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# Danish research co-operation in EU: Extent, return and participation

## An analysis of co-operation in the 4th EU Framework Programme

The Danish Institute for Studies
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# Foreword

The Ministry of Research and Information Technology asked in October 1999 the Danish Institute for Studies in Research and Research Policy to validate and analyse the Danish outcome from the Danish participation in the European Community Research and Technological Development programmes, especially the 4th RTD Framework Programme, 4FP. The Danish Institute for Studies in Research and Research Policy took on the responsibility and carried through the data collection and analyses in the period from October 1999 to March 2000. A comprehensive report in Danish was published in March 2000. This report is the English summary report from the analyses.

The previous report in Danish refers a considerable amount of information regarding the Danish participation in the 4FP. The report includes survey and register data information on participants, their companies and research institutes as well as survey information on the head of research at the work places, at the universities and at the national delegates.

This report summarizes the findings and relates them to a European audience, giving comparable figures on value-added effects such as co-operation, internationalisation, competence building, competitiveness, and additionality of the performed research. The report also refers motives, expectations, perceived research conditions and fulfilment of research targets in the 4FP.

Mette Lemming has performed excellent research assistance.

Århus, August 2000

Karen Siune
Director

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# 1. Introduction

This paper presents results selected from an analysis of the influence of European research co-operation on the development of the Danish research environment.[1] The analysis has been performed for the Danish Ministry of Research and a complete and detailed report in Danish was published in April 2000, cf. Damm, Graversen, Siune and Smith (2000)[2]. The report measures the extent, return and participation in the 4th EU Framework Programme, FP4, and characterise the Danish participants and their research co-operation. The report also measures the additional value of the performed research by measures such as experience with and outcome of co-operation, internationalisation, competitiveness, quality and competencies from the research co-operation. Additional, the report measures motives, expectations, and research conditions for the Danish participants as well as for a group of representative non-participants. Individual participants and heads of research at private and public workplaces and research institutes as well as university administrations and Danish programme representatives received questionnaires as part of the analysis.

Danish participation in the EU research co-operation under the 4th Framework Programme is so extensive and comprehensive that it has to be characterised as successful. The number of Danish participants per million inhabitants is among the highest compared to other participating countries. Although there are potentials for improvements, the overall experience among the involved researchers is positive. The Danish participants' motives for participation are in line with the intentions in the Framework Programme regarding gathering knowledge and developing methods and products. The basic research aspect is dominating among participants from research institutes, while the user-oriented aspect is dominating among participants from the private sector.

The participating workplaces are typically very research-intensive. The private companies are also larger, more export-oriented and more innovative than

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1 The analysis is the first Danish full-scale analysis of research cooperation in the EU FWP. Previous analyses have only covered specific areas. Among these are the Ministry for Research and Information Technology (1997, 1998) on parts of the FP4, Møller and Kjeldsen (1995) on the 3rd FWP and Valentin (1994a, 1994b and 1997) on the 2nd FWP. Other studies relating to the Nordic countries are referred to in the References.

2 Report 2000/3 published (in Danish) by The Danish Institute for Studies in Research and Research Policy. http://www.afsk.au.dk/Publ.htm.

other Danish companies. The sector relationship regarding the participating companies and research institutes are often a mirror of the Framework Programme, which means participation from sectors covering natural science and engineering, health-related topics and consultancy and analytics.
The research projects are typically unique and not an extension of other projects. Danish participants are often actively involved in defining and preparing projects from the very start. The majority of participants are so satisfied with the project that they are willing to apply for another. However, they find bureaucracy slow working, inflexible and complicated. Especially first-time participants report on such problems.

Participants find that they are attractive partners in EU research projects if they are internationally reputable, have unique competencies, are world leading, perform high quality research, have good networks or state-of-the-art research facilities. They find that good research partners have the same characteristics, although financial research support also matters. Spreading of risk is of no concern for project participation. In general, participants obtain what they expect from participating in research projects under the 4$^{th}$ EU Framework Programme.

# 2. Danish participation in the 4th Framework Programme, FP4

Research projects under the FP4 covers a wide range of research and co-operation types. In the following, all kinds of registered projects are included. This means all project types such as cost sharing contracts, CSC, thematic networks, THN, large facilities, LFC, etc. and all four thematic research areas: 'research and technological development and demonstration programme', 'co-operation with 3rd countries', 'dissemination of results' and 'human capital'.

A thorough search in the 'Community Research and Development Information Service' database, CORDIS, in mid-1999, showed Danish participation by 1709 named persons or workplaces in 1319 research projects under the FP4. 573 different workplaces have participated in at least one project under the FP4. This corresponds to approximately 3 instances of participation in 2.3 projects per workplace. One out of four projects with Danish participation had a Danish coordinator. A little less than 50% of the participants came from 'universities, sector research institutes and hospitals' while the rest came from 'private and public companies, technological service institutes and non-governmental organisations, NGO'. 70% of all instances of Danish participation occurred in CSC projects. Of all CSC projects under the FP4, Danes participated in 14% of them, while the share is 10% if all types of projects are considered. The highest ratio of Danish participation was in 'marine technology', MAST 3, 'targeted socio-economic research', TSER, and non-nuclear energy, JOULE/THERMIE C.

Focusing on CSC projects per million inhabitants shows that Denmark is among the leaders with approximately 200 projects per million inhabitants. Only the figures for Iceland, Luxembourg and Ireland are slightly higher. In general, the small EU and EEA countries do relatively better. The relative figures for countries such as UK, France, Spain, Italy and Germany range between 50 and 75 projects per million inhabitants. Naturally, in absolute figures they participate in the largest number of projects, cf. Table 1.1.2.2 and 1.1.2.3 in Damm et al (2000).

The number of partners with which Danish participants co-operate under the FP4 is large and has increased by 60% from the 3rd to the 4th FWP. Hence, the

EU FWP increases formal research co-operation considerably. According to the CORDIS database the number of co-operating partners is around 8200 for Danish participants under the FP4. The partners primarily come from the UK, 15%, Germany, 14%, and France, 10%. Approximately 5% of the partners come from each of the Nordic countries, including Denmark herself.[3] The largest share of partners is found under the research themes 'industrial and materials technology', BRITE/EURAM, and 'agriculture and fisheries', FAIR.

The FP4 had a budget of 13.1 billion EUR. Without the Joint Research centre, JRC, and the EU administration the reduced budget amounts to approximately 12.1 billion EUR.[4] The Danish ministry of research and Information Technology, FSK, (1998), found that halfway through the FP4 Danish participants had received 3.1% of the reduced budget. Damm et al (2000), Table 2.2.3.1, has found a similar share of 3.3% using the information in CORDIS on project funding together with questionnaire information on Danish shares of funding. Hence, a share close to 3% of the reduced budget seems to be the Danish share. In absolute figures, the Danish share of the reduced budget under the FP4 amounts to approximately 400 million EUR. This is 30% of total funding provided to projects with Danish participation. The Danish share of funding in each of the project is close to 24% on average, ranging from almost 0% in some projects to 100% in others, cf. Damm et al (2000).

Danish participants can be divided into two groups, covering private companies, etc. that perform research on a fully competitive market, and universities, etc. that perform research on a more institutional and protected market. Participants from private companies, etc. primarily come from companies carrying out 'R&D, consultancy and analysis', 49%, 'production of chemicals, medicine, plastic and iron', 24%, and 'production of electrical equipment and transport', 15%. This distribution matches the distribution of the budget under the FP4. Similarly, participants from universities, etc. primarily come from 'natural science', 32%, 'technical science', 29%, and 'health science' and 'agricultural science', each with 13%. The private companies are characterised by a positive correlation between the figures of participation under the FP4 and their money spend for R&D, their share of external financing

3 Double counting of persons, if any, has not been eliminated. In the case of Danish partners, each co-operation link is only counted once.
4 None of the JRCs is situated in Denmark, and administration is not included in potential research support.

of R&D, their number of researchers employed, their Danish market share and their share of exports of total turnover. Hence, the Danish participants typically come from R&D intensive, competitive and internationally oriented workplaces.

# 3. Participants' motives and experience

In order to analyse the less objective value-added parts of the extent of participation under the FP4, all participants received a questionnaire concerning general aspects as well as specific projects. The response rates for participants were 39% and 53%, respectively, - smallest for participants from private companies and largest for participants from university institutions.[5] The distribution of responsing units was so wide that the responses are in general representative. For close to 10% of participants, the workplace replied, that the participants were unknown at or not employed any more at the workplace found in the CORDIS database. Approximately 30% of the participants did not return any kind of response although reminders were sent out. Due to the fact that the addresses used could be up to seven years old, several of these "missing" persons might not have received the questionnaires. Only 10% of the participants replied that they would not or did not have time to answer the questionnaires.

All numbers referred to in the text and figures in Sections 3, 4, 5 and 6 are from the report by Damm, Graversen, Siune and Smith (2000).

The Danish participants under the EU-financed research projects reveal that most of the projects are new defined projects and not extensions of previous projects. The participants are usually already actively involved in projects from the early planning stage, and they carefully choose partners among researchers they already know. Participants from the private companies, etc. are often bound more by their companies when choosing projects and research themes compared to participants from universities, etc., who seems to choose more individually and freely.

Participants see themselves as attractive partners when their workplace is internationally acknowledged through for example 'unique competencies', 'scientific research', 'world leading', 'having good international networks' or

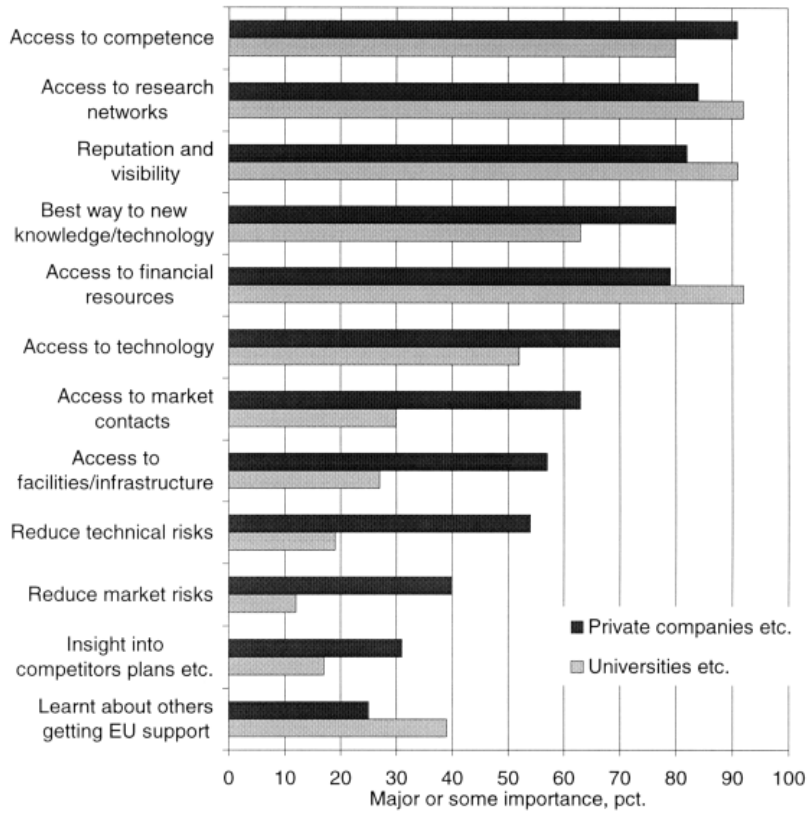
5 Other types of questionnaires, a total of seven different types, were also sent to the research managers at the workplaces participating, to a sample of similar representative non-participants, to Danish programme representatives and to university administrations in Denmark. The responses are analysed in Section 4 and 5. Research managers had a response rate of 31%, 51% and 29% for private companies, etc., universities, etc. and non-participating private companies respectively. Programme representatives and university administrations had a response rate of 78%.

'having state-of-the-art research facilities'. Major contributions from all partners regarding specific projects took place in the form of 'use of existing 'competencies and experiences', 'technology and knowledge transfers', 'competence accumulation', and further 'development of existing products or processes'. 80% of the participants claim that the project could not have been carried through without the other partners.

Close to 80% of the participants also claimed that it was of essential that the project was close to the core profession of the workplace. 65% of the participants from private companies, etc. against 45% of participants from universities, etc. also found it important that the project was part of the long-term strategy at the workplace.

Figure 1 shows participation motives among Danish participants ranked according to the motives mentioned most frequently by participants from private companies, etc. A closer look at the motives for participation in projects under the FP4 shows that access to 'competence', 'research networks', 'reputation', 'visibility' and 'financial support' dominate.

**Figure 1: The share of participants who finds the motives important to participation in research projects**



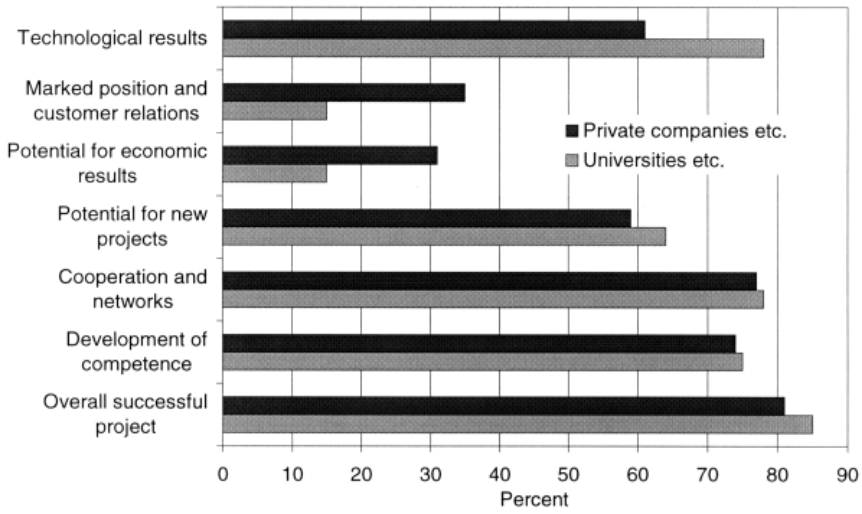

Note: The percentage of respondents who consider a certain motive for participation to be of some or major importance. Private companies also include public companies, technological service institutes and non-governmental organisations, etc. Universities also include sector research institutes and hospitals.

Market-related motives matter less although still significantly among participants from private companies, etc. Hence, as Figure 1 shows, the fundamental basis in projects seems to match the purpose of the EU FWP, i.e. basic research that improves knowledge, co-operation and innovation among European researchers and research environments.

Approximately 80% of the participants, who responded to the questionnaire, indicate research-oriented motives, 'competence', 'visibility', 'network', 'best way to new knowledge' and 'financial support', to be of some or major importance to their participation. Only 'best way to new knowledge' is lower for participants from private companies, etc. The answer to the more market-oriented motives shows larger variation among participants from the two groups. Market-oriented motives matter significantly more for participants from private companies, etc., although still considerably less than research-oriented motives.

Asked whether some elements, in general, can be successfully obtained in EU research projects, the great majority of participants found, based on their experience with the FWP, that the projects are generally successful. As Figure 2 shows, more than 80% claimed the project to be an overall success; of the remaining 20% only 5 percentage points claimed the project to be a failure.

**Figure 2: The share of participants who found successful elements in the projects**



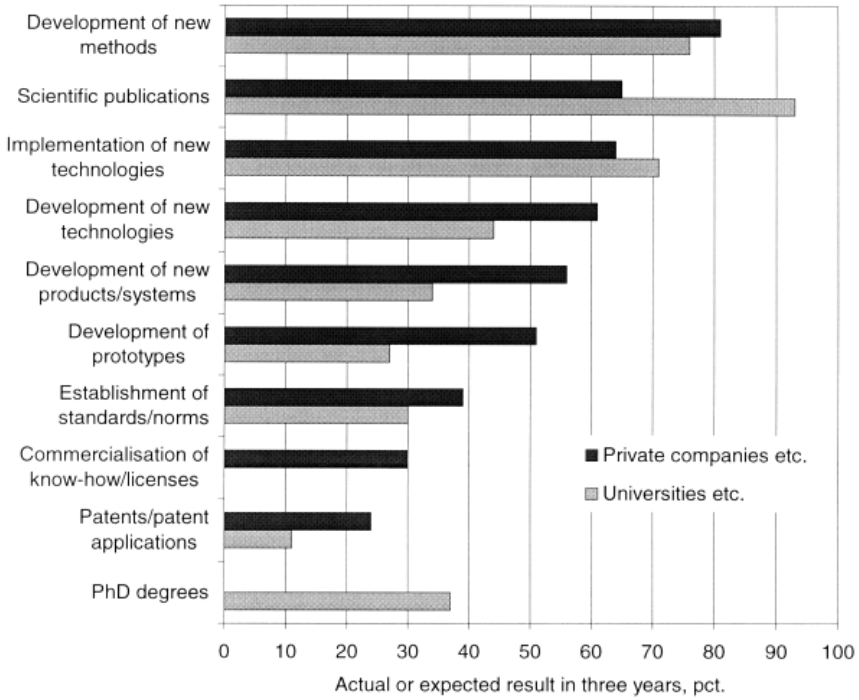

Note: See note at Figure 1 for a definition of private companies and universities.

More specifically, participants consider 'competence development', 'network and co-operation', 'technology results' and 'provider for new R&D projects' to be successful areas of the research projects. However, they do not find that

projects under the FP4 create a better 'potential for economic results' or 'market position and customer network'.

Figure 3 shows the impact of specific project in which researchers participated. The number covers both already obtained results as well as expected results within three years from the completion date of projects. The types of impact vary to a great extent, from scientific publications that increase the knowledge base in EU to implementation of new technology that improves competitiveness of researchers and their workplaces. Workplaces at universities, etc. publish and educate the most, i.e. have research-oriented output, while workplaces at private companies, etc. ensure greater development and implementation of new product-oriented items. This is also the case for patents obtained.

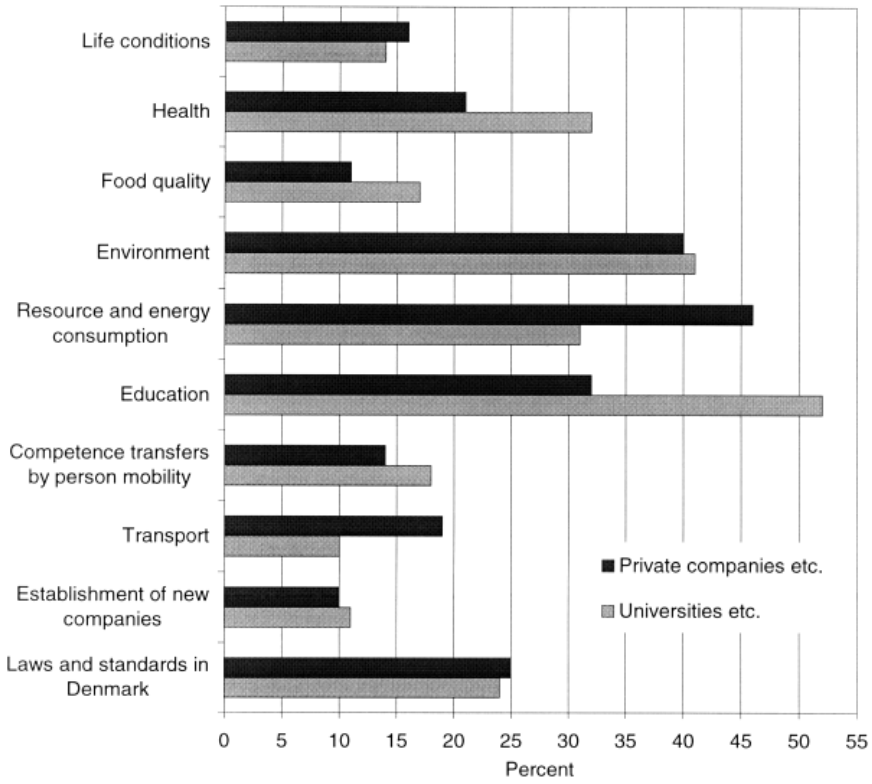
**Figure 3: The share of participants who found that research projects had a significant impact**




Note: The percentage of respondents reporting a certain result or expecting a result within three years from completing the project. See note at Figure 1 for a definition of private companies and universities. Participants from private companies were not asked about PhD degrees, and participants from universities were not asked about commercialisations of know-how and/or licenses. Hence, no observations occur in these two categories.

As Luukkonen and Hälikkä (2000) writes, societal objectives are not expected to be major incentives for participation in research projects. Instead, socio-economic or societal effects of research projects are important side effects. Asked directly whether an added-value effect could be found in various limited areas, participants responded according to Figure 4.

**Figure 4: The share of participants who found societal effects for Denmark from research projects**

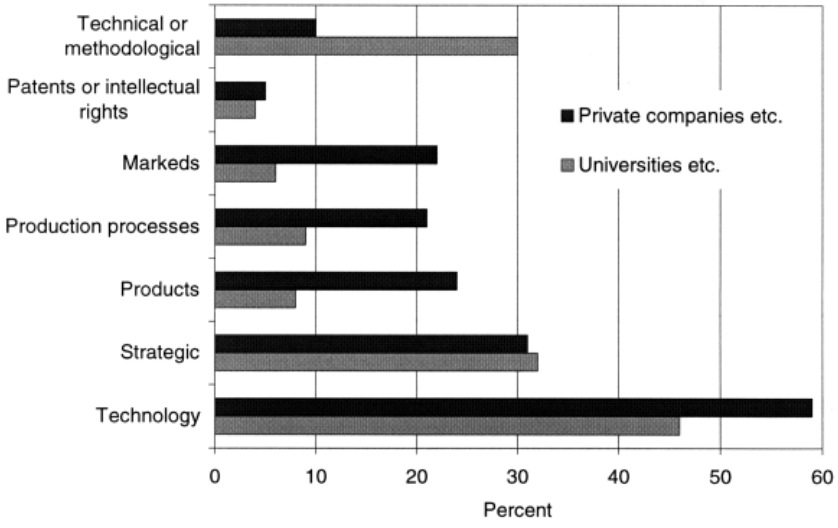



Note: See note at Figure 1 for a definition of private companies and universities.

Naturally, some of the shares are low due to few relevant projects so the shares reflect to some extent the distribution of means and subjects under the FP4. However, there are still substantial value-added effects within all areas. Effects relating to individual life are found in 15-20% of all projects, while environmental and resource-consuming effects are obtained in 30-40% of the projects. Educational effects are found by 30-50% of the participants; approximately 15% find additional exchange of competencies through mobility of researchers. Close to 10% find that projects enable the establishment of new companies. 25% find that the projects influence laws and standards used in Denmark. The difference in percentages between private companies, etc. and universities, etc. is primarily due to differences in extent of participation and not by differences in 'success' shares except in the case of educational effects.

Participants were also asked in which areas their workplace obtained competencies from participating in projects. Each respondent can give a positive answer to several items and the answers are indicated in Figure 5. On average, close to 50% found competence improvements in the area of technology, 30% in the area of strategic competence, while less than 15% found the improvements in the areas of either products, production processes or market competences. The responses cover two main types of competencies: Accumulation of professional and research knowledge and development of methods analyses and models.

**Figure 5: Share of participants who find various types of improved competencies**

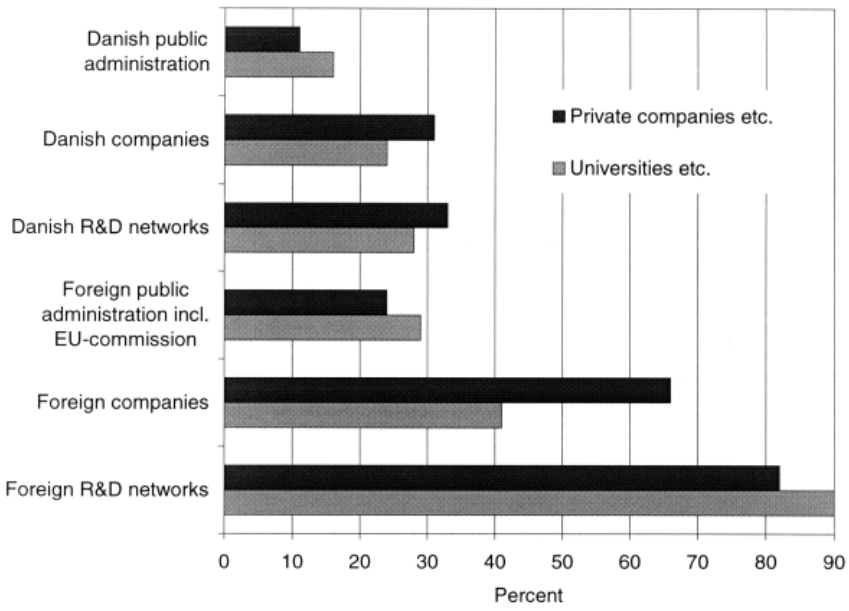



Note: See note at Figure 1 for a definition of private companies and universities.

Even though Danish participants usually choose partners they already know for the projects, they generally establish new co-operation links as well with R&D and university networks outside Denmark in close to 90% of the projects. Figure 6 shows the percentage for participants from private companies, etc. as well as from universities, etc. The corresponding figure for new links to foreign companies is 50%. New links to the similar two types in Denmark are established in 29% and 26% of all projects, respectively. Hence, establishment

of new national and international co-operation within the EU FWP seems to work very well.

**Figure 6: Share of participants who establish NEW types of co-operation relationships**



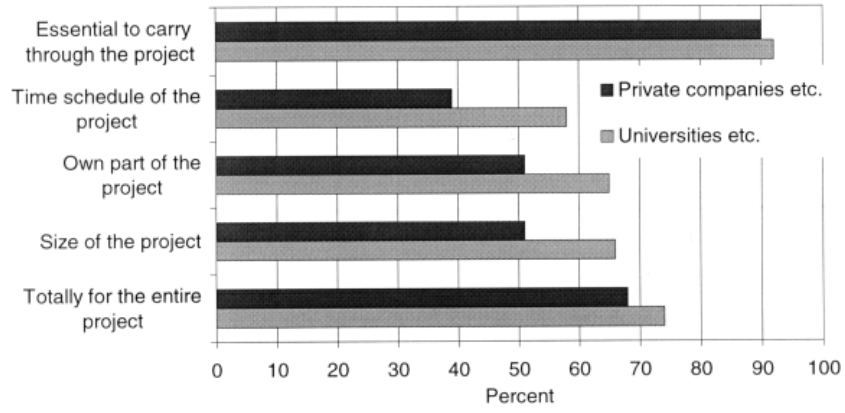

Note: See note at Figure 1 for a definition of private companies and universities.

Participants also responded to questions concerning barriers for starting projects under the FP4. The limited number of applications receiving grants seems to be somewhat frustrating although only a few will give up research projects in case of rejection. Instead, participants often apply again in another context based usually on better-prepared projects. The risk of rejection reduces the potentials for new and unique research since applicants tend to choose research items in well-tested areas and research partners among colleagues already known. Reducing this kind of risk may improve the FWP's innovation potential.

Figure 7 shows the share of participants who find EU financing important for research project. The shares illustrate the extra and additional effects of the research projects. As many as 90% indicated, that EU-funding was 'essential to carry through the project'. 70% said that funding was 'important for the entire

project'. This means that the EU FWP improves the ability to establish pan-European research projects. It improves the speed of research as well as the extent. Hence, the EU FWP indeed adds to the extent of research carried out in Europe by a significant amount.

**Figure 7: Share of participants who found EU-financing important for different parts of the project**




Note: See note at Figure 1 for a definition of private companies and universities

Another barrier seems to be EU's comprehensive reporting demands. First-time participation is particularly problematic and time-consuming, especially for the project coordinator. The risk of rejection seems to fall concurrently with the extent of participation under the EU FWP. A pre-qualification round where formal errors can be corrected could improve the quality of applications, projects and finally of research performed. Basically, the conclusion is that researchers prefer to research and not administer.

In the future, participants from private companies, etc. wish to have a research programme which is oriented more towards end users and financial support within the EU FWP as well as easier access for SME through reduced financial risk. Conversely, participants from universities, etc. wish to increase co-operation, establish more research networks and ensure research programmes focusing even more on basic and fundamental research. As an example, they showed irritation of what they call 'political correct' end-user-oriented and 'short-termed' research policy in the new 5$^{th}$ FWP.

# 4. The motives and experience of workplaces

Research managers in participating companies and university institutions received questionnaires and so did various non-participating companies. The questions concerned attitudes to R&D, EU-financed R&D, research co-operation, motives and results, risks and advantages, and, in general, strategic R&D decisions at workplace level. A detailed description of the method and samples used and the resulting database from the data collecting process is given in Appendix 1.

This section is divided into three parts, of which the first concerns participating private and public companies, the second participating university institutions etc. and the last non-participating private companies. Naturally, participating workplaces is a self-selected group of all workplaces. Hence, their responses are only valid for them and not for the population in general.

### 4.1 Participating private and public companies

20% of the participating companies are publicly owned, while 40% are parts of company groups. The remaining 40% are independent companies. On average, participating companies are considerably more research intensive than Danish companies in general. Almost all respondents, 90%, consider international contacts as important for companies. Similarly, 80% of the respondents consider R&D co-operation as important for companies. Half of the companies consider R&D co-operation with partners inside the EU to be more important than co-operation with partners outside the EU.

The companies' motives for participating in EU-financed research co-operation are a mirror of the participants' motives. Figures 8 and 9 show the workplace motives for companies and university institutes participating. Figure 8 shows the share who finds motives to be of 'some or great importance', i.e. 4 and 5 on a scale from 1-5, while Figure 9 shows the share who finds the motives to be of 'great importance', i.e. 5 on a scale from 1-5. Hence, Figure 9 illustrates a subset of the figures in Figure 8. The patterns in the two figures are quite similar although there are a few minor variations in scaling. Hence, from a methodological point of view the use of Figure 8 or Figure 9 shows the same order of motives so only levels differ between the two figures. Only the motives

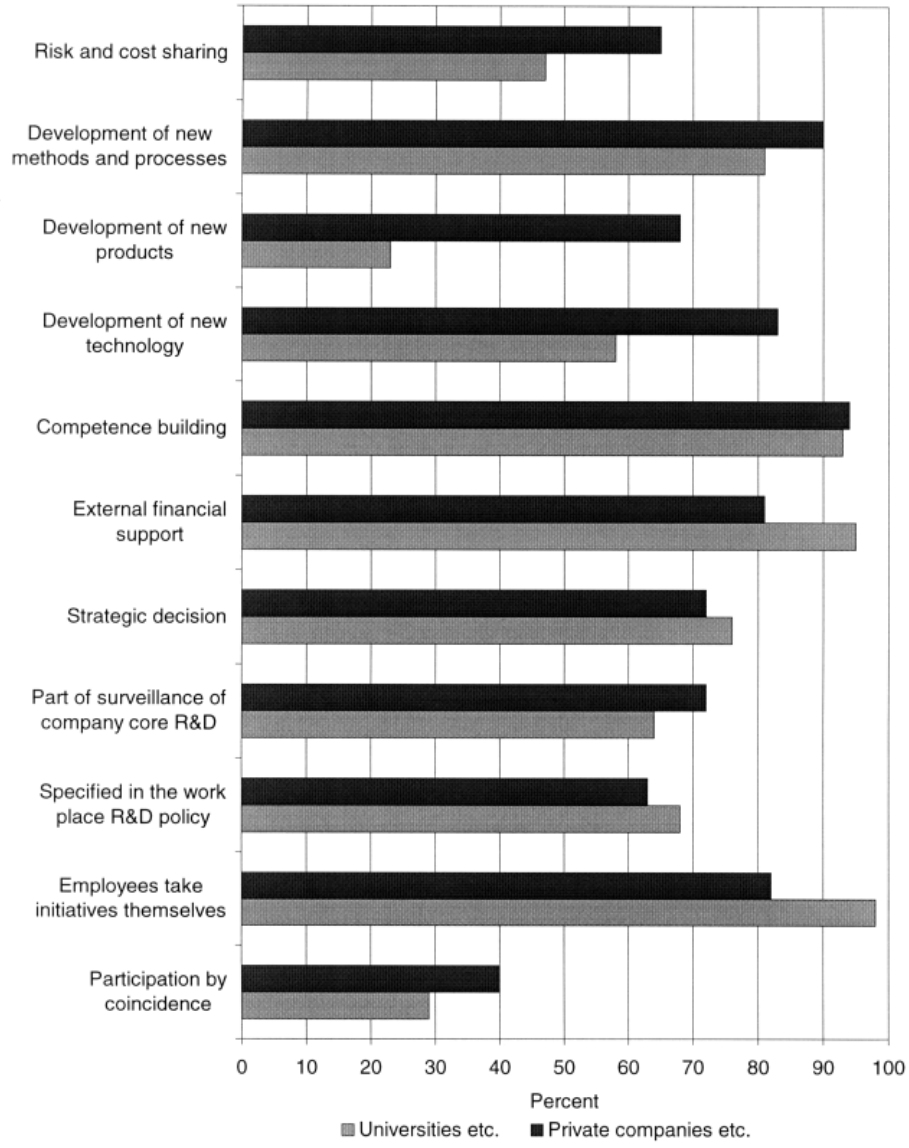
for participating companies are commented on in this section, while motives for participating university institutes are commented on in Section 4.2. The shares are shown together in Figures 8 and 9 for illustrative purposes.

In general, the most important motive among private companies, etc. is 'competence accumulation' closely followed by the possibility of developing 'new methods or processes' and 'new technology'. Less important motives are 'market surveillance', part of a 'strategic plan', to get 'external financial support', 'develop new products', ensure 'higher earnings potential' or 'improve market contact'.

The companies also indicate that in more than 60% of them, individual initiatives by the employees are important determinants for participation in research projects. Some indicate 'the international dimension in the R&D', 'front research' and 'international contacts' as motives for participation. Access to international research knowledge and establishment of contact networks are central elements in companies' decision concerning participation in research projects and research co-operation.

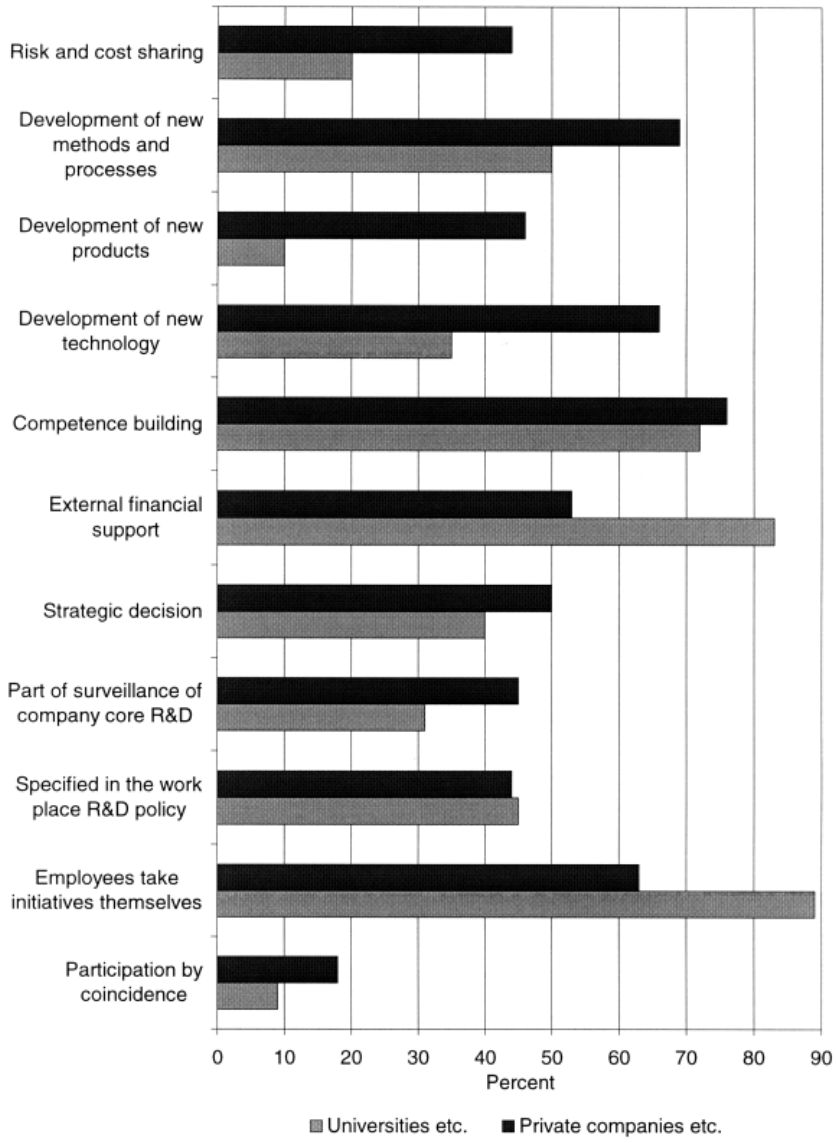
The companies indicate that 65% of them participate in research co-operation, which is not part of the 4$^{th}$ EU FWP. They do not consider participation in EU FWP to be especially risky. Areas such as protection of 'core competencies', 'intellectual rights' and 'research results' are found to be less risky than for example 'inactive partners', 'insufficient financial support' and 'communication problems' in the research group. This may partly be explained by the fact that several of these companies have participated in previous projects and that they have great experience in legal and judicial aspects of participation. Companies with significantly negative statements in this respect will typically never join projects, i.e. their expected net value of participation is negative. Following such a net value argument, the above findings are not a surprise. However, it is still a problem that 50% of the companies state that they have difficulties in financing their own share of the projects.

**Figure 8: The share of workplaces that finds motives for participation to be of some or great importance**




Note: See note at Figure 1 for a definition of private companies and universities. Some or great importance corresponds to 4 and 5 on a scale from 1-5 where 1 is no importance and 5 is great importance.

**Figure 9: The share of workplaces that finds motives for participation to be of great importance**




Note: See note at Figure 1 for a definition of private companies and universities. Great importance corresponds to 5 on a scale from 1-5 where 1 is no importance and 5 is great importance. Hence, Figure 9 illustrates a subset of the numbers in Figure 8.

Close to 40% of the companies expect 'higher earnings' from participation, while 30% expect 'no financial effects'. The share expecting 'increased turnover' is higher than the share expecting 'reduced costs'. Hence, increased earnings must come from increased market shares, which means that research projects increase company competitiveness. This is also the result of a more general question on the output of participation. 30% find 'immediate usable results' from research projects. Furthermore, an additional 65% find that they get 'usable results in the medium to the long run'. This also illustrates that expected pay-off from participation in the EU FWP is much higher in the long run than in the short run.

Asked directly about their knowledge on EU research programmes, in general, and the FP4, overall knowledge was good although satisfaction with information and guidance increases with general knowledge. Hence, experts within this field can find all kinds of information since they know where to look. Newcomers have much greater difficulty finding where to look and who to ask even though they know that the information may be available somewhere.

Naturally, the majority of participating companies find that the 4$^{th}$ EU FWP matches their needs. This is primarily caused by the self-selected sample of participating companies. Participants also claims that companies want better research possibilities for SMEs since they find it to difficult to promote project ideas. Private companies also wish increased priority in future research programmes on end-user oriented research items.

### 4.2 Participating university institutions

The administration at Danish universities together with leaders at university departments and sector research institutes also received questionnaires. 78% of the administrations responded, 51% of the departments.[6]

University administrations, in general, find that the EU FWP has a positive influence on university research, although the impact on the extent of research is moderate. There seems to be a feeling that research areas and priorities of the universities as well as the extent of basic research only to a moderate

6 Some of the departments registered in the CORDIS database did not exist anymore; others did not have the time to fill in the questionnaire. However, 100 out of 190 departments responded.

degree are improved by participation in the EU FWP. Universities wish that the demand on own share financing of research projects should be reduced combined with improved co-ordination with national research programmes. Much more positive is their attitude regarding the impact on 'internationalisation', 'international contacts' and 'network building'. All the universities see a very positive effect on these items from EU FWP research co-operation.

Involved researchers from universities participate in order to obtain access to 'financial support', 'research networks', and 'competence' and in order to ensure 'visibility and reputation'. Hence, their motives are in line with and support the experience indicated by university administrations.

Asked whether they found the project to be a success, the majority of participants confirmed this. The highest success rates are found in natural science and technology science areas followed by agricultural science and medical science.

90% of the researchers state that financial support is highly decisive for implementation of projects. On a departmental level, there is a clear correlation between departments participating in the FP4 and departments having large shares of their research activities financed by public sources.

80% of the researchers were invited by other researchers to participate in projects. 39% of the researchers took the initiative to implement the project, solely or together with others. However, their main knowledge about the research programmes comes from foreign and national colleagues. Hence, informal information systems seem to be extremely important for project participation in the university sector.

This is also confirmed by the revealed 'important characteristics' of the projects, which are 'partners' existing competencies', 'knowledge accumulation' and 'knowledge transfers'. The participants keep mentioning 'knowledge' motives and 'knowledge' results as the overall reasons for their participation.

Departmental leaders find it important that the researchers themselves take initiatives to join EU research co-operation. This is also illustrated in Figures 8 and 9. Among sector research institutes, 65% define participation as part of

their research strategy, while less than 35% of university departments state the same.

The leaders also find 'financial support' and 'knowledge accumulation' to be crucial to the departments. However, they also mention insufficient financial support as the most risky part of the projects. The leaders value research-related synergy effects and competence development highly in the department from project participation. Similarly, they point at higher scientific production as a result of participation.

Departmental leaders mention internationalisation from participation in the EU FWP as being of high importance. Networks and international co-operation are measured as items that increase the competitiveness and reputation of the department. Given these statements, the leaders also mention that co-operation inside or outside EU is equally important. It does not matter where and with whom they co-operate as long as it results in new knowledge and new networks.

Almost all research institutes indicate that they intend to apply for new projects under the EU FWP. This means that they find it valuable enough to follow-up even though all of them know of bad project examples. In the future, departmental leaders wish to ensure greater connection between national and EU research programmes and better financing of research projects.

### 4.3 Non-participating private companies

More than 300 private companies were selected randomly among all Danish non-participating companies. They are chosen so they have the same characteristics regarding R&D intensity, employees, and sectors as the companies participating under the FP4. The non-participating companies were asked about R&D activities, R&D strategies and why they did not participate in research projects under the FP4. 29% of them filled in the questionnaire.

The companies do not, in general, co-operate less within research than participating companies. They are towards EU-financed research and are willing to participate in EU FWP research projects. They do not participate, primarily due to 'lack of knowledge' about the EU FWP. Similarly, a perception of a very bureaucratic and inflexible application procedure keeps them away.

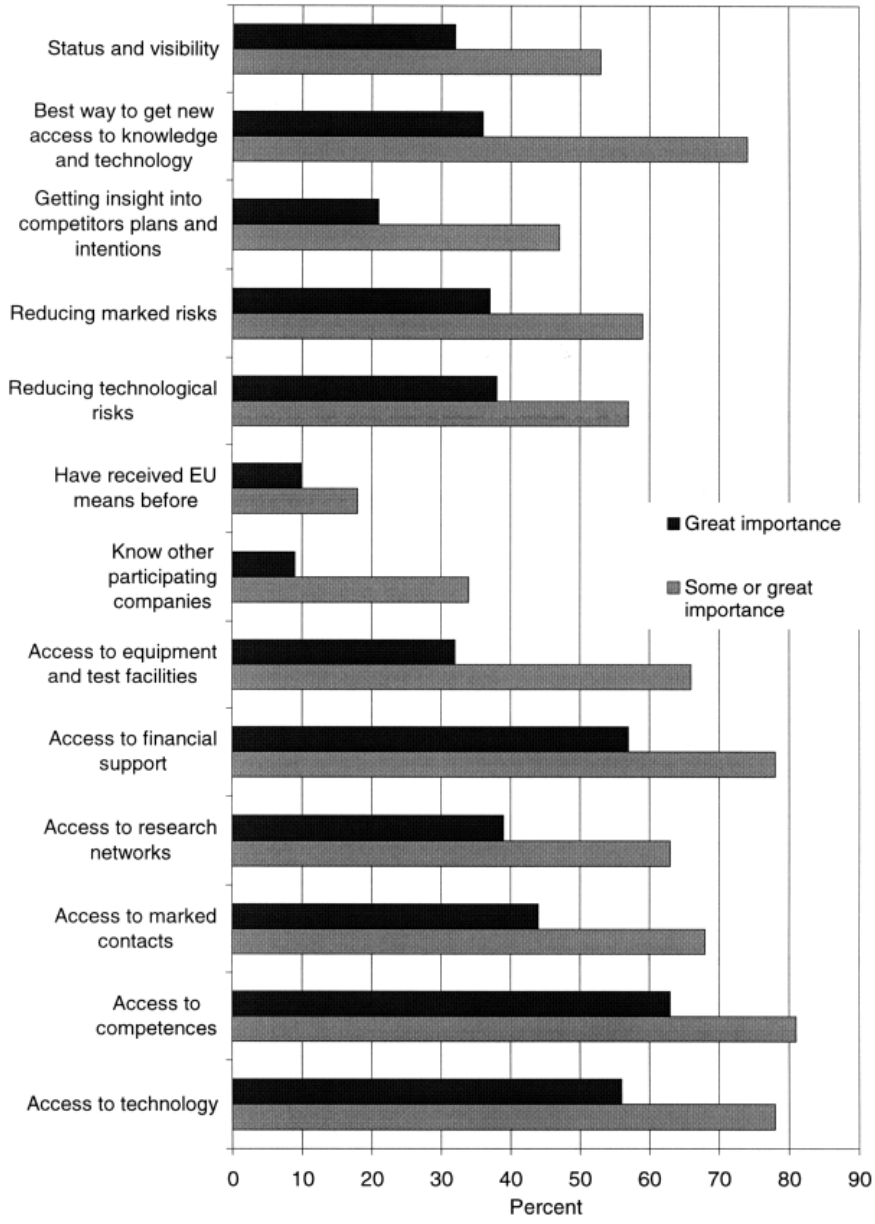
Naturally, some of the companies found the EU FWP unattractive since the FP4 did not cover their specific core activities. Instead, some of the non-participating companies prioritise other research budgets together with other research partners. A few have had a bad experience with previous participation in the EU FWP, and a few mentions that time and financial barriers keep them away. Hence, non-participation is not, in general, caused by a deliberate choice, but rather by lack of knowledge of opportunities under the EU FWP.

Even though the companies do not participate in the FP4, they know the strategic importance of 'international orientation' and surveillance of 'development in international research results'. 40% of them also find that 'actual R&D co-operation' is important for the company. This share increases to more than 75% for R&D companies and for R&D intensive export-oriented companies. Hence, non-participating companies cannot be considered as passive non-innovative companies.

Especially larger companies have deliberately chosen that their own research strategy exclude projects under the FP4. For smaller companies, reduced capacities and resource constraints seem to hamper the potential for participation. It is a common belief among these companies that contact with the FP4 is difficult to handle, since it requires relatively many resources in terms of money, employees and much time. At worst, application failure can cost the lives of companies, so often their risk-weighted costs exceed perceived benefit considerably.

Directly asked whether one or several reason from a given list could tempt them to participate, they answer pretty much like participating companies. The share that finds potential motives important is given in Figure 10. Motivating factors like access to 'competence', 'financial support', 'technology', 'equipment and test facilities', 'market contacts', 'new knowledge and technology' and 'research networks' are important reasons for a potential participation among non-participating companies. Especially the first three are mentioned as highly important factors.

**Figure 10: The share that finds potential motives for participation important among non-participating companies**




Note: Some or great importance corresponds to 4 and 5 on a scale from 1-5 where 1 is no importance and 5 is great importance.

Motivating factors such as technological and market 'risk reduction', 'visibility' or 'market surveillance' matter less. Hence, non-participating companies can be motivated for participation by a fairly simple offensive strategy where information, partner matching, financial risk reduction and a lot of case examples and experienced contacts are important pillars. The existing system where these items are available in a passive form is not sufficiently effective according to the response from the companies.[7] In general, the smaller the companies the less positive they are regarding listed motivation items, except with respect to 'financial support' where the tendency is clearly the opposite.

The share of companies that do not know the various information sources illustrates best the problems of a passive but comprehensive information system in the EU FWP. For example, less than 50% of the companies know the Danish Euro Info Centre, EIC; less than 25% know the CORDIS database; less than 45% know colleagues with experience in the EU FWP; less than 25% know foreign colleagues with experience within the EU FWP. Even though some of the companies know about the existence of information sources, they do not use them much. Only 15% have ever used the EIC or Danish experienced colleagues. Again, the smaller the company the less information sources is it aware of.

Asked which kind of information the companies need and wish, a large proportion mentions general information on the EU FWP, but also specific information on sub-programmes, themes, formal demands, application procedures and approval criteria are mentioned by some of the companies. Hence, provision of a minimum of knowledge of the EU FWP must be the first step to increase the participation rate in the EU FWP for these companies.

Asked about wishes for the future, less than 50% of the responding companies have responded. This is to be expected due to the fact that only a few of them have ever been in close contact with the FWP. However, the companies that have responded mention 'easier access for SME', 'more end-user oriented research themes' and 'administrative help to prepare the application'. These

7 The companies need to be confronted with the opportunities in a broad form followed by consultants that take contact to the companies, helping them find the best solutions. A typical project where a private company uses an independent consultant can cost several hundred thousand EUR, which makes the entire project too costly and risky for small- and medium-sized enterprises, SME.

three items were also among the most important for the participating companies.

Given all the responses from the non-participating companies, it seems like there is potential for higher Danish participation in the coming EU FWP. The key to obtain this is a co-ordinated offensive national strategy involving for example trade organisations, regional boards, co-operation among research institutes and private companies and more or easier financial and administrative support at the preliminary stage of the projects.

# 5. National representatives

Denmark had 37 national representatives in the 19 programme committees in the FP4. Between 1 and 4 Danish representatives were represented in each programme committee. The representatives come from the ministries, universities, and sector research institutes, etc. None of them came from the private sector. They all received a questionnaire concerning their role in the committees. 29 filled in the questionnaire.

The Danish representatives prioritise aspects such as increased internationalisation and strengthening of Danish R&D in their work in the committee. Strengthening of European R&D follows closely after. The overall guidelines and objectives in the FWP have lower priority. Similarly, more market related items such as Danish or European competitiveness have a considerably lower priority.

In general, representatives find their influence to be satisfactory. They have sufficient influence on contents and decisions. Careful preparation and an active effort is the best guaranty for influence, so resources and influence go to the countries that prepare themselves best. International research experience and contact to the Commission also help. The representatives do not find country alliances to be a problem although it seems as if larger countries do a 'better job' in some of the programme committees.

Danish representatives find that Danish participation improves national research competence through a more focused national research effort although participation is not considered to influence Danish research policy significantly. They also find that participation has had a positive effect for Danish participants through an increase in the number of international networks and an improved international research environment in Denmark.

# 6. The R&D additionality in a European perspective

The overall picture of Danish participation in the EU FP4 is rather successful. However, some research co-operation and research would have been performed to some extent even without the EU financing research projects. The previous sections have illustrated some of the motives and outcomes for Danish participants. This section will summarise the European dimension of the participation based on these results and try to evaluate the extent to which the EU FP4 creates additional or value-added European R&D. It is difficult to identify the exact amount of the additional European research from the EU FP4 so the following is based on indirect evidence from the questionnaires. Based on this, indices of the extent of value-adding R&D are given.

Over 1700 Danish participants have taken part in more than 1300 projects. More than 350 of the projects had a Danish coordinator. The participants came from close to 600 companies and research institutes. The Danish participants received research support amounting to more than 400 mio. EUR out of 1340 mio. EUR in the projects. The total research budgets amounted to 2500 mio. EUR. Hence, research co-operation created a considerable amount of R&D.

Participation in research projects were motivated by a desire to improve knowledge, competence and networks. Business and resource related wishes seem to matter less. Hence, research co-operation is motivated by official targets such as competence improvement, exploitation and dissemination of R&D.

More than two-thirds of the participants indicated that the projects were new in the sense that they were not an extension of other projects. Hence, a large part of the projects were developed for the EU FP4 and could therefore be considered to be value-adding research initiated by the FWP. An even higher share of participants has participated actively in developing and planning the projects. This is an indication of a great degree of commitment on this part among participants in the projects, i.e. that they consider the EU FP4 as a valuable and worthy source for financing of research projects.

Close to 80% of all participants find that the projects were, in general, successful. The areas of success were in general competences, networks, technological results, improved future opportunities and not business-related areas such as market positions and potential for financial results. Again, that is an indication of the results, which correspond to the aim of the EU FP4.

Figure 4 shows a considerable amount of societal effects for Denmark from research projects. The participants find individual life-related effects among 15-20% of the instances of participation, environmental, resource and educational effects in 30-50% of the instances of participation and effects on laws and standards in 25% of the instances of participation. Hence, research projects have a high indirect additional effect on the Danish (and properly also European) society.

Whether the research projects really create additional or value-adding European research could partly be concluded from the responses on the importance of EU-financing of projects, cf. Figure 7. More than 90% of the participants indicate that EU-financing was essential for carrying out the project, i.e. the project could not have been performed in the way planned in the original proposal. Only 4% (the same share as found for Finland in Luukkonnen and Hälikkä (2000) indicate that EU-financing had no importance at all for project feasibility.

70% indicate that EU-financing was important for the entire project, i.e. parts of the project would never have been performed without financial support. Parts of the projects would have been carried out even without EU-financing but over a longer period (50%), at a smaller scale (60%) or with less own workplace commitment (60%). Hence, an indirect measure as the importance of EU-financing indicates significant and considerable value-adding effects of the EU FP4.

Directly asked, 80% of the participants indicate that the projects could not have been performed without other partners taking part. This is probably the most direct measure of the importance of the EU FP4 and its European value-adding effect. More than 90% of the participants participate in projects with a research content close to the core of the workplace, and close to 75% of the participants indicated that the projects were part of the long-term strategic R&D

development of the workplace. Hence, participants are typically improving their core competences through their participation.

Even though a large proportion of participants in research projects know each other before starting the projects, participation results in a considerable amount of new, primarily trans-national, co-operative relationships . 90% of the participants establish collaboration with previously unknown foreign R&D networks. 50% establish new collaboration links to foreign companies. New national collaboration links are established less often (30% of the incidences of participation). Private companies more often co-operate with other private companies than research institutions, which more often than private companies co-operate with other research institutions. Danish participants and their workplaces did not find EU co-operation more important than other types of co-operation. Hence, co-operation in itself is highly valued, but the EU FP4 is just one, although very important, source to obtain this. However, the EU FP4 has improved European research co-operation through increasing co-operation among European researchers.

A representative sample of non-participating private companies indicates an R&D-profile and motivating factors similar to those of participating companies. Hence, there seems to be a possibility for even more value-adding European research through a focused campaign activating these 'sleeping', non-informed researchers and companies.

# 7. Conclusion

Danish participation in the 4th EU FWP is so extensive and comprehensive that it can at best be considered a success. There are areas for improvements but the general experience among involved researchers and workplaces is positive. The value-added output in the form of innovation, internationalisation, networks, competence accumulation and improved competitiveness highly exceeds the negative limitations in the form of bureaucracy, jurisprudence and own share financing of research projects.

Danish participants have motives for participating that are in line with the overall intention of the FWP, i.e. basic and end-user oriented research of European value. In general, motives are 'knowledge accumulation' and 'method development', mostly dominating among participants from universities, etc. and 'product' and 'end-user' oriented motives, mostly found among participants from private companies, etc.

Danish participants are in general satisfied with the content and output of the research projects although they prefer to carry out research rather than spend their time on administration of research programmes.

Apparently, there is a divergence among participants in their wish for future research programmes. Research managers as well as participants from private companies wish a continuing development towards more end-user oriented research themes. Universities and researchers from universities clearly warn against this development. However, both parties agree on the need for basic research in order to ensure the long run R&D and knowledge accumulation, c.f. Damm et al (2000).

Measured by received grants provided to projects with Danish participation, Denmark together with partner countries have national value-added effects through the extent of research performed for the money. Measured by societal effects, impacts and achievements, participation indicates significant national as well as a considerable European value-adding effect. This is also the case regarding increased internationalisation and co-operation of researchers in Europe. It seems to be the case that the EU FP4 ensures a high research synergy effects on a European level. From a Danish point of view, this is

especially important due to the fact that Denmark is one of the small European countries, measured by the amount of R&D as well as by inhabitants.

Denmark could ensure even more research synergy and higher participation in the EU FWP by a more focused, guided and national effort to increase the number of co-operating research environments. For example through increased co-operation among private sector companies and university research institutes so that competencies and networks can be disseminated easier and faster in Danish research environments. The value-added effect from participating in projects under EU FWP will then be even more beneficial for Denmark and, in the long run, for Europe.

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# Appendix 1: Method used to collect data for measuring Danish value-added participation in the 4th EU Framework Programme, FP4

The overall method used is to collect data from questionnaires, registers and other publicly available information in order to increase available information on different organisational levels of participation without bothering more than one source. The data from the different sources is then merged into a common database, which covers all aspects of the participations in order to enrich the amount and quality of the data.

- Questionnaires (7 different): All in all 2600 questionnaires. The questionnaires and the questions were prepared according to a common platform in order to improve the possibility of comparison.
    - Participants concerning actual research project
        - Participants from private companies, public companies, technological service institutes and NGOs (A)
        - Participants from universities, sector research institutions and hospitals (B)
    - Heads of research concerning workplace characteristics and strategic research considerations
        - Heads of research at (A)
        - Heads of research at (B)
        - Heads of research at non-participating private forms
    - National representatives concerning national development and priorities.
        - National Programme representatives
        - National university managers
- Register information
    - National R&D statistics on company level from The Danish Institute for Studies in Research and Research Policy
    - Additional statistics on financial performance from a Danish company collecting this information (Købmandsstandens oplysningsbureau LTD)

- Community Research and Development Information Service database, CORDIS
- Internet search engines, company and research institutions' homepages, address databases
- Telephone calls to verify information, addresses or names

All sources were used to improve the quality of the collected data, i.e. the questionnaires, and to reduce the workload, i.e. number of questions, in the questionnaires.

**Appendix 1.1: Work plan for analysing participation**

1. Danish participants in the FP4 were found through the CORDIS database, downloaded and converted to the initial participant database. Additional information on partners, nationality, funding, duration, subject, sub-programme, name of project, etc. were included.
2. All companies and research institutes were isolated and identified from the participation addresses. A matching sample of non-participating private companies was found in the national R&D statistics through a one-to-one match of participating companies.
3. National programme representatives were identified through the Danish Ministry of Research. University managers were easily found.
4. Addresses in CORDIS were up to 8 years old, giving problems in finding several of the participants and their workplaces. In case of a new contact person, the name had been changed; otherwise the questionnaire was forwarded or dropped.
5. The first page in the questionnaire included the information from CORDIS. The respondents were asked to verify and correct this. The information in CORDIS was generally correct except for some typos and missing information.
6. Returned questionnaires were merged with the initial information from CORDIS, with national R&D statistics and the commercial statistics where possible.
7. Addresses of the participants were collected and questionnaires were prepared in the period from 1st -30th October 1999. The survey period, including the first questionnaire, reminders (1st December) and repeated

sending of 'lost' questionnaires, were 1st November 1999 to 31st December 1999. The response rates were 39% and 53% for participants from private companies, etc. and universities, etc., respectively. The response rate was 31% and 51% for the corresponding research managers. The rate was 29% for non-participating companies and 78% for university administrations and 78% for national program committee members.

8. Data validation, handling and analyses were performed in the period from 1st December 1999 to 15th February 2000. The report was written in the period from 15th January 2000 to 15th March 2000.
9. The final database contains information directly from the participant as well as information, which the participant, contrary to the head of research, either does not know or would have difficulty in finding. Consequently, a wide range of research questions can be answered, seen from the participants' point of view, from the workplaces' point of view or from an accumulated national or regional level.