.

Similar problems occur in the studies by Allen et al. (1978), and by Warkov and Tourigny (1982). A highly interesting attempt to develop a control group is found in the analysis by the NSF of the Small Business Innovation Research Programme. Supported R&D projects which had competed respectively in the award selection procedure, but had been evaluated as less promising and therefore had not received an award. Another application of the control group method is explained in the following chapter in detail. These studies show that the control group concept, which has rarely been employed

empirically, is quite feasible and at least allows the order of magnitude of important impacts to be measured.

The control group approach is an evaluation method that identifies to which extent changes of scientific, technological or commercial outputs are caused by R&D or innovation policy. It helps to isolate programmes' influence from other determinants of industrial R&D and innovation. It is also an appropriate method for comparing different target groups of promotion programmes. With regard to the different aspects (eg reasons for participation/non-participation), the application of the control-group appraoch produces information on potential and real impacts of programmes. The main advantage of this method is the empirical clarification of causality.

On the other hand, this method has also conceptual and practical limits:

- The main conceptual limits is that the method does not contribute to the question of whether the R&D or innovation programme investigated represents an appropriate strategy to solve the underlying problem on the national, international or EC-level.
- The application of this method requires a theoretical base that can be used to identify which research teams or R&D performing firms are truly 'comparable' as well as to select groups of non-supported research teams or firms. This theoretical base has an essential influence on the clarification of causality problems.

On the other hand, an unappropriate theoretical base is a source for misinterpretations.

- The main practical problems arise from the respective possibilities to construct empirically a control group. This is one reason why this method is empirically rarely employed. But the above mentioned studies show that it is quite feasible and at least allows the order of the magnitude of important impacts to be measured.

On the background of rare practical experience, the *following recommendations for future implementation can be raised*:

- commence evaluation in the early beginning phase of the programme to be investigated,
- intensive development of the theoretical base,

- careful selection of promoted and non-promoted groups of research teams or R&D performing firms,
- careful interpretation of quantitative effects with special emphasis on qualitative aspects (such as learning effects, reasons of participation in government programmes).

Finally, it should be pointed out that the specific weaknesses inherent not only in the control-group approach but in all evaluation methods make it advisable to apply several of them simultaneously. This method mix has been attempted in some existing studies. Charles River Associates (1981) and Evenson (1982) linked case studies with econometric models. However, in some cases this is still done in an independent fashion despite the fact that case studies offer the possibility of providing some empirical backing for important model assumptions or for verifying such assumptions. The NSF (1982) combined the before/after type of comparison with the control group approach, thus rather closely resembling the approach by Meyer-Krahmer et al. (1983). Bräunling et al. (1981) use monitoring and before/after comparisons. The conditions under which different 'method mixes' are applicable should be considered more thoroughly in the future if the performance of evaluation research is to be improved.

3.2 Indicators of Economic Effects of R&D

Technology is considered to be a major competitive factor for countries at the macro level and for individual firms at the micro level. Joseph Schumpeter (1939) pointed out the importance of technology and innovation in the economic development process. Robert Solow (1957) has been a pioneer in establishing the quantitative impact of technology on productivity gain in the United States. Since then, many economists in the U.S. as well as elsewhere have focused on technology and its impact on the economy. Jacob Schmookler (1966) focused on inventions and patents to investigate the dynamic relationship between economic growth and development of technology.

Studies of innovation and technology development have evolved in different traditions or "paradigms". In terms of the scope of these studies, one can categorize them as follows:

- Country level studies. Here the attempt is made to discover and explain the technological growth in a country.
- Industry level studies. Here the attempt is made to understand the developments in terms of technological development.
- Technology level studies. Here the attempt is made to understand the development in a specific technological field and often assessment is made for its immediate future prospects and problems.
- Firm level studies. Here the attempt is made to understand the differences among firms in terms of their innovative ability.

All of these science indicators studies have used actual innovation data, rather than surrogate measures such as patents of papers. However, these studies vary in terms of the methods used to define the universe of innovations and sampling from that universe for further study. Three distinct traditions of research identified from this body of literature can be divided into the following categories (Chakrabarti 1989):

- Literature based approach. The universe of innovations is defined by consulting scientific and technical magazines. Subsequently experts are consulted about the rating of these innovations. Surveys of firms are conducted to obtain detailed information on these innovations.
- Expert based approach. Studies conducted in the United Kingdom and Canada have followed this approach. The Science Policy Research Unit at the University of Sussex developed this approach. The universe of innovations is defined by surveying a large number of experts in various disciplines and fields.
- Survey based approach. Studies conducted in France, Germany, Italy and The Netherlands have differed from the other two research methods in terms of defining the universe of innovations. These studies used surveys of firms as the method for identifying the innovations or innovative output of the firms.

The approach of this research project is the survey based approach. The innovation indicators on a firm level are listed up in Figure 3.2/1 including input and throughput indicators as well as output indicators. The indicators are described and discussed in detail in Chakrabarti (1989) and Meyer-Krahmer (1984). Besides the quantitative indicators describing economic effects of R&D in this study, the following qualitative indicators are perceived as essential indicators for identification of specific effects/benefits of EC-programmes:

- learning effects
- competence for cooperation
- new customers/new business fields.

One aim of this study is to clarify empirically to which extent small and medium sized firms use methods forecasting the economic benefits of R&D.

Different indicators are been used for the measurement of the innovations of the enterprises. Furthermore, different input, throughput and output indicators can be applied according to its function in the production process (see Figure 3.2.1). This, on the otherhand, is to be differentiated in quantitative and qualitative factors.

The expenditures for Research and Development (R&D) count as the most important quantitative indicators. According to experience, the requirements for personnel have by far the highest share of the R&D expenditures by the SMEs. The qualitative indicators measure important complementary factors.

Patent incomes and expences are being drawn into the so-called throughput-factors. In this context, it must, however, be considered that the conduct of patents is different from coutnry to country and enterprise to enterprise.

The innovativeness of the enterprise can therefore not be inferred directly from the conduct of the patent. Further information are necessary.

The same problem arises by the measurement of innovational output. It is, amongst others, being measured on the alteration of the range of products, the profit, the employees' structure (shares of qualitative personnel, R&D personnel of the total personel) of the productivity. Because the results are co-shaped from many other influences, only a very unsatisfactory statement about the innovative behaviours and the technological competitiveness of the enterprise can be made alone on the basis of output indicators.

Figure 3.2/1

Innovation Indicators on Firm Level

Innovation Indicators	Quantitative	Qualitative
Input	R&D-personnel R&D-expenses contract research innovation stages (costs, risks)	impulses for innovation level of organisation and planning of R&D learning effects barriers of innovation competence for cooperation
Throughput	patents applied for and granted revenues by selling patents, licenses and know-how	
Output	innovation intensity productivity profits employment non-commercial benefits	new or improved products, processes and services aims of innovation competitive position new customers/ new business fields

4. BRITE/EURAM-Subprogramme "Aeronautics"

4.1 Aeronautic Industry in Europe

4.1.1 An Overview of the European Aerospace Industry

The Aeronautic industry is a part of the Aerospace industry. The entire branch encompasses the civil and military aircraft construction as well as the spaceflight. Because these branches are very strongly intertwined with one another, it is necessary, on the onset, to give a short overview of the entire branch in order to have a better understanding of the Aeronautic industry, which, of course, is the subject matter of this analysis.

The European Aerospace industry occupies the second place after the United States of America and with Japan trailing far behind in the Western World. The industry made in 1988 a turnover of 39 billion ECU. After substracting the sales made between the Aerospace firms of the European Community, the consolidated turnover at EC level of the sector amounted to 31,6 billion ECU. The production of the branch has risen (to the prices of 1985) to around 77,5 % within ten years and thus, expanded almost faster than in the United States with a growth of 62,6 % (4.1.1/1).

The Aerospace industry is predominantly concentrated in the United States of America. The reasons for this lie, above all, in

- the large internal market for civil aircrafts. In comparison to Europe, the United States of America has, in addition to the advantage of a common market, only a relatively low developed railway network. Furthermore, the usage of aircraft is favoured through the far apart located industrial centres as well as the sparsely populated areas.
- the large defence budget. The USA has the largest domestic requirements of military aircrafts in the Western World. This as well as the military leading role of the USA have lastly led to the fact that the USA has become by far the largest producer of military aircraft.

Table 4.1.1/1

Turnover and Employment in the Aerospace Industry

	Turnover consolidated, nominal		Turnover according to prices of 1985		real alteration to previous year		Employees	
	EC	USA	EC	USA	EC	USA	EC	USA
	in billion ECU				in %		in 1000	
1978	9.2	24.5	16.5	70.1	--	--	.	720
1979	10.6	28.0	16.8	78.3	1.9	11.6	424	842
1980	14.1	34.0	19.4	86.9	15.5	11.0	472	902
1981	16.7	49.1	20.6	89.3	5.7	2.8	500	900
1982	18.4	59.9	21.3	86.4	3.5	3.1	483	831
1983	19.3	72.0	21.4	89.9	0.8	4.0	482	830
1984	21.5	84.2	22.7	86.0	6.2	4.4	465	850
1985	24.7	103.3	24.7	103.3	8.5	20.2	481	939
1986	27.5	86.5	27.3	108.7	10.3	5.2	488	967
1987	29.3	77.7	28.8	114.8	5.7	5.6	492	992
1988	31.6	77.9	29.3	114.0	1.6	0.7	502	975
1978-88					5.9	5.0		

Source: EC - DG III.

As the table 4.1.1/2 shows, the American aerospace industry has relinguished since 1960 production shares to Europe and has also reinforced this in recent times to non-European countries. A decreasing dominance of the USA in the area of aerospace production is not to be derived from the above connection. This would, of course, be the case if original or independent competitive products were hidden behind the increasing production shares of the other countries. The reasons for the shifting of shares could also be licence productions and deliveries.

Table 4.1.1/2

Changes in the Geographical Breakdown of World Aerospace Production from 1960 to 1987
- in % -

	1960	1964	1968	1972	1976	1978	1980	1982	1984	1986	1987
United States[1]	86.0	82.0	83.0	74.0	67.0	64.0	59.6	63.7	68.0	64.8	62.4
Europe	11.0	14.0	12.0	20.0	25.0	27.0	31.2	26.5	21.3	24.4	27.0
including											
France	2.6	3.7	4.0	6.2	11.3	11.2	10.8	8.8	7.6	8.0	8.2
Great Britain	7.8	7.4	6.0	8.7	9.4	10.6	11.9	9.6	7.6	7.9	9.6
West Germany	0.5	1.3	1.3	3.7	4.1	4.7	4.8	4.5	3.4	4.6	5.0
Rest of World[2]	3.0	4.0	5.0	6.0	8.0	9.0	9.0	9.8	10.4	10.8	10.6
including											
Canada	2.0	2.3	2.2	2.4	2.3	2.0	2.4	2.5	2.1	2.3	2.6
Japan	0.5	0.6	0.8	1.6	3.0	3.8	2.3	2.8	2.8	3.5	3.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
in current $ billions	18.4	23.1	31.7	27.4	36.3	48.4	77.0	88.4	103.0	135.0	151.0
in constant 1982 $ billions	59.5	70.2	84.0	58.9	57.5	67.0	89.8	88.4	95.3	117.8	127.5

1) Excluding related products and services.- 2) Consolidated production value.- 3) Excluding China, the Soviet Union and the COMECON countries.

Sources: Euroconsult's ECOSPACE Data Base; Industrial statistics from the different countries.

5)

A glance at the employment development in the European Aerospace Industry illustrates that the employment expanded considerably at the end of the 1970s. It decreased continuously till 1985 and began again to increase. With 502,000 employees in the year 1988, the highest level of 500,000 employees reached in the year 1981 was already lightly surpassed. The employment development proceeded generally in the same form in the United States though in quite higher proportion. But in USA there are much more fluctuations because they adapt the third of employment to the needs of the production. The production comparison between USA and Europe portrays an obvious higher production level in the United States: While in the year 1988 an average turnover of around 83,000 ECU (to prices of 1985) per employee was achieved in Europe, in the United States, however, it was 110,000 ECU per employee. Even when structural differences influence the productivity standard, many factors accounted for the fact that the leading position of the USA over Europe resulted at least partly from a higher production efficiency.

The importance of the Aerospace industry in Europe has relatively increased continuously since the begin of the 1970s. Its share of the gross inland product (GIP) was 0,6 % at first in the year 1972, and was already by 1 % in 1987. The corresponding share in the USA was 2,1 % and 0,25 % in Japan.

The Aerospace is a small industry, measured on their employees and the shares of their real net output, however, enormous importance is generally attached to this branch. This resulted, above all, from two functions of the branch:

- National autarchy: In the case of crises, the Aerospace industry is supposed to help secure the particular defence capability of the country. The agriculture or the energy economy has a similar function which, in such a situation, is supposed to sustain the independent supply of the country.
- Industrial political/technological: The Aerospace industry is regarded as technological key area. This, in itself, is already portrayed on a close examination of the research and development expenditures (R&D Expenditures): 15 % of the

total turnover is allotted to R&D. No other industrial sector has a similar high relation.

The European Aerospace industry occupies with 13,8 % of the total expenditures of industrial R&D the third place behind the electric and electronics industry as well as the chemical industry.[1] In this industry - so the argument from industry and politics - many technologies are not only going to be pushed forward but the development results are going to be scrutinized in the practical application at a very early state. This, above all, is to be traced to two influences. Savings, amongst others, are fundamentally more pronounced by costs and output considerations in the civil area than in other branches. In the military area, solving of technical problems for the accomplishment of the "Mission" come first before the economic aspects. Because of the military terms of reference and the technological significance which is attached to it, there exists in the Aerospace industry a close relationship between government and economy in the respective countries. The governmental engagement is frequently buttressed with the higher development costs and the longer phases of advanced financing by the Aerospace products.

With respect to the product areas within the Aerospace industry, these are generally differentiated in "airframes", "engines", "equipment", "space" and with respect to utilization in "military" and "civil". The respective product areas had, at least, the following percentages in 1987:

airframes	46 %
equipment	30 %
engines	18 %
space	6 %

A clear production displacement has ensued within the branch during the period 1980 to 1987:

[1] A competitive European Aviation Industry: Memorandum of the Commission 1990, Extract, p. 14).

- The significance of the main aircraft parts has decreased continuously from 54 % of the production share in the year 1980 to 46,3 % in 1987.
- The share by the engines decreased from 19,6 % to 17,8 %
- The importance of the equipment construction has increased, amongst others, due to the enormous importance of the electronics. The production share was 23 % in 1980 by the equipment and it was already 29,7 % in 1987.
- The increase of the production share of the spaceflight production from 3,1 % to 6,1 % is chiefly to be traced to the bosstle rocket Ariane and the commercial satellites.[2]

The production shifts are, above all, to be traced to the following influences:

- The airframe has a duration of twenty to thirty years. Within this period and with respect to its equipment, the aircraft will, in the rule, be re-equiped and modernized repeatedly.
- The value share of the equipment in the aircraft increases, at least, due to the technical progress in the electronics and avionics.

At least more than 60 % of the production in the European Aerospace industry are apportioned to the military area. In view of the increasing détente between the super powers and the current high demand for large civil transport aircraft, the importance of military production must decrease in favour of the civil production (see Table 4.1.1/3).

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[2] Aerospace Industry, NACE 364.

Table 4.1 1/3

Production of the European Aerospace Industry according to Product- and Utilization Areas[1]
- in Million ECU -

	1980	1981	1982	1983	1984	1985	1986	1987	1988
Product Areas									
Airframes	11043	13589	15386	16295	17218	18177	18712	19480	.
Engines	3998	5028	5642	5249	5829	6649	7181	7470	.
Equipement	4710	6017	6346	7504	8195	8704	11871	12470	.
Space	643	775	1046	1132	1310	1922	2186	2580	.
Utilization Areas									
Military	14276	17834	19871	20371	22170	23562	25210	26300	.
Civil	6118	7575	8548	9808	10382	11890	14740	15700	.
Total	20394	25409	28419	30179	32552	35452	39950	42000	46000
of which:									
civil in %	30.0	29.8	30.1	32.5	31.9	33.5	36.9	37.4	.

1) Non-consolidated production.

Source: Panorama der EG-Industrie 1990, Euroconsult.

The determining scope conditions for demand and development of both areas are differentiated from one another:

- In the military area, the demand is predominantly determined by the political situation, ie the restrictions which the budget policy of the government are subjected as well as the military strategy.

- In the civil aviation, the economical influence generally dominates the technical and political. This sequence will, of course, be changed in favour of technique when serious technical developments, such as the Jet aircraft take place with which new markets will be opened. Moreover, alterations in the scope conditions, such as noise protection requirements and lower direct operating costs, could also pose new demands on the techique and could lead to the accelerated exchange of old aircrafts or to their modernization.

Because of the partly similar technical terms of references, there exists today a far-reaching agreement in the industry that only the interlacing of the three business fields -

aviation, spaceflight and defence technique - will create the prerequisite for an economic conversion of the technical development. With few exceptions, the big enterprises in the USA, Europe and Japan are active in all important business fields of the branch (Figure 4.1.1/1).

Figure 4.1.1./1

Business Fields of System Firms of the Aerospace Industry

	Military Aircraft	Civil Aircraft	Helicopter	Defence Technique	Space
UTC			●	●	●
Boeing	●	●	●	●	●
McDonnell Douglas	●	●	●	●	●
Lockheed	●	●		●	●
Aérospatiale, Dassault	●	●	●	●	●
British Aerospace	●	●		●	●
Aeritalia[1)]	●	●		●	●
DASA	●	●	●	●	●

1) Alenia exists since 1990 through the fusion of Selenia and Aeritalia.

Source: Dornier.

The Aerospace production takes place essentially in four countries within the European Community: Great Britain, France, Germany and Italy. Besides, committed countries to mention in this area are the Netherlands, Belgium and Spain. Measured on the total production, the engagement of the remaining countries of the European Community is of secondary importance. Sweden is still to be mentioned in this connection as a further European country which has her own aerospace production. The analysis of the shares of the countries in the periods of 1978 to 1988 portrays an enormous increase of the Federal Republic of Germany from 15 % to 25 %. Simultaneously, the shares of France decreased by 9 %-points to 31 %-points at present and Great Britain by 3 %-points to also 31 %-points at present. The Italian share has also risen noticeably. It increased from the former 6 % to 9 % today (see Table 4.1.1/4).

Table 4.1.1/4

The Shares of the Respective Countries on the Turnover of the European Aerospace Industry
- EC = 100 -

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Belgium	1	2	2	2	2	1	1	1	1	1	1
Germany	15	20	17	16	18	18	17	18	25	24	25
Spain	1	1	1	1	2	1	1	1	1	1	2
France	40	38	36	35	35	36	36	35	33	31	31
Italy	6	7	6	7	8	9	9	9	9	9	9
Netherlands	2	2	2	2	2	2	2	2	2	1	2
Great Britain	34	31	38	38	36	33	34	34	31	33	31
EC	100	100	100	100	100	100	100	100	100	100	100

Source: EC - DG III.

The European Aerospace Industry is considerably determined by sixteen big system enterprises (prime contractors). The system enterprises distinguished themselves through the fact that they developed and produced in their respective competences aircrafts or the socalled subsystems. Because the award of contracts within the Aerospace Industry is often traded on the principle of "buy national", a very central role for the entire European Aerospace Industry will fall towards these enterprises.

The following Table 4.1.1/5 of the civil aircraft, helicopter and power plant production serves here the concretization of the aforementioned problem. It explains respectively the produced low number of items and gives information about the individual market volume. The development in the European large civil aircraft construction is, most especially, to be addressed in this relationship. This has strongly expanded in recent times and its production volume will further increase. Thus, this will enable new possibilities to be opened for the entire European Supply industry in the area of aviation.

Two exceptional features of the branch, amongst others, must, of course, be considered by the evaluation of the BRITE/EURAM Subprogramme Aeronautics:

- Enterprises below the system level have, in a very limited form, only the possibility to find markets with their respective product ideas. Instead, they are dependent on the system enterprises. This, of course, opens also production possibilities for the suppliers through the aircrafts and power plants produced by them, whereby the product to be developed or supplied must conform with the given technical scopes of the system manufacturer.
- The dependence of the equipment industry is still increased through the relatively respective low multiple variants of the produced aircrafts or power plants, the limited number of the system enterprises as well as the difficulty of the market entry. To be able to be active as producer in the area of aerospace, an enterprise must not only acquire the confidence of the customer, but must also be licenced as producer.

Table 4.1.1/5

Big Enterprises of the Europan Aviation Industry

	sales 1988 (ECU in millions)	employees 1988
GREAT BRITAIN		
British Aerospace	5 993	87 500
Rolls Royce	2 919	40 900
Westland	530	9 163
FRANCE		
Aérospatiale	3 996	36 000
Dassault	2 520	13 318
Snecma	1 427	13 482
Matra	996	5 586
WEST GERMANY		
MBB	3 430	38 774
Telefunken Systemtechnik *	1 106	9 885
Dornier	748	9 178
MTU	695	7 787
ITALY		
Aeritalia	1 290	16 000
Agusta	718	9 500
Fiat Aviazione	430	4 800
THE NETHERLANDS		
Fokker		11 809
SPAIN		
Casa	561	10 652
SWEDEN		
Saab	722	7 816

* AEG Aerospace

Overall profitability is still low

Quelle: Panorama EC-Industry

If one proceeds from the premise that the market controlled competition can in itself be realized faster in the civil area of the aeronautic industry, then the development of this market segment is especially of importance under the viewpoint of a competitive European Aviation industry. Although all larger military plans of the European Aviation industry are also to be executed in the scopes of countries overlapping cooperations, nevertheless, the division of the work piles here is still to be politically determined in a far higher degree than in the civil area. Lastly, it is generally to be expected that the significance of the international division of labour will increase.

4.1.2 Peculiarities of the Branches and Effect Hypotheses

The evaluation of a promotion programme - including the BRITE/EURAM Programme has basically the duty to examine

- to what extent the measures of th laid down goals have been achieved;
- which intended and non-intended side effects have occured through the promotion;
- if the laid down assumptions of the programme are correct and
- if the programme goal and/or the adopted measures for achieving the goal are adequate in order to be able, if the need arises, to undertake modernization.

Before its empirical execution, every evaluation must begin with working hypotheses. Firstly, this resulted from the situation of the branch to be promoted and secondly, from the established assumptions of the promotion. For the area of the small and medium-sized enterprises in the European Aviation industry which is to be analysed here, the following working hypotheses stand in the forefront:

- Financing of R&D is a central bottleneck area in the concerned enterprises.
- The enterprises are dependent on cooperations with enterprises and institutions which have their seats in other European countries.

- The financial support in the R&D area helps the enterprises by the execution of the expensive R&D-plans and creates therewith important prerequisites in order to be entrusted, as cooperation partner, with the solving of specific formulated questions in the scopes of bigger projects.
- The entry into a cooperation creates good prerequisites for the further engagement in the aviation area.
- Through the promotion conditioned stronger engagement in technological superior areas of the aviation, the enterprises receive a supply of knowledge which will generally contribute to the improvement of the technological competitiveness of the enterprises.
- Through the promotion programme, the cooperation within Europe will be promoted beyond the boundaries and will enhance the fusing together of the national markets into a European domestic market.
- The market entry barriers are very high for small enterprises in the aviation industry. This is especially valid for enterprises of the "Small Member States". The reasons for this are, amongst others, to be seen in
  - o the low number of the final products for which the system firms, in the rule, are responsible;
  - o the relatively easy comprehensible market with already traditional business relationships;
  - o the higher security demands on the products which especially make a registration as aviation producer necessary;
  - o the risk of product insurance by simultaneous higher development costs and relatively lower produced items;
  - o the dependence of the policy of the system and subsystem industry which opens not only its product policy but also its preparedness for the division of labour of the activity field for the small enterprises of the European Aviation industry.

In the scopes of this analysis, the contents of the surveys to be executed were laid down on the basis of the acquired characteristics of the branches as well as the effect

hypotheses that resulted thereof. With respect to the enterprises of the "Small Member States", the question of their comparative advantage and the possibility to produce through the measures of the European Community and the scope conditions which allowed them a stronger engagement in the European Aviation was thereby of special interest.

To push forward the European industry towards the common market and to strengthen it in its international competitiveness and thereby integrate also countries, which have no individual system industries at their disposal into the European Aviation industry should be the duty of the BRITE/EURAM-Subprogramme Aeronautics. As the loc cit already portrayed, this was also a reason to question enterprises from Ireland and Denmark in the scopes of this project.

4.2 The Programme

BRITE/EURAM is a European Community programme of support for collaborative industrial research which has been proposed by the Commission for the years 1989-1992. It builds on the activities of two previously separate programmes covering research in industrial technologies (BRITE) and in advanced materials (EURAM). The Council of Ministers approved, on 14th of March, 1989, the BRITE/EURAM programme including the following five areas of activities (see CEC 1989):

- Advanced Materials Technologies
- Design Methodology and Assurance for Products and Processes
- Application of Manufacturing Technologies
- Technologies for Manufacturing Processes
- Specific Activities relating to Aeronautics.

The last area covers precompetitive civil research in technological areas which are of primary relevance to aeronautics - both fixed wing and rotary wing aircraft - and which are not covered in other programme areas. A budget of 35 million ECU is allocated for specific activities relating to aeronautics. This was a three year programme which was started in 1989. The prime objective of the Aeronautical programme is to ensue the continued competitiveness of the European aeronautical industries in world markets. It aims to achieve this objective by encouraging these industries to undertake common measures to tackle commonly-recognised issues by fostering increased cooperation in research and technology activities, concentrated on key technology areas. Through this programme, the Commission supports, on a shared cost basis, European industrial R&D on the promise of new projects to be undertaken in a framework of international cooperation within the European Community and, under certain special conditions, the EFTA countries. It promotes collaboration in strategic industrial research between industrial firms and complementary centres of expertise in industry, universities and research institutes.

The aeronautical programme will also encourage transfer of technology between industrial sectors including small and medium sized enterprises (SMEs) which need to exploit new technologies to improve their performance.

The Aeronautical programme is open to all industrial enterprises, research institutes, universities and other interested organisations within the European Community and, under special conditions, within EFTA countries. Organisations participating do so under research contracts with the Commission of the European Communities, normally on a cost-shared basis. Participating organisations will be engaged in one of the two main types of cost-shared projects; an industry-led project of industrial applied research or a project of focused fundamental research led by a university, research institute or similar institution, but with industrial endorsement.

The Commission and the European Aeronautic Industry are afraid that Europe could suffer subsidization conditioned competitive losses through the American and Japanese Research and Development programmes. During 1986, the Commission arranged to seek that the industry's views on whether an initiative to help redress the imbalance in research activity at community level would be welcomed by the industry and, if so, on what priority themes it should be focused.

In 1987 and 1988, the Commission sponsored a study by representatives of the major airframe manufacturers, the EUROMART study, which identified areas of research which were considered to be critical to the future competitiveness of the industry in world markets. This study also proposed a range of priority topics for research projects within these areas. These were refined in a series of seminars and workshops, held during 1988, which involved experts from a wider section of the aeronautic industry and from universities and relevant research organisations within the European Community. In addition, separate reports, conveying views on the content of a European research programme in aeronautics, were submitted to the Commission in 1988 by representative groups of the European aero-engine manufacturers and the European aerospace equipment manufacturers and system suppliers.

The workprogramme for the Aeronautics research activities aims to achieve a balance between the financial support available and the perceived needs of the aeronautic industry. The topics and workpackages included in the two year programme are uniquely aeronautics related and have been selected from those defined in consultation with the aeronautic community as described above. The main milestones of the current programme are:

16th December 1988	Council's Common Position on BRITE/EURAM Including Area 5 Aeronautics
14th March 1989	Council Decision on BRITE/EURAM Including Area 5 Aeronautics
23rd March 1989	Formal Call for Proposals
9th June 1989	Deadline for Area 5 Aeronautics Proposals
19th-28th June 1989	Evaluation by Experts on Proposals Received
17th July 1989 - 12th September 1989	Agreement to the Lists of Selected Proposals by Aeronautical Management Committee
September to December 1989	Contract Negotiations
1st December 1989	First Project Started (24 Month Duration)

The specific activities relating to aeronautics, as approved by the Council, cover:

- aerodynamics
- acoustics
- airborne systems and equipment
- propulsion systems

The technical objectives of the work envisaged on these activities is given in outline in Fig. 4.2/1, and are documented in the workprogramme of 10th March, 1989 (see CEC 1989).

The important field of computation is not separately represented but aspects of computation are included in each of the four specific activities. This workprogramme should encourage software development with the long-term view of having computer codes which are available to any company in the European aircraft industry. The

existence of compatible software would reinforce European cooperation and make an important contribution to standardisation, which is an essential prerequisite for future competitiveness.

Knowledge transfer is seen as an important and beneficial aspect. On specific applications, this will involve the close interaction and collaboration of the scientists involved. Community-wide knowledge transfer will involve interaction with researchers from government, industry and academic institutions in order to enhance research effort and increase efficiency.

Figure 4.2/1: Specific Activities Relating to Aeronautics

1. *AERODYNAMICS*
   - Analysis and optimisation of configurations of supersonic aircraft, including an estimation of aerothermodynamic heat loads;
   - Investigation of laminar flow technology;
   - Development of numerical methods;
   - Integration of computerized design technologies;

2. *ACOUSTICS*
   - Noise source identification, prediction and reduction;
   - Basic investigation of acoustic fatigue and related damage tolerance of advanced composites;
   - Investigation of different construction methods;
   - Development and application of simulation models for response calculations under selected acoustic loads.

3. *AIRBORNE SYSTEMS AND EQUIPMENT*
   - Integration and operation of modern systems and equipment and corresponding new architectures;
   - Investigations concerning the use of onboard intelligent knowledge based systems (IKBS);
   - Investigations into the concept of the "All Electric Aircraft".

4. *PROPULSION SYSTEMS*
   - Integration of advanced propellers and propeller-rotor systems.
   - Provision of mathematical models for different design evaluation;
   - Specification and design of wind tunnel models and their components;
   - Specific aspects of air-breathing engine comustion.

Source: CEC 1989

4.3 Status of the Programme as at June 1991

A Call for Expressions of Interest was issued on 9th February 1989 and more than 400 replies were received by April 1989 coming from all Member States, Norway, Sweden, Switzerland and even South Korea.

The corresponding workprogramme dated 10th March 1989, was issued after the Call for Proposals has been published, 23rd March 1989, together with the Information Package which gave details on how to present a proposal to the Commission.

Two types of activities were available for support by the Commission on a cost-shared basis:

Type 1	projects for industrial applied research
Type 2	projects for focused fundamental research

The former, generally larger projects (1 million ECU minimum) had to be presented by at least two industrial companies from two different member-states, the latter, generally smaller projects (usually 0.5 MECU of total cost) had to be presented by at least two universities or research establishments of two different member-states, endorsed by at least two aeronautic companies.

The costs were to be supported by the Commission, up to 50 % of total cost in the case of industrial or non-universitary organizations, up to 100 % of marginal cost for universities.

The closing date for submission of proposals was 9th June 1989, 112 proposals were received (see Annexes 1 and 2) from all member states except Luxembourg, plus Norway, Sweden and Switzerland, and from all types of organisations: large aeronautic and non-aeronautic companies, small and medium enterprises, research centres and universities (see Figure 4.3/1).

Figure 4.3/1

Programme Statistics

- More than 400 Expressions of Interest
- 112 Received Proposals
  - o 96 Industrial Applied Research (Type 1)
  - o 16 Focus Fundamental Research (Type 2)
- 28 Selected Projects
  - o 23 Industrial Applied Research
  - o 5 Focus Fundamental Research
- 35 Mio ECU EC-Funding Budget for Two Years

The 112 initial proposals had been submitted by 47 different coordinators including:

- 32 industrial companies
- 3 research centres
- 12 universities

The 28 projects selected are led by 17 different coordinators including:

- 13 aeronautic companies
- 2 research centres (VKI and ONERA)
- 2 Greek universities (Athens and Thessaloniki)

Large aeronautic companies appear in 25 out of 28 projects (and endorse the 3 additional type 2 projects). Universities also appear in 25 (not exactly the same ones) out of the 28 projects. The non-university research centres appear in 20, SMEs in 15 and large non-aeronautic companies in 5 out of the 28 projects (see Table 4.3/1, 4.3/2 and Figure 4.3/2).

Table 4.3/1

Number of Proposals and Prime Proposers per Country

Country	Number of Proposals	Total Cost MECU	CEC Funding req MECU
Belgium	5	8	4
Germany	31	84	44
Denmark	1	2	1
Spain	3	5	3
France	39	92	49
Greece	2	1	1
Italy	7	16	9
Ireland	--	--	--
Luxembourg	--	--	--
Netherlands	3	5	3
Portugal	--	--	--
United Kingdom	21	53	29
Efta	--	--	--
Total	112	266	143

Source: Commission of the European Communities, BRITE/EURAM Area 5, Progress Report; DIW.

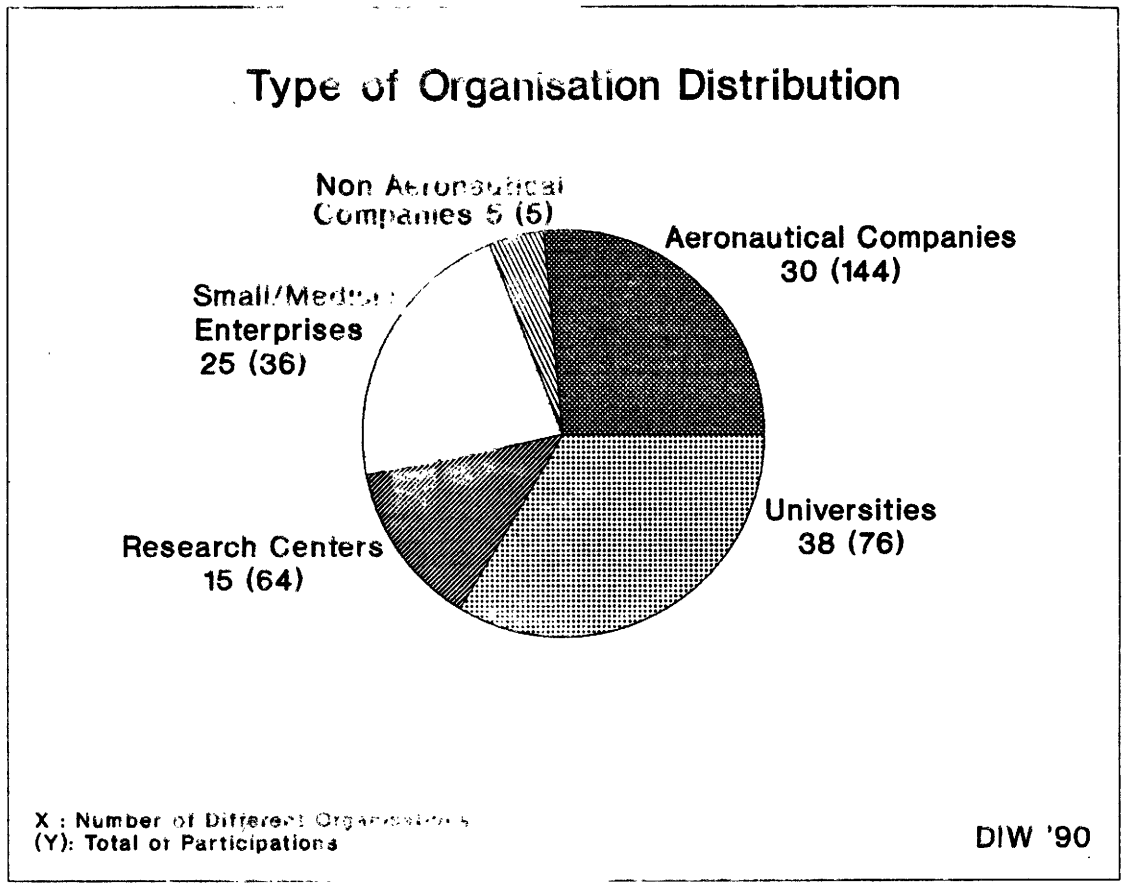
Table 4.3/2

Distribution of all Participations

Country	Large Aero-nautical Companies	Small and Medium Enterprises	Large Non-Aeronautical Companies	Research Centers	Universities	Total
Belgium	3	3	0	3	6	15
Denmark	0	5	0	0	5	10
Germany	36	0	3	13	8	60
Spain	7	1	0	1	3	12
Greece	1	5	0	0	11	17
France	36	8	1	18	7	70
Italy	16	0	0	6	8	30
Ireland	0	9	0	0	3	12
Netherlands	11	0	0	18	1	30
Portugal	0	2	0	0	9	11
United Kingdom	27	2	1	5	15	50
	137	*35*	*5*	*64*	*76*	*317*
Norway	0	1	0	0	0	1
Sweden	7	0	0	0	0	7
Total	144	36	5	64	76	325

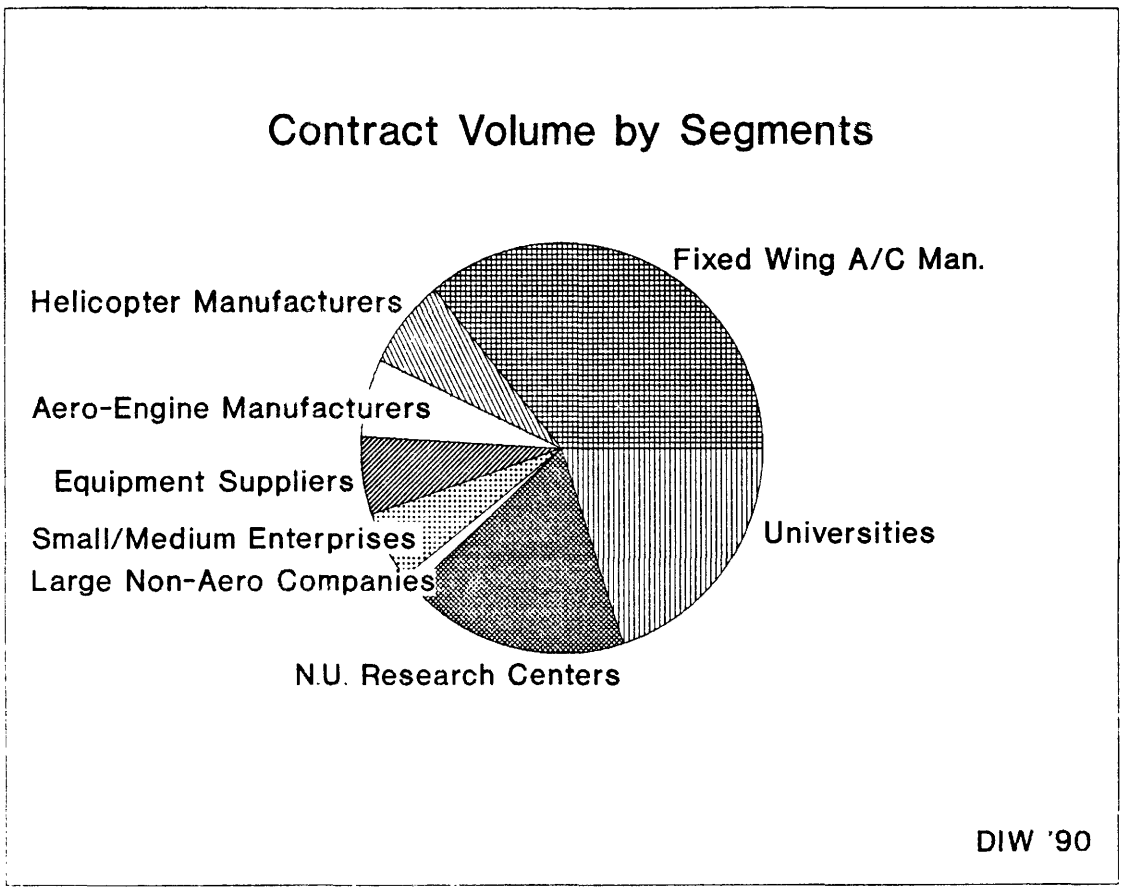
Source: Commission of the European Communities, BRITE/EURAM Area 5, Progress Report; DIW.

Figure 4.3/2



Source: Commission of the European Communities. The Community R & T Activities in Aeronautics, 1990.

Figure 4.3/3



Source: Commission of the European Communities: The Community R & T Activities in Aeronautics, 1990

In terms of Commission funding, the focussed fundamental research represents only 6,5 % (instead of 7 to 10 % which was the initial target of the Council of Ministers decision). It was noticed by the evaluators that the type 2 proposals were in general not of the same quality and the same relevance as those of type 1. However, the funding of universities is 20 % of the total Commission budget.

The Commission funding of the various segments is given in Figure 4.3/3. However, these figures do not presently take into account the subcontracts that industry will pass on to the national research centres.

The various topics and subtopics which are covered in the selected projects are gathered into their relevant groups and presented in Table 4.3/3, as well as the corresponding allocations of Commission funding.

Status of the programme as of June 1991:

- All retained projects have been negotiated, the technical content, the participants and the funding are settled, and very little money (about 200 kECU) is left for contingency.
- The contracts related to 13 projects have been signed, amount of Commission funding is 18,173 kECU.
- The advance payments (about 60 % of the Commission contribution) has been made for those 13 projects, which amounts to 10,927 kECU.
- One project (1004, investigation of laminar flow control) started on 1st December 1989, 10 projects could start as of 1st January 1990. It is expected that the Commission will agree a start date of 1st February or 1st March 1990 for the rest of the projects.

Table 4.3/3

Distribution of CEC Funding by Topics

		KECU	KECU
Aerodynamics		**14,377**	
Supersonic flow phenomena	4.4 %		1,522
Laminar flow technology	14.7 %		5,074
CFD for helicopters	7.2 %		2,480
CFD for aircraft	15.2 %		5,301
Acoustics		**4,899**	
Interior noise of aircraft [1]	5.0 %		1,745
Exterior noise of helicopters	4.8 %		1,695
Acoustic fatigue/damage tolerance	4.2 %		1,459
Airborne Equipment and Systems		**8,148**	
Integration and operation of modern systems and equipment	15.1 %		5,260
Health and usage monitoring of helicopters	2.4 %		,834
All electric aircraft	5.9 %		2,054
Propulsion Systems		**7,333**	
Integration of advanced propulsion systems	7.2 %		2,507
Computational FD for propulsion components	4.8 %		1,654
Modelling of bearing lubrication	2.2 %		778
Specific aspects of air-breathing engines	6.9 %		2,394
Total	**100 %**	**34,757**	

1) Include 150 KECU for interior noise of helicopters.

Source: Commission of the European Communities, BRITE/EURAM Area 5, Progress Report; DIW.

5. Empirical Results of the Pilot Phase

5.1 Conception of the Survey

The Aviation industry - as was stated under 4.1 - is an industrial sector with many peculiarities which traditionally succumbed in greater extent to direct and indirect exertion of government influence. The evaluation of one of the established promotion programmes for this industry, such as the BRITE/EURAM-Subprogramme "Aeronautics" portrayed, could though be executed with the already described methodological conceptions, the question formulations by the surveys of the enterprises as well as the interpretation of the answers must take into account the peculiarities of the branch. Applicable, most especially, to the participating small and medium-sized enterprises in this industry was that they could actually gain a market entry only through a division of labour cooperation with bigger enterprises of this branch.

In the scopes of the Euromart Study, technology fields in which the European Aviation industry saw research requirement were located in view of their improved competitiveness. It was not the duty of this study to place into question these results. First of all, the necessary technical know-how for their processing were hereto missing. Secondly, industries and enterprises were questioned here and there so that a review of the Euromart Study was not possible even from the standpoint of the methodological application. The duty of the here executed surveys was to find out which effects had resulted from the BRITE/EURAM Subprogramme Aeronautics and to check whether the here applied instruments were suitable for such evaluation.

Enterprises in Ireland, Denmark and the Federal Republic of Germany were questioned The previously pursued concept to be executed in all these countries which were mainly case studies had to be dropped due to diverse difficulties by the appointment coordination. Hence, 12 enterprises were writtenly questioned after telephone conversation. From these enterprises, 5 had their seat in Ireland, 2 in Denmark and 5 in the Federal Republic of Germany.

The suitability of the evaluation method of written and oral survey under the application of the control group concept, above all, is supposed to be examined with this survey. This applies, of course, only if this happened on the basis of a concrete programme evaluation. For the programme Aeronautics, this survey is tantamount to a Pre-test in which the hypotheses and question formulations are to be tested in order to be followed with the construction of a broadly written survey.

The former concept in which only enterprises with less than 500 employees were supposed to be included in the inquiry was watered down in favour of including also some bigger enterprises of the Equipment industry. This was most especially necessary for two case studies in the equipment enterprises in the Federal Republic of Germany. Thus it was possible to receive also information from bigger equipment enterprises about:

- the division of labour of the Equipment industry with the System industry;
- the necessary scale of an enterprise in order to be competitive in the branch;
- the dependence of the equipment industry on the national aviation programme and the possibilities to gain a foothold on the international market;
- the cooperation possibilities and forms between bigger and smaller enterprises of the equipment industry - partly beyond the national boundaries;
- the importance of the BRITE/EURAM Subprogramme Aeronautics for these enterprises in view of their international competitive position.

Through the selection undertaken by the survey of

- countries with or without System industry,
  BRITE/EURAM Subprogramme Aeronautics participants and non-participants as well as
  the scale of the enterprise,

important prerequisites were supposed to be created in order to be able to portray correspondingly the manner of the effect differentiation of the promotion programme.

By the written survey, the following topic cycles were addressed:

- General information about the enterprises such as turnover and share of aeronautic production as well as the corresponding R&D expenditures.
- The most important fields of sales or production areas.
- Patents and national promotion programmes.
- The importance of the national economic and industrial policy for the activities in the area of the Aeronautic Industry.
- The most important problem fields in the business area Aeronautics.
- Market expectations.
- The significance of the BRITE/EURAM Subprogramme with questions about
  - o the promoted project and its importance for the entire enterprise;
  - o how the enterprises had heard about the programme;
  - o the role of the enterprises within the cooperation;
  - o the expected effects that had resulted from the presently promoted project;
  - o problems with the promotion and wishes for an improved form of the programme.
- R&D cooperation behaviours, difficulties and necessary improvements;
- the role of the EC for the design of better scope conditions for R&D cooperations.

5.2 Results of the Survey

5.2.1 Written Survey

It is to be considered by the interpretation of the findings that the number of the enterprises is very small. Hence, they have, above all, an example of the nature of some of the information obtained and how this can be interpreted. A sound description of the reality would have necessitated the survey of a larger number of enterprises.

The surveyed enterprises had their most important customers in Europe. The German as well as the enterprises of the Small Member States (SMS) in Denmark and Ireland supplied enterprises of the airframe, engine and supply industries. It was hereby noticeable that the share of the enterprises which predominantly supplied the Supply industry is clearly more by the enterprises of the Small Member States than those in Germany. In contrast, the American market played practically no role for the questioned enterprises (see Table 5.2.1/1).

Table 5.2.1/1

The Enterprise Characterizing Questions
- Number of Answers -

	Ger	SMS
Question: Who are the main customers in the field of aeronautics?		
airframe industry	5	2
US	1	1
Europe	5	1
engine industry	3	2
US	0	0
Europe	3	2
supply industry	2	4
US	0	0
Europe	2	4

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

The majority of the surveyed enterprises found themselves economically dependent on their customers. There existed for three of the five German enterprises beyond economical also a technical dependence (see Table 5.2.1/2).

Table 5.2.1/2

The Enterprise Characterizing Questions
- Number of Answers -

	Ger	SMS
Question: In which respect is the firm dependent on the customers?		
legally	1	0
technically	3	0
economically	5	5
others	0	1

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

To what extent the enterprises participated both on the military as well as the civil demand portrayed itself from the fact that the products from four German and three enterprises from the Small Member States were used both in the military as well as the civil area. Products from four enterprises of the Small Member States and only from one German enterprise found exclusively civil utilization. This illustrated the great importance of the military demand for the industry in the Federal Republic of Germany for the national aeronautic industry. This also may partly be correct for the Danish indsutry, but not for the Irish industry (see Table 5.2.1/3).

Table 5.2.1/3

The Enterprise Characterizing Questions
- Number of Answers -

	Ger	SMS
Question: Where are the aeronautic products used?		
only military sector	0	0
only civilian sector	1	4
both sectors	4	3
others	0	0

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

It was interesting to see that all the surveyed German Equipment enterprises had patents and three realized also earnings from these patents. In contrast to the German enterprises, only two of the eight enterprises of the Small Member States had their own patents. Only one enterprise realized patent earnings. In a branch in which technology plays such a central role, the lower number of the patent owned by the Small Member States was, of course, a pointer to the fact that these states were working predominantly in technological but less sophisticated fields (see Table 5.2.1/4).

Table 5.2.1/4

The Enterprise Characterizing Questions
- Number of Answers -

	Ger	SMS
Question: Does the firm		
use patents in the field of aeronautics?	3	1
hold patents in the field of aeronautics?	5	2
pay royalities for licenses?	4	0
earn royalities from licenses?	3	1

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

Up to date, all the German enterprises and only two of the seven enterprises of the other group had received aids from national programmes. Two or three enterprises would like to request grant from the European Community. The higher share of the German enterprises on governmental technology programmes could be traced to two influencing factors: firstly, there was no existing promotion programme in Ireland or Denmark which corresponded to the German. Secondly, the technological organization of the surveyed enterprises in the Small Member States was not sophisticated enough in order to be able to take advantage of technological programmes. This illustrated also the fact that only relatively few enterprises had their own patents (see Table 5.2.1/5).

Table 5.2.1/5

The Enterprise Characterizing Questions
- Number of Answers -

	Ger	SMS
Question: Does the firm receive R&D funding from		
national programmes?	5	2
EC programmes?	3	2
Question: Is the funding paid for aeronautic activities?		
yes	4	3
no	1	3

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

The different position of the enterprises of both groups in the supplier hierarchy and the significance of governmental economic policy showed also the structure of the answers to the next question: While support for the German enterprises in the areas of development and research was especially important, the enterprises of the Small Member States emphasized the prime importance of governmental support by the initiation of cooperations or production helps. This must be related to the missing System industry in these countries (see Table 5.2.1/6).

Table 5.2.1/6

The Enterprise Characterizing Questions
- Number of Answers -

	Ger	SMS	Ger	SMS	Ger	SMS
Question: How important is the national government policy for the firm's aeronautics business?						
	very important		important		less important	
production	0	0	3	2	2	2
development	4	1	1	1	0	1
research	3	1	0	1	2	1
cooperation	1	3	2	0	2	1
others	0	2	0	3	0	0

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

The majority of the interviewed enterprises have the same opinion about the future of the market development. Generally, a decline of the military and an increase of the civilian demand are to be expected. In this regard, the enterprises are obviously staking out stronger on the European than on the American market. In view of the present orientation of many enterprises towards the military market, the expected alteration in the demand structure must have consequences for the future production programme of the enterprises. In this context, the German enterprises were obviously more affected than the Irish enterprises (see Table 5.2.1/7).

Table 5.2.1/7

The Enterprise Characterizing Questions
- Number of Answers -

	Ger	SMS	Ger	SMS	Ger	SMS
Question: What are the expectations in market development within the next 15 years?						
	increasing		stagnating		decreasing	
military market	0	0	0	0	5	4
civilian market	4	7	1	0	0	0
European market	5	7	0	0	0	0
world market						
US market	2	3	3	2	0	0
other world market	5	5	0	0	0	0

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

The question about the main difficulties was supposed to give more information about the present situation of the enterprises and possible stages for governmental assistances. It showed hereby that the enterprises of the Small Member States saw the main disadvantage in the missing System industry. The higher market entry barriers which was mentioned in the second place, must as well be seen in this relationship. Enterprises of both groups saw a greater problem in the dependence on demander. This could not be surprising because, as alerady stated, the Equipment industry could only develope their products in close coordination with the System or Subsystem industry. In contrast to the Automobile industry where there were still numerous chances through the space parts market for a relatively independent product and price policy, these possibilities were hardly given in the Equipment industry (Table 5.2.1/8).

Table 5.2.1/8

The Enterprise Characterizing Questions
- Number of Answers -

	Ger	SMS
Question: Which main Problems is facing your firm in the aeronautic business?		
dependence on the demanding firm	4	3
the small national market	3	0
the small European market	2	0
big firms have better R&D- and production conditions	2	2
inappropiate frame conditions (eg. norms/standards)	0	0
internal problems (qualified personnel, financing etc.)	0	0
high market entrance barriers	3	4
as a result of a "buy national" policy	2	2
resulting from difficulties in getting certification	2	1
the country has no own aeronautic system industry	2	6
others	2	0

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

The questions about the importance of the promoted project and the status of the BRITE/EURAM Programme were only addressed to the enterprises which had participated on the promotion. These were three German and three enterprises of the group Small Member States. Hereto belong two Irish and one Danish enterprises.

A technical and a lower economical relevance was, above all, attached to the programme. The enterprises were relatively satisfied with the programme preparation and the "call for tenders". It was interesting to see that the cooperation of the German enterprises was, in essence, a continuation of the already existing cooperation relationships, while the enterprises of the Small Member States were requested to participate on their own in the cooperation or this came about from their respective cooperation efforts (Table 5.2.1/9).

Table 5.2.1/9

Questions only for Participants
- Number of Answers -

	Ger	SMS
Question: Please explain project's relevance for the firm		
more technically	3	2
more economically	0	1
Question: Was the project already planned before		
first annoucement of Community programme	1	
its legal approvement	0	1
its call for proposal	2	1
Question: How did the firm learn of the existance of the programme and its context?		
from other cooperation partners	1	1
from the EC	1	1
other informations	1	1
Question: Was the call for tenders sufficiently explicit with the regard to the field of interest?		
yes, it was sufficiently	3	2
no, it was not sufficiently enough	0	0
Question: How did the firm find its cooperation partner?		
from previous cooperation	3	0
the firm was asked by another partner to cooperate	0	2
the cooperation is a result of a traditional partnership	2	0
result of Commission suggestions	0	0
through their activities	1	1
other reasons	2	0

* n = 6
Germany (Ger) = 3
Small Member States (SMS) = 3

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

Relatively equal was the assessment of the importance of the programme in both groups as regards the strategy of the firms. It served predominantly the assistance of the general strategy and had - also for the research strategy - a rather subordinated significance. This result would, however, be qualified roughly by the case studies. Personnel employments in the scopes of the promoted project was undertaken only by one enterprise in each of the respective group (Table 5.2.1/10).

Table 5.2.1/10

Questions only for Participants
- Number of Answers -

	Ger	SMS
Question: Does the aeronautic project application hold a marginal or a significant place in the general (research) strategy of the firm?		
general strategy	3	3
significant place	1	0
marginal place	2	3
research strategy	3	3
significant place	2	1
marginal place	1	2
Question: What are the implications of the application for your means of research resources?		
Staff	2	3
research impacts in the existing teams	1	2
new researchers	1	1

* n = 6
Germany (Ger) = 3
Small Member States (SMS) = 3

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

Clearly different was the role of the enterprises within the cooperation: While the German enterprises had a rather developing function inside the cooperation, the enterprises of the other group executed clearly defined, ie, predicated terms of reference (Table 5.2.1/11).

Table 5.2.1/11

Questions only for Participants
- Number of Answers -

	Ger	SMS
Question: What was the firm's specific role within the cooperation		
producer and/or performer of R&D on the basis of a given specification (subcontractor)	0	3
complementary partner for special problems	1	0
contributor to project design and specification	1	0
leading partner, coordinator	1	0

* n = 6
Germany (Ger) = 3
Small Member States (SMS) = 3

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

The stronger technological orientation of the German enterprises was portrayed therein that they expected an improvement of their competitive position and would want to close the technological gap through the project, while the enterprises in Ireland and Denmark were, above all, interested in the continuation of the business relationship (Table 5.2.1/12).

Table 5.2.1/12

Questions only for Participants
- Number of Answers -

	Ger	SMS
Question: What are the main strategic aims due to this project:		
filling technology gaps	2	0
continuation and/or amplification of business	1	3
ensuring competitive advantage	3	1
keeping up with the state of the art	1	1
others	0	0

* n = 6
Germany (Ger) = 3
Small Member States (SMS) = 3

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Sub-programme Aeronautics", 1990; DIW.

The spectrum of the answers to the question of the expected effects of the project was very differentiated. While the development of new fields of responsibilities and substitutions, above all, stood in the forefront by the German enterprises, besides new fields of responsibilities, improvements in the product quality and the expectation from spin-off-effects were well-pronounced by the other group (Table 5.2.1/13).

Table 5.2.1/13

Questions only for Participants
- Number of Answers -

	Ger	SMS
Question: What does the firm expect from this project on the operational level:		
quality improvements	0	2
cost reductions	1	0
new applications	2	2
better product performance	1	1
substitution	2	0
spill-over effects to other research activities of the firm	1	2
patents, codes (eg. non patentable software)	1	0
others	0	1

* n = 6
Germany (Ger) = 3
Small Member States (SMS) = 3

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/ EURAM-Subprogramme Aeronautics", 1990; DIW.

When questioned about the yields of the trans-national cooperation, the German enterprises presented very clear results. They expected a continuation of the relationship in the cooperation. Furthermore, they attached thereby great importance to the EC-Activities. The situation was different in the group of the enterprises in the Small Member States.

Table 5.2.1/14

Questions only for Participants
- Number of Answers -

	Ger	SMS
Question: Does the firm expect specific benefits from the transnational cooperation engendered by the aeronautic project?		
no specific benefits	0	0
cost reduction	1	0
learning effects due to technical knowledge, thinking and planning in international dimensions, language etc.	1	1
initiation and enforcement of existing relations between the cooperating partners, establishment of scientific community and working relations (contacts, networks)	3	1
the project could only be realized on an EC-level and is initiated mainly by the EC-programme	2	0
spreading knowledge of the company's capabilities to potential customers in other countries	1	2
learning of the existence of useful skills/ potential partners in other countries	1	1
others	0	0
Question: Does the firm continue the cooperation		
in this field?	3	0
in other fields?	2	1
Question: Does the firm use the project		
as a way to become a competent partner		
for international cooperations?	2	1
for finding new customers?	0	1

* n = 6
Germany (Ger) = 3
Small Member States (SMS) = 3

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

The surveyed enterprises were satisfied with the assistance of the EC-Administration. This was valid, above all, for the information and - though mostly for the German enterprises - for the advisory support. It is to be noted in this relationship that the EC had organized conferences in the Small Member States in which the national aviation industry was able to present itself and was informed through the EC-Programme (Table 5.2.1/15).

Table 5.2.1/15

Questions only for Participants
- Number of Answers -

	Ger	SMS
Answers to the programme profile:		
The topics are of primary interest	2	1
The application delay is too long	0	0
Significant contribution from the Commission's staff	3	3
information	3	3
advice	3	1
finding cooperation partners	0	1
others	1	0

* n = 6
Germany (Ger) = 3
Small Member States (SMS) = 3

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Sub-programme Aeronautics", 1990; DIW.

"Main Problems and Proposals for Improvements" were differentiated according to enterprises in Germany, the Small Member States and non-programme participants in the complex questions. To know, through the application of the control-group-concept, whether the enterprises in the respective groups had different problem situations and where they saw signs for the improvement of their situation were the goals of this broaden differentiation.

Answers from five German and seven enterprises from the Small Member States were available to these complex questions. Six from twelve enterprises had not participated in the promotion programme.

The first question was supposed to give information about the present cooperation behaviours of the enterprises: almost all the enterprises had cooperated with industrial partners in the area of Research and Development (R&D). However, the German enterprises as well as the enterprises which participated in the promotion programme had obviously diverse cooperation relationships. This was especially conspicuous by cooperation with Universities and Research establishments. This was also valid with respect to the cooperation with big enterprises and enterprises from the area of the small and medium-sized firms (Table 5.2.1/16).

Table 5.2.1/16

Questions to Participants and Non-Participants
- Number of Answers -

	Ger	SMS	all	non-participants
Question: Did the firm cooperate in R&D mainly with				
industrial partners	5	5	10	5
large firms	3	5	8	3
small and medium sized firms	4	0	4	2
universities, research institutes	5	1	6	2

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

The question about the cooperation difficulties in the area of research produced no clear results. This was also the case both in respect of the predicated range of difficulties as well as also for the control-group comparison (Table 5.2.1/17).

Table 5.2.1/17

Questions to Participants and Non-Participants
- Number of Answers -

	Ger	SMS	all	non-participants
Question: Has the firm encountered specific difficulties in dealing with the research partners, due to				
management	2	0	2	1
sharing of expertise	2	1	3	2
language	1	0	1	1
communication	1	0	1	0
research programming or coordination	2	0	2	1
anticipated sharing in results	2	1	3	2
others	1	1	2	2

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

The greatest external problem for the R&D activity resulted from the difficulties of the market entry, the financing as well as the personnel qualification. Nonetheless, there existed here practically no difference in the reply structures between the programme participants and non-participants (Table 5.2.1/18).

Table 5.2.1/18

Questions to Participants and Non-Participants
- Number of Answers -

	Ger	SMS	all	non-participants
Question: Which general problems are facing the firm performing R&D internationally in the field of aeronautics, due to specific problems of SMEs?				
external problems				
market entry	4	3	7	4
finding cooperation partners	2	0	2	1
norms/standards	0	1	1	1
other inappropiate frame conditions	2	0	2	0
internal problems				
qualified personnel	3	1	4	2
financing	5	2	7	4
others	0	0	0	0

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

Improvements of the scope conditions, above all, were expected from the national governments and were even more frequently expected from the programme participants than from the non-participants. But all the same, three of the twelve surveyed enterprises were of the view that improvements from the EC were necessary (Table 5.2.1/19).

Table 5.2.1/19

Questions to Participants and Non-Participants
- Number of Answers -

	Ger	SMS	all	non-participants
Question: In which sector main improvements are to be done?				
industry	2	1	3	0
national bodies	3	2	5	2
EC, other international agencies	1	2	3	2
none	1	2	3	2

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

Improvements and simplifications in the relation between the System firms and enterprises of the Small Member States were seen as the most important duty of the EC. The EC should obviously help most especially by the cooperation arrangement. In contrast to this, the enterprises had difficulties due to the missing standardizations. This area was generally attached high importance by the growing together of the markets and was seen as action field of the EC (Table 5.2.1/20).

Table 5.2.1/20

Questions to Participants and Non-Participants
- Number of Answers -

	Ger	SMS	all	non-participants
Question: Are there main tasks for the EC to come to better frame conditions?				
no	0	0	0	0
standardization	2	1	3	2
cooperation and simplifying of market entry (permission conditions)	5	2	7	3
relationship between system firms and SMEs	3	5	8	5
initiating cooperations	3	3	6	3
others	0	0	0	0
Question: Do firms not located in a country with an aeronautic system industry have significant business opportunities?				
yes	1	2	3	1
no	3	1	4	2

* n = 12
Germany (Ger) = 5
Small Member States (SMS) = 7

Source: Survey "Evaluation of Economic Effects of R&D - Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme Aeronautics", 1990; DIW.

On the whole, the results of the written survey could be summarized as follows: The surveyed German enterprises were averagely more technology-intensive than the enterprises of the Small Member States. They had obviously more leeway for individual developments in the cooperations and had also, in higher proportion, individual patents at their disposal.

The market entry was a great problem for all enterprises. Because the enterprises were also in greater part engaged in the military area, where, of course, they reckoned with declining demand, they must have to deviate forcefully to other fields. The problem of armament conversion is a topic which concerns many of the European Aeronautic enterprises. In view of the general higher market entry barriers, it is going to be difficult to deviate to the civil market. Obviously, the enterprises from countries without individual System industry have especially, in this context, a hard time.

The greatest number of the enterprises welcomed the programme information of the EC and the programme maintenance even though, measured on the enterprises' strategy, they attached less importance to the promotion programme. However, in the area of R&D Strategy and for the development of cooperation relationships, the programme had more significance. Here, the statements corresponded to those of the executed analyses in the Federal Republic of Germany whereby the small and medium-sized enterprises prosecuting R&D sought increasingly contact to research establishments and other cooperation partners.[1]

Helps were still expected by the enterprises for their problems and, at earliest, from the national governments. Support, above all, was expected from the EC for the initiation of cooperations.

In the differentiation of programme participant and non-participant, the written survey brought no significant results. The structures of the answers were almost equal in both groups. It is due to the small sample.

---

[1] Study of the R&D Personnel Costs Committee, ZF as reference of Literature.

5.2.2 Case Studies

The case studies were supposed to provide precise information about the problem situation of the Equipment industry with respect to its expectations and possibilities to cooperate and the effects of the programme. These case studies were carried out in the three considered countries.

By the selection of the enterprises to be surveyed, small number of the total possible enterprises attracted negative attention. It was relatively difficult to arrange discussion appointments. The attempt to coordinate many appointments in one country failed. Despite the small number of case studies, relatively clear results were achieved. This was, first of all, to be traced to the willingness of the interlocutor to speak not only about the matter of his own enterprise, but about the situation of the national aeronautic industry under the special viewpoint of the small and medium-sized enterprises. To the second, the information which was received here, was supplemented through discussions with experts of the EC as well as from gathered expericences in the scopes of the studies on aeronautic industry.[2] The portrayal of details as regards location and production programme of the surveyed enterprises was abandoned due to reasons of the data protection. In view of the little basic totality, the description of these characteristics made possible a very quick identification of the surveyed enterprises.

A very central result of the surveys was that small and medium-sized enterprises were hardly in the position to overcome, from their own source, the hurdle of market entry in this branch. There existed in the Aviation industry traditional relationships in the cooperation. A market newcomer must not only be more favourable in price and/or qualitative than the already existing competitor, he must also overcome the existing confidence barriers by the demanders. Products of the Aviation industry were subjected to a higher security risk so that the enterprises tended to work together possibly with partners which had already shown the proof of their performance capability on this field.

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[2] See hereto Chapter 6.

Furthermore, the principle "buy national" was still valid in higher degree in this industrial sector. This had its origin, above all, from the general higher governmental engagement in this branch, be it through the military demand or through subsidies in the civil area.

The commencement of production in the area of aeronautics for small and medium-sized enterprises meant, first and foremost, an enormous engagement in Resarch and Development and the construction of a corresponding production plants. The period of time before the point of "return of investment" is reached, was, in the rule, comparatively much longer by small number of items.

The surveyed enterprises traced their production commencement to governmental assistances. Hereby, clear differences manifested themselves in the scope conditions between Germany and Denmark on the one side and Ireland on the other side. The enterprises of the two first mentioned countries traced their engagement in the Aviation production to the national military demand. The enterprises received production tasks assigned through the exertion of governmental influence. In Germany, it concerned predominantly licence productions, while the engagement in Denmark resulted from off-set businesses. The accumulating development and investment costs by the military projects could be settled through the project.

Also in the civil area, the market entry was mostly achieved through governmentally determined quotas in the production allocation in the scopes of the trans-national cooperation plans. The conditions of the Irish enterprises were, in this respect, different because this country had no considerable defence budget at its disposal through which the national industry could be promoted and was practically not involved on other European civil big projects. Thus, the chances of the small and medium-sized enterprises of the Irish aeronautic industry resulted predominantly through special functions in the area of aircraft maintenance which this country had overtaken in the area of the civil large aircraft. The performance spectrum offered by this country existed primarily from services.

The BRITE/EURAM Programme was, without exception, welcomed by the surveyed enterprises. The extent of the promotion stood rather less in the forefront than what the cooperation partner would want to admit. Hence, a continuation of the programme was welcomed by the enterprises in order to solidify the relationships in the cooperation and, in any event, to be able to enter into new relationships in the production. Supports in the civil area of the aeronautic industry were thus seen as especially necessary and helpful because the present profit yielding military production would strongly loose much importance in future.

Basically, there existed nearly an unsolvable problem for the enterprisees of the Equipment indsutry with technically sophisticated productions in relation to the System industry. The subcontractors were already forced to relinguish their technical knowledge before the materialization of the cooperation and thereby ran the risk of transfering this know-how without a corresponding reward. The EC should promote, more extensively than it does presently, also projects in which the Equipment industry would take over the leading role of the project: this was seen, in this respect, as a duty of the EC. Despite numerous applications - so the statement of a surveyed enterprise - there existed only one project in which the Equipment enterprises held the "Leading Function".

According to the statement of the questioned representative of the firms, the programme, besides the opening of cooperation possibilities with European System enterprises, had a significant function most especially for the smaller countries in the area of technology promotion. The smaller the country was, the lower and so firms specific were the national technology programme. Here, enterprises with location in smaller countries, compared to the German enterprises on account of the varied numerous technologies and comprehensive promotion programme in Germany, were disadvantaged. EC-Programmes, such as the BRITE/EURAM, worked as a compensatory source.

As the written survey had already shown, the promoted enterprises were by far satisfied with the preparation and execution of the promotion as well as its organization. A possible point of criticism which could not be proved here, was the exertion of influence by the System industry on the development of the programme. The preliminary

Euromart-Study which was done on the programme by enterprises of the European System industry during the approval of the promotion was, in higher degree, used by the former co-workers of the System industry.

On balance, the result of the oral surveys could thus be characterized: The surveyed Equipment enterprises had, through the BRITE/EURAM Subprogramme Aeronautics, opened for themselves new cooperation possibilities. Thus, support by the initiation of cooperation was often more important than the financial assistance. Hence, the support of the EC was, above all, of importance because it concerned a branch which, in higher degree, was governmentally influenced and cooperations, in the rule, were entered into on the basis of traditional business relationships. The continuation of the programme was, of course, welcomed because one hopes, on the one side, to be able to gain a stronger foothold on the civil area which is increasingly gaining importance. To the other, there existed the possibility that development works would be promoted in technologies for which there were no national programmes.

Here, a specific competitive disadvantage which the enterprises of the Small Member States had, in contrast to the big industrial countries, would be removed. To what extent technologies were also relevant to other areas of the enterprises was not answered through the case studies in the scopes of this study.

6 Annex:

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DIW Deutsches Institut für Wirtschaftsforschung

Evaluation of Economic Effects of R&D
- Small and Medium Sized Firms in the BRITE/EURAM-Subprogramme "Aeronautics"

Interviewguideline

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I. General situation of the firm

I.1 Name: _____

Address: _____

_____

phone: _____

fax: _____

Interviewee: _____

I.2 Main product lines
(and their proportion of turnover)

	percentage of turnover
1. _____	_____ %
2. _____	_____ %
3. _____	_____ %

I.3

		1985	1989
Turnover (ECU)	total	_____	_____
	aeronautics	_____	_____
Employees	total	_____	_____
	aeronautics	_____	_____
R&D personnel	total	_____	_____
	aeronautics	_____	_____
	R&D expenses aeronautics	_____	_____

a) When did the firm start production in aeronautics?

_____ year

I.5 Who are the main customers in the field of aeronautics?

O airframe industry
  O US
  O Europe

O engine industry
  O US
  O Europe

O supply industry
  O US
  O Europe

In which respect is the firm dependent on the customers?

O legally

O technically

O economically

O others: _____

I.6 Where are the aeronautic products used? In the

O military sector

O civilian sector

O both sectors

O others

I.7 Does the firm

O use patents in the field of aeronautics?

O hold patents in the field of aeronautics?

O pay royalties for licences?

O earn royalties from licences?

I.8 Does the firm receive R&D funding from

O national programmes?

O EC programmes?

Is the funding paid for aeronautic activities?

O yes O no

1.9 How important is the national government policy for the firm's aeronautics business?

	very important	important	less important
- production			
- development			
- research			
- cooperation			
- others*			

*Please explain the sector:_____

I.10 Which main problems are facing your firm in the aeronautic business?

O limited demand from the public sector

O dependence on the demanding firm

O the small national market

O the small European market

O big firms have better R&D- and production conditions

O inappropriate frame conditions (eg. norms/standards)

O internal problems (qualified personnel, financing etc.)

O high market entrance barriers
  O as a result of a "buy national" policy
  O resulting from difficulties in getting certification

O the country has no own aeronautic system industry

O others:

I.11 What are the expectations in market development within the next 15 years?

The demand is	increasing	stagnating	decreasing
military market	O	O	O
civilian market	O	O	O
European market	O	O	O
world market			
US market	O	O	O
other world market	O	O	O

I.12 The Airbus Industrie: Does its growth open new perspectives for the firm?

O yes, it will have significant positive effects

O we expect positive effects, but they are still uncertain

O of no relevance for the firm

ONLY FOR FIRMS WHICH DO NOT PARTICIPATE IN THE BRITE/EURAM-SUB-PROGRAMME "AERONAUTICS"

I.13 Are you familiar with the BRITE/EURAM-Subprogramme "Aeronautics"?

O yes

O no

If yes: Reasons for non-participation

O no information on the programme

O no significant R&D within SME

O SME is unsufficiently known as potential partner

O deficiencies of application procedure

O "wrong" programme topics

O cooperation unattractive

O others: _____

ONLY FOR PARTICIPANTS OF THE BRITE/EURAM PROGRAMME!
OTHERS PLEASE GO TO IV

II. The project (applied for or promoted)

II.1 Please explain project's relevance for the firm

O more technically

O more economically

Was the project already planned before

O first announcement of Community programme

O its legal approvement

O its call for proposals

II.2 How did the firm learn of the existence of the programme and its context?

O from other cooperation partners

O from the EC

O other information: _____

What were the main reasons which led it to participate in the programme?

Was the call for tenders sufficiently explicit with regard to the field of interest?

O yes, it was sufficiently

O no, it was not sufficiently enough

O did the firm become aware of / reply to the call for .....

How did the firm find its cooperation partner? Did the firm choose the research partners

- O from previous cooperation
- O from following meetings

O was the firm asked by another partner to cooperate

O the cooperation is a result of a traditional partnership

O we followed commission suggestions

O through own acqusition

O other reasons: _____

II.3 Does the aeronautics project application hold a marginal or a significant place in the general (research) strategy of the firm?

O general strategy
- O significant place
- O marginal place

O research strategy
- O significant place
- O marginal place

II.4 What are the implications of the application for your means of research resources

O Staff
- O Does the application stir research interest in existing teams?
- O Do you have recruited new researchers?

O Capital
- O Did you make specific capital investments to launch research?
- O Which is the proportion of the aeronautics project to the total R&D budget in the aeronautic sector of the firm?

II.5 What is the firm's specific role within the cooperation?

O producer and/or performer of R&D on the basis of a given specification (subcontractor)

O complementary partner for special problems

O contributor to project design and specification

O leading partner, coordinator

III. Objectives and expected effects

III.1 What are the main strategic aims due to this project:

O filling technology gaps

O continuation and/or amplification of business

O ensuring competitive advantage

O keeping up with the state of the art

O others: _____

_____

III.2 What does the firm expect from this project on the operational level:

O qualitiy improvements

O cost reductions

O new applications

O better product performance

O substitution

O spill-over effects to other research activities of the firm

O patents, codes (eg. non patentable software)

O others: _____

III.3 Did the firm make a forecast of economic benefits expected from the project?

O yes

O no

If yes, due to which parameters?

_____

III.4 Does the firm expect specific benefits from the transnational cooperation engendered by the aeronautic project?

O no specific benefits

O cost reduction

O learning effects due to technical knowledge, thinking and planning in international dimensions, language etc.

O initiation and enforcement of existing relations between the cooperating partners, establishment of scientific community and working relations (contacts, networks)

O the project could only be realized on an EC-level and is initiated mainly by the EC-programme

O spreading knowledge of the company's capabilities to potential customers in other countries

O learning of the existence of useful skills / potential partners in other countries

O others: _____

III.5 Further cooperation

Does the firm continue the cooperation

O in this field?

O in other fields, which ones: _____

Does the firm use the project

O as a way to become a competent partner for international cooperations?

O for finding new customers

Are such customers also in overseas?

O yes O no

III.6 How do you assess the existence of the aeronautics programme:

Are the topics of primary interest in your business field?

O yes O no

Are there any topics which do not figure in the call for tenders which you would have liked to see there?

O no

O yes, which ones: _____

_____

Is the application delay too long?

O yes O no

Did you receive any significant contribution from the Commission's staff involved in the research programme?

O no

O yes, which ones:

- O information
- O advice
- O finding cooperation partners
- O others: _____

III.7 Should the design or the administration of the EC-aeronautics programme be improved due to

- O topics
- O information on the programme, call for tenders
- O administrative procedures
- O systematic information on the progress of other research projects in the framework of other European programmes
- O information on progress achieved outside the European Community
- O contribution of the Commission's staff involved in the research programme (more help finding cooperation partners)
- O others: _____
- O no

IV. Main problems and proposals for improvements

IV.1 Did the firm cooperate in R&D mainly with

- O industrial partners
  - O large firms
  - O small and medium sized firms
- O universities, research institutes
- O others: _____
- O no major R&D cooperations in the past

If yes, has the firm encountered specific difficulties in dealing with the research partners, due to

- O management
- O sharing of expertise
- O language
- O communication
- O research programming or coordination
- O anticipated sharing in results
- O others: _____

_____

IV.2 Which general problems are facing the firm *performing R&D* internationally in the field of aeronautics, due to specific problems of SMEs?

external problems	yes	no
market entry	O	O
finding cooperation partners	O	O
norms/standards	O	O
other inappropriate frame conditions:	O	O

_____

internal problems		
qualified personnel	O	O
financing	O	O
others:	O	O

_____

IV.3 Which main improvements are necessary?

O industry: _____

O national bodies: _____

O EC, other international agencies: _____

O none

V. EC Tasks

V.1 Are there main tasks for the EC to come to better frame conditions?

O no

O standardization

O coordination and simplifying of market entry (permission conditions)

O relationship between system firms and SMEs

O initiating cooperations

O others:

V.2 Do firms not located in a country with an aeronautic system industry have significant business opportunities?

O yes

O no

Commission of the European Communities

EUR 14197 - Evaluation of Economic effects: Relevance and Impacts of EC Programmes promoting Industrial R & D with special emphasis on Small and Medium sized Enterprises (Pilot methodological study)

K. Hornschild, F. Meyer-Krahmer

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This study has two main objectives. The first objective is a methodological one, identification of appropriate methods evaluating programmes promoting industrial R&D and testing the feasibility of one selected methods. The second objective of the study is to draw some preliminary lessons on the participation, expected effects and the extent to wich these firms take into account the economic effects of R&D.

The study proposes a methods mix, integrating the control groups method together with case studies. The report also states that this will only be effective provided that appropriate work is done in advance, particularly an investigation of the commercial environment in which the evaluation takes place.

Analysis of innovation behaviour of SME's shows that in addition to their flexibility they are both suppliers of ideas, and play an important role in the diffusion of technologies in relation to larger enterprises. Due to their specialization in the division of labour, SME's increase both the flexibility and the efficiency of the total econoic system.

The BRITE/EURAM (sub-programme aeronautics) has been taken as an example of how to implement the methodological suggestions of the report.

In the context of future evaluations, the report recommended giving consideration to the following:

- starting evaluation in the early beginning phase of programmes;
- intensive development of the theoretical base;
- careful selection of promoted and non-promoted groups of research teams or R&D performing firms;
- careful interpretation of quantitative effects with special emphasis on qualitative aspects.

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