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OXFORD RESEARCH

Evaluation of the Centre Contract/ Innovation Consortium Programme

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for the Danish Ministry of Science, Technology and Innovation

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Contents

1. Summary and recommendations

The Innovation Consortium Programme made its appearance in the 2002 Budget. It represented a continuation of the Centre Contract Programme with various adjustments to the programme guidelines aimed at making it attractive to even more players – especially small enterprises.

This means that the same programme has in fact been in existence for ten years, the Centre Contract Programme having been set up in 1995.

The programme has been evaluated twice before – in 1998 and 2001. Both evaluations concluded that the programme contributes to new cooperative configurations, which create more innovation, improve technological service in Denmark and help boost research.

At the outset of this evaluation, it is important to remember that many things have changed since the programme began in 1995 in the context of what is referred to in professional circles as "the national innovation system":

- Unlike before, innovation consortia are now very much the dominant form of enterprise development programme as far as promoting cooperation between knowledge institutions and the business community is concerned. The government has wanted to concentrate state funding for innovation cooperation in fewer programmes.[1]
- Universities and sector research institutions are becoming increasingly involved in commercial cooperation as a strategic target area on a par with research and education.
- Competition based on knowledge and innovation is increasing sharply, making it more important for small and medium-sized enterprises to cooperate with knowledge institutions to a greater extent.
- Globalisation and new demand patterns mean that enterprises are competing increasingly on the basis of user-driven innovation. Technology and product development is just one of several elements in a modern innovation strategy. Business development, management and market understanding are becoming more important competition factors, with enterprises needing to cooperate with knowledge institutions to an increasing extent.
- The government, parliament and research councils are all planning increasingly for Denmark to focus its development resources on areas that are particularly promising. Prominence is typically given to areas such as IT, biotechnology, nanotechnology and, to some extent, energy.

The purpose of this evaluation is therefore not just to assess the results of the projects that have been initiated since the last evaluation, but also to look at

[1] See Ministry of Science, Technology and Innovation (2003): "Nye veje mellem forskning og erhverv – fra tanke til faktura" (New paths between research and business – from concept to invoice)

whether the programme and funded projects overall are in line with the development that has taken place in the national innovation system. The status of the programme as the dominant instrument for promoting interaction between knowledge institutions and the business community means that it must embrace and reflect the development trends described.

Major economic impact

In the evaluator's assessment, the economic impact of the programme goes well beyond what the government and parties involved invest in the projects. It is difficult to assess the overall impact with any accuracy, however, as it is the product of a number of factors that are very difficult to quantify. This is reflected in the fact that many of the results are not realised until several years after the consortia have ended.

Overall the evaluation shows the following results with regard to the economic impact of the programme:

- By far the majority of the participating enterprises have developed better products and/or production processes or expect to do so in connection with the consortia.
- There are great expectations in many consortia that enterprises outside the consortia will benefit from the results – primarily through traditional Approved Technical Service (ATS) activities, but also through the dissemination of knowledge from the participating research institutions.
- Where quantification is possible, the participating ATS institutes expect an annual increase in sales of at least DKK 2 million, and in some cases much more, as a result of the project.
- Case studies from centre contracts completed several years ago indicate that the results can give rise to new innovations and knowledge dissemination several years after consortia have ended.
- For the majority of consortia the evaluation clearly indicates that the results in question could not have been achieved without the programme. The parties would typically have continued their development work on their own, and the interaction between research, technological service and enterprises is highlighted as either 1) accelerating the innovation process or 2) being a prerequisite for producing the technologies in question.

There are also examples of less successful consortia, however. There are various reasons for this. Sometimes the technological ambitions proved unrealisable, which is a natural consequence of working on projects involving a substantial degree of uncertainty and risk. In some cases the project management did not function well enough, and there are a few instances of one of the key parties not fulfilling the agreements that were entered into.

Small and medium-sized enterprises play a relatively modest role in consortia

The programme guidelines were adjusted in connection with the changeover to innovation consortia. One of the aims in so doing was to increase the involvement of small and medium-sized enterprises in consortia. Thus the way was opened for enterprises with less than 100 employees to participate in certain project stages. A desire was also expressed in connection with "Fra tanke til faktura" (From concept to invoice), the Ministry of Science, Technology and Innovation's action plan, for more small and medium-sized enterprises to take part in the programme.

However, the programme guidelines also contain a number of requirements with regard to the contribution to be made by participants that in actual fact harmonise less well with the involvement of more small and medium-sized enterprises:

- The research function must contribute new, research-based knowledge at a high level.
- Enterprises must contribute technological knowledge and competence at a high level.
- Innovation consortia must have a generic content.
- Innovation consortia must have a high level of research and innovation.
- Consortia must not be in the nature of product development for the individual enterprise.

In the evaluator's assessment, the guidelines described are not, therefore, very compatible with the desire for greater SME participation. The aim that contracts should have a generic content and high level of research does not accord well with the desire to involve small enterprises more. In order to satisfy the requirements described, consortia would almost inevitably have a time frame and distance to market and product development that the majority of SMEs do not operate with.

Only one of the approximately 15 innovation consortia initiated has made use of the opportunity to involve small enterprises along the way and allow them to participate in part of the project. Firstly, it has proved difficult to get enterprises to promise up front to join a project in a year or two. Secondly, this option entails a number of legal problems to do with rights when new enterprises become involved and have access to results.

In the 30 consortia evaluated (approximately half of the evaluated projects were initiated under the Centre Contract Programme) one in five enterprises have less than 50 employees, with enterprises of this size participating in around half of the consortia. A review of the previous evaluations shows that these figures have not really changed since the programme began.

A closer look at the various types of consortium provides a good picture of where small enterprises participate and where not. With a little simplification the innovation consortia can be divided into two types of project, with the first type being most common:

- Development of a new base technology with a substantial research content. SMEs rarely take part in this type of project, and where they do participate, the SMEs in question are typically hi-tech enterprises that build their entire strategy on the base technologies in question. The SMEs may even have emerged from one of the participating research institutions.

- Enhanced use of new technologies in specific product areas (e.g. through the development of new test systems, etc.). There is greater SME participation in this type of project.

The evaluation also shows that there is a limit to how much extra effort is made to involve SMEs in consortia.

In the first type of project in particular many project managers stress that the projects will not become relevant for SMEs until the dissemination phase. The specialist requirements are too high and the projects do not accord well with the time frame of SMEs. On the other hand, many project managers emphasise that there is great potential for the dissemination of knowledge to SMEs if the projects succeed.

In the second type of project more of an effort is made with regard to SMEs, and the possibility that the political focus on small enterprises has had some effect cannot be ruled out.

It is worth observing, however, that in practice (without it having been the Ministry of Science, Technology and Innovation's intention) the Innovation Consortium Programme is a programme for *existing networks*. Owing to the long-term nature of the projects and the substantial resources that have to be invested, most project managers attach importance to their projects consisting of a core of people who already know each other. Mutual trust and experience of working together mean a lot when large resources are being invested in cooperation lasting three or four years.

Experience also shows that the circle of participants should preferably not be too large. Coordination costs rise sharply if a project involves more than six or seven parties. It also becomes difficult to create frameworks for integrated cooperation.

As a consequence of these two factors, consortia tend to be formed around a fixed core, after which there may be room for one or two more participants. This makes it difficult in many cases to involve SMEs to a greater extent, since they are typically not part of an existing network.

The project managers also stress that the involvement of smaller enterprises makes the consortia more vulnerable. They are a little uneasy about involving SMEs because there is a greater risk of insolvency or withdrawal from the project.

The fact that not more SMEs are involved is scarcely a major problem as far as the economic impact of the individual projects is concerned. Seen in isolation, it is far more important for SMEs for there to be effective knowledge dissemination than for maybe five or ten more SMEs a year to be involved in the programme.

The real problem is of a different nature. Many small enterprises face the challenge of having to raise their level of knowledge substantially and so work with innovation and technology development in a more systematic and targeted way. In this context there is great value in enterprises being involved in cooperation projects and alliances with knowledge institutions. Since the Innovation Consortium Programme is currently very much the dominant instrument in the government's framework conditions for innovation cooperation, it might be argued that it is important for the programme to build up such relations.

On the other hand, the programme has been successful so far precisely because it has managed to bring hi-tech enterprises and strong knowledge incubators together in promising projects. The solution is not, therefore, a general focus on making the majority of consortia attractive to SMEs. This would have a negative impact on the quality of the consortia and lead to fewer technological breakthroughs.

Knowledge dissemination

Since the programme began in 1995 there has been a strong emphasis on the results from the projects benefiting outside enterprises and SMEs in particular. The present guidelines formulate this as follows in the section on objectives:

- "Cooperation in an innovation consortium should enable the technological service to build up competences and develop services that can subsequently be disseminated on a broad basis to Danish trade and industry – including small and medium-sized enterprises in particular."
- "The projects should have a generic content that can be used by and disseminated to a wide circle of enterprises."

And the section on organisation and establishment contains the following:

- "The technological service function has two tasks…. Secondly, the knowledge developed in the innovation consortium should be anchored in the technological service function so that it can be disseminated and transferred to trade and industry in a broad sense in the form of services sold to the business community on commercial terms."

In the first place the evaluation points to a large part of the programme's economic impact being realised precisely through knowledge dissemination. Case studies from projects completed several years ago indicate that the competences, technology platforms, etc., developed are disseminated to enterprises outside the consortium through a broad spectrum of channels.

The evaluation also shows that ATSs selling knowledge on commercial terms is far from the only way in which knowledge is disseminated. There are many other examples of successful knowledge dissemination in both the completed and ongoing projects:

- Several of the research institutions offer or have plans to offer business-oriented courses in continuation of the projects.
- New teaching material and cases are being developed for engineering courses, for example, which means that the knowledge developed will be disseminated to new enterprises that recruit the engineers.
- Seminars are held, experience exchange groups are set up, etc., during and in continuation of the projects.
- Individual research institutions sell or expect to sell services on commercial terms when the projects are complete.
- The projects provide new knowledge on application of the research, forming the basis for spin-outs from the research institutions. In more than half of the consortia the participating researchers expect the results to contribute to spin-outs.
- In several cases the results are used in new cooperation projects between knowledge institutions and other enterprises that are financed by the parties themselves or with EU funding.

In the evaluator's assessment, the impact of several projects on these area is just as great as the impact achieved through the sale of ATS services. And in some cases knowledge dissemination through "alternative channels" even exceeds knowledge dissemination through ATS services.

The evaluator is of the opinion that the economic impact of the Innovation Consortium Programme can also be increased substantially by focusing more on knowledge dissemination in the programme design and guidelines.

Firstly, the Ministry of Science, Technology and Innovation and the Council for Technology and Innovation can attach importance in its criteria to the dissemination of knowledge to the business community through the research party. The consortia currently differ widely on this point, which presumably reflects, among other things, the fact that this is not something on which they compete. This means that it is mainly researchers who already have experience of business cooperation who focus on business-oriented activities in the wake of the projects.

The innovation consortia could become a lever for the research institutions to draw up concrete strategies for business cooperation, research-based continuing education/training, consultancy, etc. That is to say, in order to realise the objective of adding another string to their bow. This would require greater managerial involvement in the innovation consortia on the part of the research institutions, however. It is currently up to the participating researchers to decide how they want to benefit from the innovation consortia, and the results and commercial potential they produce are rarely seen by anyone other than those researchers. It is the evaluator's overall assessment that the interaction between the innovation consortia and the ongoing work of the research institutions to add another string to their bow could be improved markedly.

Secondly, there are potential channels for knowledge dissemination that are not currently being used. The most important are probably vocational schools, centres for higher education and technical academies. Many of the innovation consortia evaluated have produced results and developed competences that are very relevant to several vocational training institutions. This applies to both the courses on offer and the institutions' work on developing knowledge centre functions. In other words, centres that work to promote innovation in regional business clusters through courses, consultancy, projects, networks, etc.

In this latter area in particular there is great potential for enhancing the innovation capacity of small and medium-sized enterprises through the programme. The evaluator believes that it would be of great importance with regard to the dissemination of results to involve non-university educational establishments in the projects to a greater extent as well – possibly at a later stage.

Finally, the evaluator is of the opinion that the ATS institutes generally have a relatively passive attitude to knowledge dissemination. It is only natural for them to focus on how knowledge can be integrated in their commercial services, but the impression is that, apart from this, there is very little creative thinking in the project management of the consortia with regard to knowledge dissemination. There are, for example, very few project managers who have given any consideration at all to whether vocational schools, regional growth incubators and other types of bridge builder could benefit from the results.

It is the evaluator's recommendation that the guidelines should make provision for the projects to compete on the basis of new ideas for knowledge dissemination to a much greater extent. It is true that it may be difficult before the start of a project to decide how best to disseminate the knowledge it will generate, but adjusting the guidelines in this respect might encourage the consortia to start thinking about involving new partners.

The technological service function

In connection with the changeover from centre contracts to innovation consortia in 2002 the way was opened up for non-ATS institutes to participate in consortia as the technological service party. This was motivated by, among other things, a desire to initiate projects in specialist areas not covered by ATS institutes.
Of the 30 projects evaluated, around half started after the changeover from centre contracts to innovation consortia. In all the innovation consortia evaluated, the ATS function is performed by an ATS institute. In other words, no use has been made of the new opportunity.

The evaluator conducted an interested party analysis among a number of institutions that might be envisaged performing matchmaker and project manager functions, while at the same time being able to play an important role with regard to disseminating knowledge and technology during and after the projects. The analysis covered highly market-oriented units at research institutions, bridge

builders such as Alexandra Instituttet and Crossroads Copenhagen, technical academies and centres for higher education, for example.

What all the organisations have in common is that they have established or are on the way to establishing a broad commercial interface. They also organise and originate cooperation projects between research and business.

The recurrent theme is that the organisations in question are not aware of the opportunities offered by the present guidelines. Knowledge of the programme is patchy or non-existent, or the programme is perceived as an "ATS programme".

If the ATS function is to be performed by new players, it is therefore imperative for the programme to be marketed far better than it is today. The evaluator also recommends that the title of the function should be changed, as the term "technological service function" in itself prevents non-ATS institutes from using the programme.

The analysis also drew attention to the following points:

- The organisations interviewed showed great interest in participating in projects under the programme, including taking on the roles of originator, project manager and knowledge disseminator.
- Many of the institutions interviewed would like to develop their business-oriented activities by building up new business areas. They see a programme such as the Innovation Consortium Programme as a possible lever for developing such business areas.
- The study shows that non-ATS institutes can make a particular contribution in areas where technical knowledge is combined with other areas such as design, architecture, management, sociology, etc.
- Most institutions think that the current financing rules for the ATSs are not attractive enough. This should be seen in the light of the fact that there are fewer opportunities for self-financing, while the institutions' contribution to subsequent knowledge dissemination would also be non-commercial in nature.

All in all the analysis indicates that there is great potential for enlarging the circle of participants around the function currently performed by the ATSs. It must also be stressed, however, that the ATSs represent an indispensable partner in many of the present consortia – both as a bridge builder between research and the business community, and when it comes to turning research into practical, usable knowledge.

In the evaluator's assessment, however, greater competition in this area would be beneficial. This might encourage the ATSs to think about knowledge dissemination more creatively. And, in particular, it might enhance the ability of the programme to promote innovation in Danish trade and industry across a broader spectrum of areas.

Specialist areas represented in the consortia

The evaluation shows that the programme has achieved greater specialist breadth on the research side. In the first year of centre contracts only technical and scientific research environments took part. The consortia evaluated involve a number of research environments in medical science. Social science is also represented in some consortia. This indicates that the spread of specialist areas is increasing.

More than half of the consortia are in IT, biotechnology and nano/microtechnology. This reflects the fact that the programme already focuses on the areas that the High Technology Fund would focus on.

Against this background the evaluator believes that there is *no* need for the programme to focus on specific scientific and technological fields. Future prioritisation of government research policy, the new high-technology networks and other initiatives linked to the government's commitment to high technology will presumably further increase the tendency for innovation consortium applications to come from the aforementioned fields. It is important to preserve the opportunity for promising projects in other fields to obtain funding.

If the projects are grouped by innovation type, technical innovation is still completely dominant. As already mentioned, there are several institutions outside the ATS circle that attach importance to integrating other specialist areas in the consortia. This might increase the programme's impact on areas such as concept development, new business strategies, market and cultural understanding, place branding, etc. That is to say, user-driven innovation.

It is also the impression from interviews with potential users of the programme, however, that the existing guidelines make it difficult to utilise the programme as a lever for user-driven innovation.

This is due in particular to the fact that user-driven innovation is often about experimenting with new products, business strategies, services, etc., that combine technical, commercial and sociological competences. Many projects in this area would therefore involve testing new product types and services in new environments and customer groups using ethnographic/sociological methods and research competences, for example. This is not very compatible with the programme's requirement that projects must not be in the nature of product development.

Limited participation by foreign knowledge incubators

As part of the changeover to innovation consortia it was also stressed in the guidelines that *foreign research environments* could participate in projects as subcontractors and contributory suppliers.

This option has only been taken up in some of the 30 innovation consortia that have been initiated. Interviews with project managers show a still widespread

perception that projects with foreign applicants have a harder time of it than all-Danish projects. In some cases this prevented the project coordinators from approaching cooperation partners whom they would have liked to involve in their projects.

Many ATS institutes perceive the programme as "Danish" and so focus on Danish partners.

In the very research-intensive projects in particular there are several project managers who say that their projects would be strengthened by the involvement of specific foreign research environments.

In the evaluator's assessment, there is a need for clearer guidelines on how the Ministry of Science, Technology and Innovation and the Council for Technology and Innovation view the involvement of foreign partners, and under what circumstances participation by foreign parties would be regarded as strengthening the consortia. This area is also an example of how difficult it is to change existing perceptions of what counts for and against in the assessment of consortium applications, and an indication of the size of task involved in communicating adjustments to the programme guidelines.

Two windows in the programme

As already mentioned, the programme as a whole is a success. Both the "old" centre contracts and the new innovation consortia are contributing to new knowledge and innovation, creating great commercial and social value in relation to the government funds invested.

But, at the same time, the evaluator is also of the opinion that the portfolio of projects under the programme has not kept up to a sufficient extent with the development of "the national innovation system" outlined at the beginning of the summary.

There is a need for:

- The programme also to support projects with SME involvement, or, alternatively, the creation of a complementary programme for this purpose. Greater SME involvement must not, however, happen at the expense of the programme's ability to generate new base technologies through cooperation at a high level between research-intensive enterprises, research institutions and ATS institutes.
- The creation of better opportunities for innovation consortia outside the specialist fields of the ATSs with a view to greater competition and development of new knowledge in more fields.
- For the guidelines to provide more support for forms of knowledge dissemination other than the commercial services offered by the ATSs. In particular this means knowledge dissemination through the research institutions and educational establishments.

- The creation of greater flexibility with regard to who can perform the various roles, in particular the technological service function and participation by foreign key players.

There are several ways of realising these goals. The evaluator suggests a solution in which two windows would be created in the programme.

The first window is the larger (financial) and would focus on the development of new base technologies (technology platforms). In this window the emphasis would be on specialisation. In other words, the participants on the enterprise side would typically be large and technology-intensive. And it would frequently be relevant to consider involving leading foreign knowledge incubators and enterprises.

The other window would be aimed at projects of a more applied nature, with SMEs and educational establishments being more frequent participants. Product development could form an element in the projects if it would help to clarify the possible applications of technologies, for example. In this area we would recommend maintaining a duration of at least two years so as to give new institution types the opportunity to use the consortia to develop new commercial services, among other things. But there should be greater flexibility with regard to consortia being able to consist of several part projects, which would allow smaller enterprises, for example, to participate in activities of shorter duration. This should make it possible for some of the enterprise financing to be realised along the way. Table 1.1 shows the main differences between the two types of project.

Table 1.1: Two types of innovation consortium

	Development of base technologies	Innovation projects
Nature	Generic knowledge and high research content	Experimental projects in which knowledge is applied and various specialist fields are combined
Duration	At least three years	At least two years, with it being possible for a consortium to involve several projects of shorter duration
Research party	Top international level, involvement of foreign incubators encouraged	Researchers with an understanding of innovation and the application of knowledge
Enterprises	The best in the business and typically from existing networks	A broad spectrum, with the involvement of enterprises from outside existing networks being encouraged
Technological service party (the name of this category should be changed)	Typically an ATS institution, but it would also be possible for a research institution to perform the task	ATS institutes, educational establishments and other bridge builders

The division into two windows is intended to ensure that projects that are difficult to compare do not compete for the same funds, and that the individual projects do not compete on factors that could adversely affect quality:

- Consortia aimed at developing technological breakthroughs should not compete on the involvement of SMEs, but on their specialist quality and relevance. The SME relevance of such projects should be ensured in the dissemination phase, so this type of project should also compete on ability to think in terms of dissemination channels.
- Consortia that involve SMEs and focus on finding new applications for existing knowledge should compete less on the level of specialist research in the project itself and more on the ability to produce innovation. The same applies to projects with educational establishments, for example, as the "technological service party".

2. About the evaluation

2.1 Purpose of the evaluation

According to the terms of reference from the Ministry of Science, Technology and Innovation, the main objectives in carrying out the evaluation of the Centre Contract/Innovation Consortium Programme are to clarify:

- The commercial and social utility value of the programme
- Any need for changes in the design of the programme

The evaluation should consider the programme's performance – are the goals described in the programme guidelines being achieved? – but also its relevance and rationale – is the programme relevant to the target group and how, as an instrument of innovation policy, does it interact with the challenges and development trends of the national innovation system?

As far as the need for changes to the programme is concerned, the evaluation should focus in particular on fulfilment of the intentions that lay behind the changeover from centre contracts to innovation consortia in 2003. This ought to reveal whether SMEs are being involved in consortia to a sufficient extent and whether there is a need for further initiatives with a view to expanding the circle of players who can perform the technological service function.

More specifically the evaluation should:

- Identify the projects' existing circle of participants and specialist focus together with the opportunities/need to enlarge the circle of participants by means of further initiatives
- Chart the direct impact for the parties and future expectations
- Chart how the competences built up are incorporated and developed further by the parties
- Chart the indirect impact in the form of knowledge dissemination to – and innovation in – SMEs outside the consortia in particular and the possibilities for increasing knowledge dissemination by making changes to the guidelines, etc.
- Assess the interaction between the parties during the life of the consortia and over the course of the project
- Chart the consortia's assessment of the application process, administration and interaction with the Ministry of Science, Technology and Innovation, and the possibilities for making improvements in these areas.

2.2 Centre contracts/innovation consortia covered by the evaluation

The evaluation covers 30 centre contracts/innovation consortia that have not previously been evaluated. A list of the centres/consortia covered by the evaluation can be found in chapter 3.

Around half of them are centre contracts initiated under the old pre-2002 guidelines, while half are innovation consortia started up under the new guidelines.

The evaluation is limited in time to centres/consortia approved in the period 2000-2003. Consortia approved after 31 December 2003 are not included in the evaluation.

It should be noted that the term "consortia" is used throughout the evaluation to designate both centre contracts and innovation consortia unless specifically stated otherwise.

2.3 Data used for the evaluation

2.3.1 Questionnaire survey

As part of the evaluation a questionnaire survey was conducted among all the participants in the centre contracts/innovation consortia and involved all three parties.

The project managers were asked to provide the names and email addresses of contacts for the parties. A total of 255 people were sent the questionnaire on line, with this number being made up of 62 people from research institutions, 46 people from ATS institutes and 147 people from enterprises.

Of these 255 people, 185, or 73%, returned the questionnaire. The response rates for the research party, the technological service party and the enterprises are 84%, 72% and 63% respectively. In 25 of the 30 centre contracts/innovation consortia all three parties responded, while in the remaining five cases only two of the three parties responded.

Viewed overall, therefore, the questionnaire survey is regarded as presenting a true and credible picture of the circumstances in the 30 centres/consortia evaluated.

2.3.2 Interviews with project managers

In connection with the evaluation telephone interviews were conducted with the project managers, typically a member of staff with an ATS institute. The interviews lasted about an hour and dealt with background, composition, establishment, the application phase, the course of the project and competence development/knowledge dissemination for each of the three parties. Finally, the social utility value of the programme was also touched on. A record was kept of all the interviews. A list of interviewees can be found in the appendix.

2.3.3 Case analysis

The following case analyses were carried out with a view to obtaining a more detailed understanding of knowledge/competence development and dissemination in the individual centres/consortia:

- A case analysis of four of the centres/consortia covered by the present evaluation. The cases were selected as good practice based partly on the questionnaire survey and interviews with project managers, and partly on a dialogue with the Ministry of Science, Technology and Innovation. Round table discussions were held for the cases, with all the participants from the four centres/consortia being given the opportunity to contribute, and individual supplementary interviews were conducted. The four centre contracts/innovation consortia selected as cases are Machine Acoustics – Analysis and Optimisation of Industrial Components and Systems, MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers, Talent@IT and The SCC Consortium – Self-Compacting Concrete.
- A case analysis of four centre contracts that are not covered by the evaluation and finished several years ago. The case analysis was based on two or three interviews with participants in the centre contract. The four centre contracts are the Centre for Slush Ice, the Centre for Management and Control in Small Enterprises – LOS, the Centre Contract for Cooperation on the Development of Microsystems – SUM and the Centre for Sensor Technology. A list of interviewees can be found in the appendix.

2.3.4 Interested party analysis

An interested party analysis was carried out in addition to the above analyses. The analysis is aimed primarily at institutions that might potentially take part in a consortium but are not yet doing so. This includes research institutions that are involved as a research party but are also judged to be potential technological service parties. The analysis took the form of an interview survey and also includes interviews with central trade organisations for the purposes of discussing the current guidelines.

3. The programme since 1995

3.1 Programme design

Since 2003 the government has been providing support through the Innovation Consortium Programme for project cooperation in consortia involving enterprises, research institutions and technological service parties with a view to developing knowledge and competences (technology platforms) that can form the basis for product and service development by Danish businesses within a time frame of five to ten years. With various adjustments and a change of name, the Innovation Consortium Programme is a continuation of the earlier Centre Contract Programme, which was launched in 1995. This means that the programme has actually been in existence for around ten years.

The Innovation Consortium Programme is an example of a systemic instrument of innovation policy that seeks to break down "system errors" connected with cooperation and knowledge sharing between the players in the innovation system. The programme is thus intended to help strengthen the network between central players, develop shared knowledge and technology platforms, and so support capacity in private enterprises. This type of instrument enjoys solid support in the theoretical literature and there are many examples of its use[2]. The basic rationale for the programme thus seems to be in place.

The fact that the programme has been allowed to run for ten years in Denmark is also due to its having given rise to, among other things, new networks, technology development and innovation. This was documented in two previous evaluations of the programme in 1998 and 2001 respectively[3].

The first evaluation, which was carried out when none of the centre contracts had been completed, concluded that the programme held great potential, and also indicated that, in addition to knowledge and competence development, the programme could lead to major innovations in enterprises. This was confirmed by the second evaluation, which documented that participation in the programme led to new products and/or new production processes for the majority of enterprises.

Adjustments have been made to the programme on a couple of occasions since 1995, primarily with a view to optimising the administrative routines and framework for the programme, partly on the basis of the recommendations of the two earlier evaluations.

With a view to enlarging the target group for the programme, the Danish Parliament, the Folketing, decided in 2002 to make some adjustments to the

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[2] The concrete design can vary, particularly with regard to research and technology intensity and the degree of business involvement in the consortium, but examples include the Swedish materials research consortia, the Swedish competence centres, the Danish-Swedish Øresund contracts, the British Interdisciplinary Research Centres (IRCs) and the American Engineering Research Centres (ERCs).

[3] Oxford Research (1998): "Evaluering af Centerkontraktordningen" (Evaluation of the Centre Contract Programme, PLS (2001): "Evaluering af Centerkontraktordningen" (Evaluation of the Centre Contract Programme).

programme. The name was also changed from centre contracts to innovation consortia.

The changes took effect from 2003, when:

- The way was opened for institutions other than the Approved Technological Service Institutes (ATS institutes) to act as the technological service party. This was partly done in recognition of the fact that research institutions with a wide range of business-related services could also take on the role. This change might also give rise to project ideas in areas where the ATSs do not currently operate.
- Greater importance was attached to the participation of small and medium-sized enterprises in consortia. Specifically, the way was opened for enterprises with less than 100 employees to participate in certain project stages. Experience showed that it was difficult to get small enterprises in particular to commit to a long project.

3.2 Participants in the programme since 1995

With the changes made to the programme, support has been given from 1995 to the present day to a total of 85 consortia, 70 of which are covered by the Centre Contract Programme. A total of DKK 0.8 billion has been approved since 1995, with in the regions of DKK 100 million being approved on an annual basis, cf. table 3.1. The highest figure, DKK 118 million, was approved in 2000.

Table 1.1: Distribution of approval for centre contracts/innovation consortia, 1995-2003, current prices

	DKK millions
1995	45.3
1996	88.7
1997	89.2
1998	103.1
1999	93.9
2000	118.0
2001	91.0
2002	99.4
2003	110.9
Total	839.5

Source: Ministry of Science, Technology and Innovation

Taking the time limits given in the two previous evaluations and this one as a basis, the following offers a brief description of developments in the circle of participants since 1995 for the three types of party. It should be noted that this evaluation concerns 30 centre contracts and innovation consortia initiated since 2000 that have not previously been evaluated, cf. section 3.3 below.

3.2.1 Research institutions

As far as research institutions are concerned, the Technical University of Denmark and, to a slightly lesser extent, Aalborg University, have been the dominant institutions over the years. In this evaluation period the Technical University of Denmark has taken part in 14 centres/consortia and Aalborg University in 12, cf. table 3.2.

The strong representation of the Technical University of Denmark and, in part, Aalborg University reflects the fact that the programme has had a relatively strong technical focus since 1995, with the result that the research institutions largely come from the technical and scientific fields.

This was particularly noticeable in the programme's infancy, when all the participating research institutions came from the technical, scientific and agricultural/veterinary fields. However, some centres did work on management and organisation development to do with software development and so touched on the field of social science.

Table 3.2: Research institutions that have participated since 1995

	Number		
Research institutions	Participants covered by 1st evaluation, 1995-1997	Participants covered by 2nd evaluation, 1997-2000	Participants covered by 3rd evaluation, 2000-2003
The Technical University of Denmark	17	12	14
Aalborg University	4	5	12
The University of Southern Denmark		1	4
Copenhagen University	1	2	3
Risø National Laboratory	2	4	4
The Aarhus School of Business			2
Roskilde University			2
The Royal Veterinary and Agricultural University	3	2	1
The University of Aarhus		2	1
The Danish University of Pharmaceutical Sciences			1
The Copenhagen Business School		5	1
The IT University of Copenhagen			1
Rigshospitalet, Department of Clinical Microbiology			1
Statens Serum Institut			1
Others	6	10	

Source: Data from the Ministry of Science, Technology and Innovation. Three contracts could not be placed in the 1st or 2nd round of evaluation, so they have been left out.

In the centres and consortia covered by this evaluation technology and science continue to occupy a prominent position, but the fields of medical and social science are now represented as well. Of the 53 researchers who responded to the questionnaire, eight say that they work in the field of social science. Examples of their areas of research include "distribution and supply chain management", "environmental management" and "organisation research".

All the research institutions named in the table are Danish, but a few foreign research institutions, including Stockholm University and Dresden University. In this round of evaluation very few Danish universities are involved in the consortia, however[4].

[4] There are, however, examples of foreign knowledge incubators participating as subcontractors to some of the parties. One example is Frauenhofer, which is involved as a subcontractor in this way.

3.2.2 Technological service parties

As with the research institutions, the circle of technological service parties is dominated by a small number of institutes, with the Danish Technological Institute and the Biotechnological Institute / Bioneer being most prominent, followed by FORCE Technology and DELTA, cf. table 3.3.

Of the participants covered by this evaluation, seven of the nine ATS institutes that exist at present are represented. Only the Danish Institute of Fire and Security Technology and the Danish Standards Association are not involved. The strong representation of the Danish Technological Institute in the programme also has to be seen in the light of its size. With 864 employees, it is Denmark's largest ATS institute.

It must also be mentioned that, despite the intention of making it possible for bodies other than the ATS institutes to take on the role of technological service partner, there are still only ATS institutes performing this role up to and including 2003[5].

Table 3.3: Technological service parties who have participated since 1995

	Participants covered by 1st evaluation, 1995-1997	Participants covered by 2nd evaluation, 1997-2000	Participants covered by 3rd evaluation, 2000-2003
The Danish Technological Institute	8	14	11
The Biotechnological Institute / Bioneer*	2	3	9
FORCE Technology	2	1	5
DELTA	3	2	5
The Danish Toxicology Centre		1	3
Sensor Technology**			3
The Danish Hydraulic Institute/The Institute for the Water Environment	3	3	1
The Danish Institute of Fundamental Metrology		2	1
The Danish Maritime Institute	3	1	
The Danish Institute for Fisheries Technology and Aquaculture	1		
The Danish Centre for Terminology		1	

Source: Data from the Ministry of Science, Technology and Innovation. Subject to changes in the composition of contracts/consortia during the course of the project.

*In 2003 the Biotechnological Institute was split into two companies, one of which became in part the Bioneer ATS institute (limited company under the Technical University of Denmark), while the other was taken over by the Danish Technological Institute.

** Sensor Technology is a network organisation owned by five ATS institutes (Bioneer, the Danish Technological Institute, Delta, the Danish Hydraulic Institute/the Institute for Water Environment and FORCE Technology).

[5] Post 2003 approval has been given to one innovation contract in which the Department of Product Development at the Technical University of Denmark is acting as the technological service party.

3.2.3 Enterprises

In contrast to the participating research institutions and technological service parties, the participating enterprises represent a broad spectrum of industries and sizes of enterprise.

As far as the size of the participating enterprises is concerned, however, there is a high proportion of large companies with more than 500 employees, cf. table 3.4. The proportion of large enterprises has only changed slightly over the years and still accounts for half of participating enterprises. Around one in five of the participating enterprises have less than 50 employees.

Table 3.4: Enterprises that have participated since 1995, classified according to size

	Participants covered by 1st evaluation, 1995-1997	Participants covered by 2nd evaluation, 1997-2000	Participants covered by 3rd evaluation, 2000-2003
0-49 employees	19%	21%	23%
50-499 employees	29%	32%	30%
500+ employees	48%	45%	47%
Don't know/no information	4%	0%	0%

Source: Previous evaluations and questionnaire survey. The figures for the 2nd evaluation are subject to some uncertainty (read off a graph). Allowance must also be made for possible differences in the methods of calculation.

Compared with the business structure of Danish trade and industry, very large enterprises are distinctly overrepresented. Some of the large enterprises appear several times over the years. For example, Danfoss appears 19 times since 1995, Novo Nordisk and NovoZymes together appear 12 times, while Grundfos, Danisco and B&O appear seven times each.

The intention of involving more small and medium-sized enterprises in the consortia has therefore not yet made an impression. It is also apparent from the interviews conducted that the opportunity for smaller enterprises to take part for a shorter period has only been used to a very limited extent, cf. chapter 4.

3.3 The 30 centres/consortia covered by this evaluation.

This evaluation covers just a small part of the 10 years for which the programme has been in operation, i.e. the 30 centres and consortia approved during the period 2000-2003 that have not previously been evaluated. Around half of the 30 are centre contracts, while the remainder are innovation consortia. Only eight of the 30 centres/consortia have been completed so far.

The 30 centres and consortia are described in brief in table 3.5 below. As the table shows, the typical centre/consortium has one or two research institutions, one or two technological service parties and between three and six enterprises, but there are also some marked exceptions.

A review of the specialist focus of the centres and consortia based on recommendation memoranda and interviews with the project managers reveals that they fall into a number of special areas, in particular bio/medical technology, nano/microtechnology and IT. An exact account is difficult, as there is also a considerable overlap, but roughly nine centres come under bio/medical technology[6], roughly six can be classified as nano/microtechnology[7] and roughly three are concerned with various aspects of IT[8].

The political intention of concentrating research and development funds on a smaller number of prioritised areas targeted for special initiatives therefore seems to have made an impression with regard to the approval of new centres and consortia based on the applications received.

Table 3.5: Centre contracts and innovation consortia covered by the evaluation

Centre contract / innovation consortium	Research institutions	Technological service parties	Enterprises	App.
1 Centre for Extremophile Microorganisms and Enzymes *	Copenhagen University – Department of Molecular Biology	The Biotechnological Institute (now Bioneer)	Novozymes A/S Arla Foods amba Royal Greenland	2000
2 KEMI – Centre for Chemicals in Industrial Production *	Technical University of Denmark – Department of Production Roskilde University – Department of Environment, Technology and Social Studies	Danish Hydraulic Institute – Institute for Water Environment The Danish Toxicology Centre	Akzo Nobel Decorative Coatings Brødrene Hartmann A/S Henkel-Ecolab P.Brøste Skanska Danmark A/S	2000
3 Development of Transport Concepts of the Future *	Aalborg University – Centre for Industrial Production Aarhus School of Business – Department of Management Science and Logistics Roskilde University – Department of Environment, Technology and Social Studies The University of Southern Denmark, Sønderborg Department of Transport Studies Technical University of Denmark – Department of Production and Management	The Danish Technological Institute	Marketing Group for Pot Plants Flügger Railion Johannes Fog A/S	2000
4 Devices on the Internet *	Copenhagen University – Department of Computer Science	DELTA	Scientific Atlanta A/S Cubic Nordic Radiometer Medical	2000
5 SeaSense – Centre for Safety-Critical Maritime	Technical University of Denmark – Department of	FORCE Technology	Lyngsø Marine A.P. Møller	2000

[6] Chitosan-Based Nanoparticles and Membranes for Biomedicine, Centre for Ex Vivo Cultivation of Human Cells in a Medical Context, Centre for Nanostructured Polymer Surfaces for Medical Use, Living Bacteria for the Administration of Medicine and Vaccines, Biological Interaction Analysis, Centre for Biofilm in Technical Systems, BioMed – Diagnosis, Prevention and Control of Biofilm on Medical Equipment, Extremophile Microorgnaisms and Enzymes, Monitoring and Restriction of Bacterial Growth

[7] MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers, MiNaP – Micro- and Nanoproducts, DaMF – the Danish Microfactory, Cemost – Centre for Microoptical Structures, Centre for Nanostructured Polymer Surfaces for Medical Use, Chitosan-Based Nanoparticles and Membranes for Biomedicine

[8] Talent@IT, Devices on the Internet and WANDA

Sensors *	Mechanical Engineering		Naval Materiel Command	
6 Centre for Organisational Learning – 3 *	Aalborg University – Knowledge Centre for Learning Processes	The Danish Technological Institute	Cubic Modulsystemer A/S Dan-doors A/S Radiometer A/S TC Electronic A/S Grundfos Management A/S Novozymes A/S	2000
7 The Importance of Structure for Aroma Release in Food – Measurement and Perception *	Royal Danish Veterinary and Agricultural University – Department of Dairy and Food Science Technical University of Denmark – Department of Biotechnology	The Biotechnological Institute (now the Danish Technological Institute)	Dandy A/S Arla Foods amba Aarhus Olie Fabrik A/S Aktieselskabet Beauvais	2000
8 Centre for Ex Vivo Cultivation of Human Cells in a Medical Context *	Aalborg University	Bioneer	Menifix Aps NsGene A/S ViVoX Aps	2000
9 Centre for Improved Plastic Products - MONEPOL	Risø – Danish Polymer Centre	FORCE	AVK Gummi A/S Danfoss A/S GRUNDFOS A/S LEGO Engineering A/S Løgstør Rør A/S Unomedical NKT Flexibles A/S Novo Nordisk A/S Radiometer Medical A/S	2000
10 Centre for Optical Sensors – Interaction between Light and Biomolecules	Risø National Laboratory – Optics and Fluid Dynamics Department Technical University of Denmark – Research Center COM	Bioneer	Crystal Fibre A/S Foss Electric A/S STC A/S Micro Managed Photons A/S NUNC A/S	2001
11 MALARIA – Methods for the Effective Development of Drugs in Small and Medium-Sized Enterprises – exemplified by the development of chalcons for antimalarial drugs	The Danish University of Pharmaceutical Sciences Copenhagen University – Department of Medical Microbiology Rigshospitalet – Department of Clinical Microbiology	Danish Toxicology Centre	Lica Pharmaceuticals A/S	2001
12 Machine Acoustics – Analysis and Optimisation of Industrial Components and Systems	Danish Computing Centre for Research and Education Aalborg University – Department of Mechanical Engineering	FORCE Technology DELTA	Dantherm A/S Danfoss A/S Grundfos Management A/S Sauer Danfoss A/S YORK Refrigeration	2001
13 Centre for Biofilm in Technical Systems	Aalborg University University of Aarhus	Danish Technological Institute Bioneer A/S	Danfoss A/S GRUNDFOS A/S H. Lundbeck A/S Dalum Papir A/S AVK Gummi A/S	2001
14 MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers	Technical University of Denmark – Department of Micro and Nanotechnology and Department of Production and Management	Danish Technological Institute DELTA Sensor Technology A/S	Radiometer Medical A/S Atonomics Aps Scandinavian Micro Biodevices Aps Danfoss A/S MemsFlow	2002
15 Living Bacteria for the Administration of Medicine	Statens Serum Institut, Department of Virology	Bioneer	ALK-Abelló A/S	2002

and Vaccines		Danish Toxicology Centre	CMC Biotech A/S	
16 Centre for Network and Service Convergence	Aalborg University Technical University of Denmark - Communications, Optics and Materials (COM)	Danish Technological Institute	Eriksson Telebit A/S NetTest A/S Sonofon A/S	2002
17 Centre Contract for Model-Based Monitoring and Control	Aalborg University – Department of Control Engineering Technical University of Denmark – CAPEC at Department of Chemical Engineering and Department of Informatics and Mathematical Modelling	FORCE Technology	Elsam A/S Danfoss A/S Skov A/S FLS Automation A/S 2-Control A/S Seven Technologies A/S	2002
18 Talent @ IT – A Better Improvement and Innovation Ability	IT University of Copenhagen	DELTA	ATP-Huset SimCorp A/S Danske Bank A/S PBS	2002
19 CNP – Centre for Nanostructured Polymer Surfaces for Medical Use	Risø	Bioneer	Novo Nordisk A/S Nunc A/S Danfoss Bionics A/S Coloplast Research A/S Scandinavian Micro Biodevices A/S	2002
20 CEMOST – Centre for Microoptical Structures	Technical University of Denmark – Research Center COM Aalborg University – Department of Physics	Danish Institute of Fundamental Metrology (DFM) Danish Technological Institute Sensor Technology A/S	Hymite Aps Ibsen Photonics A/S Kalaido Technology A/S Koheras A/S LuKa Optoscope ApS	2002
21 BioMed – Centre for Diagnosis, Prevention and Control of Biofilm in Medical Equipment	Technical University of Denmark - BioCentrum Aalborg University	Danish Technological Institute	Coloplast Research A/S Egalet A/S Melitek PBN Medicals Denmark A/S Radiometer Medical A/S	2003
22 MiNaP – Micro & Nano Products	Technical University of Denmark – Department of Micro and Nanotechnology Aalborg University - iNANO	DELTA	Capres A/S NKT-Research A/S	2003
23 The SCC Consortium – Self-Compacting Concrete	Technical University of Denmark – IMM and BYG The Benchmark Centre for the Danish Construction Sector	Danish Technological Institute Occupational Health Service for Danish Building and Construction Industries	4K Beton MT Højgaard A/S Aalborg Portland A/S Videometer A/S Betonelement A/S NCC-Råstoffer Dragsholm Beton ApS Emineral A/S Elkem Materials Road Directorate	2003
24 Chitosan-Based Nanoparticles and Membranes for Biomedicine	Aalborg University - iNANO	Bioneer	Coloplast A/S Novozymes A/S Pipeline Biotech A/S Zgene A/S	2003
25 CEMIP – Centre for Effective Environmental Communication in Product Chains	Copenhagen Business School Aalborg University	FORCE Technology	Brdr. Hartmann A/S Junckers A/S Vestas Elsam A/S	2003

			Coloplast A/S	
26 DaMF – The Danish MicroFactory	Technical University of Denmark – Department of Production and Management University of Southern Denmark - Mærsk McKinney Møller Institute for Production Technology	Sensor Technology A/S Danish Technological Institute	Byrum A/S Chempaq A/S Microbotic A/S Møller & Devicon A/S Radiometer Medical A/S Visiopharm ApS Widex A/S	2003
27 InnoLink – Product and Process Development in Competence-Based Supply Networks	University of Southern Denmark Aarhus School of Business	Danish Technological Institute	GRUNDFOS A/S A/S Dantherm Holding Sjørring Maskinfabrik RK Plast MBL A/S	2003
28 Biological Interaction Analysis	University of Southern Denmark – Department of Biochemistry & Molecular Biology	The Biotechnological Institute (now the Danish Technological Institute)	7TM Pharma A/S Topo Target A/S Danisco A/S	2003
29 WANDA – Wireless Access Network Devices & Applications	Aalborg University – Department of Control Engineering	Danish Technological Institute	Texas Instruments Denmark A/S Siemens Mobile Phones A/S RF Micro Devices Denmark A/S BLIP Systems	2003
30 Monitoring and Restriction of Bacterial Growth (originally Sensors for Monitoring Bacterial Growth Conditions)	University of Aarhus Aalborg University Technical University of Denmark Risø	Danish Technological Institute DELTA Danish Hydraulic Institute	Århus Kommunale Værker GRUNDFOS A/S AVK International A/S Nordisk Wavin Danfoss analytical Per Aarsleff A/S PBI Dansensor A/S	2003

Source: Information from the Ministry of Science, Technology and Innovation and project managers. Some players in the consortia may have been replaced.

* = Consortium finished

4. Establishment and composition of the consortia

4.1 Project initiation

As has been the case since the programme was set up, it is usually an ATS institute that takes the initiative to put together a consortium and submit an application. In slightly more than half the 30 consortia covered by the evaluation the initiative came primarily from an ATS institute, and in nearly all consortia one or more ATS institutes, either alone or in collaboration, played a major role in setting up the consortium.

This means that there are not many examples of the initiative coming from a private enterprise or research institution and the ATS institution not coming in until later. It does happen, however.

The Centre for Improved Plastic Products – MONEPOL, for example, was set up on the initiative of Novo Nordisk, NKT Research and Mærsk Medical, who, together with other enterprises, needed to increase their knowledge of plastic products and so joined forces to approach FORCE Technology, who helped set up a consortium whose other participants also included RISØ. In the case of the Centre for Network and Service Convergence the initiative came from Aalborg University, which also put together a circle of enterprises from its own network, with the Danish Technological Institute not entering the process until a late stage. With Machine Acoustics – Analysis and Optimisation of Industrial Components and Systems there was a fusion of two ideas that originated in the Danish Computing Centre for Research and Education and a dialogue between Aalborg University and Grundfos.

In the questionnaire survey 59% of the technological service parties say that the primary initiator of the consortium was one or, in some cases, more ATS institutes. The previous evaluations discussed whether too much of the initiative comes from the ATS institutes and whether it should come more from enterprises in particular in order to ensure a high degree of commercial relevance in knowledge and competence development.

It can be noted in this context that the role of the ATS institutes as initiators has declined slightly in relation to the first evaluation, where 70% of participants regarded an ATS institute as the primary initiator. However, this is mainly due to the fact that the research institutions are making more of an effort, see also the examples above.

As was also stated in the last evaluation[9], the ATS institutes have a natural interest in the programme, which serves partly as an important source of finance and partly as a tool for developing their existing services, especially services in new areas.

Table 4.1: Who was the primary initiator in putting together the centre contract/innovation consortium?

[9] PLS (2001): "Evaluering af Centerkontraktordningen" (Evaluation of the Centre Contract Programme)

	According to enterprises	According to research institutions	According to technological service parties
A technological service party	52%	55%	59%
A research unit	8%	8%	5%
An enterprise	4%	6%	3%
A few ATS institutes	6%	0%	5%
A few research parties	6%	8%	5%
A few enterprises	1%	2%	0%
A small group of different types of participant	11%	13%	15%
Most of the participants	4%	6%	8%
Don't know	9%	3%	0%
Total	100%	100%	100%
Source: Questionnaire survey			

According to the interviewees and the questionnaire survey, participation in the programme gives the research party the opportunity to get new inspiration for its research, but also to obtain finance for research that could not otherwise be funded. Enterprises mainly join consortia in order to gain access to knowledge and competence, and to develop activities at the core of their business. Textbox 4.1 gives some examples of what motivated the participants.

Textbox 4.1. Motivation to participate in a consortium

"We had a dialogue with Aalborg University about how the field of machine acoustics – which had previously been strong in Denmark – was wasting away and there being a need to boost research in this area, which was of great industrial interest." (Grundfos, Machine Acoustics – Analysis and Optimisation of Industrial Components)

"We went into the work in order to create new networks, find sparring partners among the other firms, and specifically to become better at software development." (PBS, Talent@IT)

"We became involved in order to create new services that could benefit Danish trade and industry. We've been doing work in this area for many years and know that software development often fails. We'd like to change that. First and foremost, however, we'd like to acquire knowledge we didn't have before that we can turn into commercial services." (DELTA, Talent@IT)

"We're currently involved in four consortia to do with nano and microtechnology. This is a field we're very committed to. The consortia enable us to build networks and obtain external funding for our research." (Department of Production and Management/Technical University of Denmark, MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers)

"We're a new business based on funds from the innovation incubators. For us the consortium is an opportunity to gear up our own research and development work, and then the opportunity to build networks is also important." (MemsFlow, MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers)

Once the central concept of the consortium has been defined, the circle of participants is expanded, usually on the basis of existing networks and often as a further development of previous cooperation as well, with a previous consortium being the springboard in many cases. MikroKAP, for example, is the fourth consortium within the field of nano and microtechnology (in a broad sense) in which the Danish Technological Institute is participating, with their being a certain overlap in the circle of participants from consortium to consortium. What is more, the Institute subsequently applied to participate in another two consortia within this field.

In the questionnaire survey 61% of participants state that they cooperate or have cooperated with one or a few of the other participants in the consortium, 22% state that they have cooperated with most of the parties to the consortium, and 16% state that they have never cooperated with the others before. The remaining 1% did not give an answer. Put simply, consortia therefore build on existing networks, but also let some new faces into the circle. See also textbox 4.2.

Textbox 4.2. Further development of existing networks

Talent@IT

This consortium was initiated by DELTA and builds on the experience from a previous centre contract. The project came about through discussions between DELTA and the IT University of Copenhagen, and then with the participating enterprises. There was close personal contact between DELTA and the IT University of Copenhagen, and this contact provided the fulcrum for setting up the consortium. The project manager at DELTA also had connections at PBS and SimCorp – and at Grundfos, incidentally, but they did not join the consortium in the end.

The SCC Consortium – Self-Compacting Concrete

This consortium came about on the initiative of the Danish Technological Institute in close dialogue with the Technical University of Denmark, as well as with various enterprises. The enterprises in the project were brought in via the Danish Technological Institute's network in the building industry, while the Technical University of Denmark was in touch with an enterprise working on vision technology. In addition, some of the enterprises also brought their subcontractors into the project with them.

MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers

This consortium was thought up by the Danish Technological Institute and the Department of Micro and Nanotechnology at the Technical University of Denmark, with the Institute providing the driving force. The circle of enterprises came from the Institute's network in the field, with some spin-outs from the Department of Micro and Nanotechnology also being involved.

This approach has proved viable, because, as many of the project managers say, some prior knowledge and good chemistry between the parties are important if the consortium is to be successful. The project managers are also of the view that seeking partners from outside their own network is relatively resource-intensive.

The amount of matchmaking that goes on before a consortium is formed with a view to defining projects that are of interest and relevance to research, technological service and business is therefore limited. With existing practice there is consequently a potential risk of the purpose of the consortia being formulated too much on the basis of the competences and requirements of the ATS institutes, and the circle of participants being taken too much from their immediate networks.

This underlines the importance of broadening the networks surrounding the ATS institutes, research institutes and enterprises. This might be done through the new high-technology networks, for example, which could act as feeders for the consortia.

The evaluator also believes, however, that the ATS institutes have a good feeling for what is happening internationally and use it as inspiration for creating new consortia, and that great importance is attached in the concept and application phase to discussing the specialist focus of the consortium with both enterprises and researchers. The ATS institutes typically hold a number of bilateral meetings with the enterprises, but there are also examples of a small circle of participants producing the content of the project description in a brainstorming session, or the enterprises having written input in the project application. The project managers say that this work is rewarding in terms of ensuring that the project runs smoothly afterwards, but in many cases it can also be resource-intensive and time-consuming.

The interviews with project managers also give the impression that there is a lot of work involved in putting the agreement complex in place, particularly because matters to do with rights and cooperation have to be sorted out by negotiation. Whereas the problem has been traditionally linked to the relationships between enterprises and between the enterprises and the ATS institutes, several people say in connection with this evaluation that in recent years the universities have also become very aware of their rights, which has made the work of setting up the agreement complex more difficult[10]. An experienced project manager also points out that the various universities see the rights problem very differently, and in some cases also very differently from the enterprises.

4.2 Specialist level and international partners

The specialist level is also set as part of the project initiation. The interviews with project managers clearly indicate that soundings are mainly taken within Denmark's borders when it comes to putting a consortium together. In this connection it is relevant to clarify whether the level of research in the consortia is high enough in international terms, and whether there may be consortia that do not get going because there is no Danish research institute with the specific research competences required.

[10] The question of the agreement complex is also dealt with in chapter 9.

Among the project managers interviewed there is currently a general view that the research party involved represents the best research in the field in Denmark. The majority of project managers also believe that the research party is on a par with the best international environments and in some cases right up with the world's elite.

As part of the questionnaire survey the technological service party was asked, among other things, to asses the technical/research standard of the research party, with 45% replying that the level is high and 50% that it is very high. With regard to the enterprises, 21% of the technological service parties say that the technical/research standard is medium, 50% that it is high and 29% that it is very high. This positive assessment should, of course, be seen in the light of the fact that some of Denmark's largest and most research-intensive companies are strongly represented in many of the consortia.

There is thus nothing to indicate directly that the level of research in the consortia as a whole is not high enough, but consideration should at the same time be given to whether, in an age of increasing globalisation, it is possible to maintain such a distinctly Danish circle of participants as is the case today.

No international research incubators are involved in the 30 consortia covered by the evaluation, and only a very small number of foreign enterprises have found their way into the programme.

The main explanation for this seems to lie in the fact that the programme has historically been perceived as a "Danish programme". The 2002 guidelines may well open the way for foreign partners to participate as subcontractors to Danish partners, but the information from the Ministry of Science, Technology and Innovation has been interpreted by the participants as meaning that consortia with foreign involvement are not possible or will be given lower priority, cf. textbox 4.3.

Several of the examples are from before 2002, when the guidelines were changed, but two are from 2003. This is a good indication that the guidelines may well have changed, but the message has not got through to programme applicants clearly enough.

The questionnaire survey shows that around half (51%) of the technological service parties did not consider involving foreign partners, either because it was not relevant or because they were not aware of the possibility. The other half tried to involve foreign partners, but their efforts were only realised to a limited extent. In those consortia where involving foreign partners could have raised the specialist level, a handful of cases perhaps, the projects are basically developing generic technology.

Textbox 4.3. Project managers' opinions on the involvement of foreign partners

"Some consideration was given to involving the Frauenhofer Institute, but if you involve a foreign institute your application has to be very convincing on the subject of what Danish trade and industry will get out of it, and for that matter what the Frauenhofer Institute would have got out of it." (DaMF – The Danish MicroFactory, set up 2003)

"Early in the project (before the Centre Contract Programme was chosen for co-financing) we considered involving international partners, but it was not possible under the Centre Contract Programme, one of the main purposes of which is to build up Danish competences, of course." (SeaSense – Centre for Safety-Critical Maritime Sensors, set up 2000)

"We're not very strong in this field of technology in Denmark, and we'd have liked to bring in a foreign partner. But the Ministry of Science, Technology and Innovation gave a clear signal that such an application would be given lower priority, as Danish money ought not to go to foreign institutions. The involvement of an American or Norwegian partner could have strengthened the consortium." (Chitosan-Based Nanoparticles and Membranes for Biomedicine, set up 2003)

"In another application, not this one, we thought about involving foreign enterprises. This, however, caused eyebrows to be raised at the Ministry of Science, Technology and Innovation, which did not want to support foreign enterprises. We therefore reformulated the application so that all the business participants were from Denmark." (Centre for Extremophile Microorganisms and Enzymes, set up 2000)

"The market is international and we'd have liked to involve foreign firms, but we had the impression that it wasn't possible." (KEMI – Centre for Chemicals in Industrial Production, set up 2000)

In a number of other consortia it would not have been relevant to involve foreign partners because, for example, the participants had international networks, the consortium involves the use of technology platforms where research at the highest international level was not the most important criterion for success, or the consortium was about organisation development, etc., with language and an understanding of Danish culture being vital, cf. textbox 4.4.

Textbox 4.4. Project managers' opinions on the involvement of foreign partners

"It wasn't necessary. The participating firms are global and the other parties have the relevant international contacts." (CEMIP – Centre for Effective Environmental Communication in Product Chains)

"A foreign partner is involved as a subcontractor to the Danish Technological Institute. It works fine. The only thing is that the language used by the consortium is Danish." (The SCC Consortium – Self-Compacting Concrete)

"We didn't consider foreign partners. It's not particularly relevant to the project." (Centre for Organisational Learning)

"An understanding of Danish corporate culture is vital in the project, and there would probably have been too much of a culture gap if a foreign partner had been involved." (Talent@IT)

In the light of the experiences gathered, there seems to be a need to discuss how the programme can be made more attractive when it comes to involving foreign partners. If the Ministry of Science, Technology and Innovation, as stated in the guidelines, regards participation by foreign knowledge incubators as a real opportunity, there is at any rate a need for this to be communicated to the programme's target groups more clearly than has been the case so far.

The reasons for involving foreign partners in consortia should, of course, be that the economic returns in Denmark would be made greater by integrating them in competence and knowledge development together with Danish partners than by not doing so. This argument basically seems stronger for projects developing generic technology than for projects with a more application-oriented focus.

The Ministry of Science, Technology and Innovation should consider drawing up guidelines to indicate when a consortium meets the conditions for participation by foreign research incubators. There might, for example, be a requirement for international knowledge incubators to be "world class" in order to participate, or for Danish PhD students to be enrolled at the university as part of the project in order to ensure the best possible transfer of knowledge.

4.3 The participation and role of smaller enterprises in consortia

As chapter 3 showed, large companies have been greatly overrepresented on the enterprise side every since the programme started. The duration of the projects, the focus on generic technology development and the requirement for enterprises to have high technological competence mean that many small and medium-sized enterprises find it difficult to participate.

With the changeover to innovation consortia the Folketing and the Council for Technology and Innovation wanted to make participation more attractive for smaller enterprises. Specifically, it was made possible for enterprises with less than 100 employees to participate in parts of a project (but they must do so for at least six months)[11]. The statistics for the composition of consortia do not suggest, however, that there has been an appreciable increase in participation by smaller enterprises, cf. chapter 3.

If the participants in consortia are asked whether a special effort was made to get smaller enterprises to take part, the response is overwhelmingly positive. Not surprisingly, the most positive answers come from the technological service parties, who are typically responsible for putting a consortium together and matchmaking, cf. table 4.2.

Table 4.2: When the centre contract/innovation consortium was being put together, a special effort was made to involve small enterprises (less than 50 employees)

	Research institutions	Technological service parties	Enterprises
No	21%	16%	25%
Yes, but it didn't work out	8%	18%	1%
Yes and it worked out	42%	58%	32%
Don't know	29%	8%	42%
Total	100%	100%	100%

[11] But administered in such a way that enterprises have to give an undertaking when the consortium is being set up.

Table 4.2: When the centre contract/innovation consortium was being put together, a special effort was made to involve small enterprises (less than 50 employees)			
	Research institutions	Technological service parties	Enterprises
Source: Questionnaire survey			

It is worth noting that, according to the project participants, the effort made to get enterprises with less than 50 employees to take part in the consortia was successful[12].

The interview survey does not present quite the same positive picture, however, and seems to confirm the figures from chapter 3. The interviews with project managers suggest, for example, that the consortia can be classified in five groups:

- Consortia in which smaller enterprises are natural participants because they are industry leaders in research and technology. This is mainly the case in the field of biotechnology.
- Consortia in which a special effort was made and which succeeded in involving smaller enterprises that would not otherwise have participated.
- Consortia in which smaller enterprises are involved but there was no special focus on this when the consortium was being set up (e.g. they were suppliers to other consortium partners).
- Consortia in which a special effort was made but which were not successful in attracting smaller enterprises.
- Consortia in which no smaller enterprises are involved and none of the participating parties gave this matter special focus.

The interviews give the impression that this last group is the largest (35-40%), while the other groups are roughly equal in size. In other words, smaller enterprises are involved in around half of the consortia, only a minority of which made a special effort to bring more small enterprises in.

It is difficult to say why the results of the questionnaire survey and the interview survey differ so much from each other on this point. The most logical explanations are as follows:

- Several project managers may have interpreted the participation of smaller enterprises as meaning that a special effort had been made. In principle it can be said that a "special effort" has been made in respect of all the participants when a consortium is being set up!
- The considerable political focus on small and medium-sized enterprises may in some cases have caused the participants to paint slightly too positive a picture in answering the questionnaire.

[12] The large proportion of enterprises in particular that answer "don't know" is presumably due to their not being sure whether a special effort was made in respect of smaller enterprises and not knowing how many employees the consortium parties have.

The conclusion from the interview survey is therefore that the changeover to innovation consortia and the new guidelines have brought about a modest increase in participation by smaller enterprises.

There are several reasons for the modest increase. Firstly, despite the recent changes in the guidelines, the programme is still primarily aimed at large, technology-intensive enterprises. The aim that contracts should have a generic content and high level of research does not accord well with the desire to involve small enterprises more. Such aims inevitably mean that the contracts have a time frame and distance to market and project development that the majority of smaller enterprises do not operate with.

Only one of the 30 innovation consortia initiated has made use of the opportunity to involve enterprises with up to 100 employees along the way. For one thing, it is difficult to get enterprises to promise to join a project in a year or two. Also, this option entails a number of legal problems to do with rights when new enterprises become involved and have access to results. In other words, it seems that the instrument used to increase participation by smaller enterprises has not been very effective.

Secondly, several of the project managers interviewed stress that the programme is aimed at existing networks of researchers, enterprises and ATS institutes that have tried cooperating before, cf. chapter 3. The consortia last several years and substantial resources are tied up in the projects. This means that great importance is attached to good chemistry and experience of cooperation when setting up a consortium. As one project manager puts it: "We first find a core group of players who have proved that they can work together. Then you can think about whether there is room for a smaller enterprise. But there's also a limit to how many people can be involved."

Several project managers stress that there is an upper limit on how many participants a consortium can have. Establishing integrated cooperation between everyone in the consortium is a real challenge, and the difficulties increase substantially if a project has more than six or seven participants. Many ATS institutes also find that the task of coordination becomes too difficult if more players take part in the consortia. This means no extra effort is made in several projects to involve enterprises that are not part of the existing network.

Several project managers also stress that the involvement of smaller enterprises makes the consortia more vulnerable. As one project manager puts it: "We're slightly worried about involving SMEs. There's a risk of them going bust or pulling out of the project. This can easily cause a domino effect owing to a lack of corporate capital. It might be useful to have a programme to safeguard against that sort of thing."

However, there are also some examples of consortia that have succeeded in involving smaller enterprises, cf. textbox 4.5.

Textbox 4.5. Positive experiences with smaller enterprises

MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on

Polymers

SMEs used to be a problem because they didn't want to be involved in a four-year project. This is no longer a problem. Probably because we've found a model that works. What it comes down to is selling the product better. The innovation consortia should be part of the firms' development work and involve activities that they can conduct better through the innovation consortium. It's important for it not to seem too academic. We shouldn't turn up and present a complete package that firms have to say yes or no to.

SMEs are very sensitive with regard to potential investors. They want to see that the firm is focused. An innovation consortium is perceived as something new that by definition is outside the firm's core area. This means that we have to fine-tune projects so that they fall within the firm's focus and demonstrate that results will be achieved quickly. Small firms can't live with long development periods.

The general picture is that small enterprises mainly participate in projects where the distance to market is not too great and which therefore contain a degree of concrete product development (or other forms of practical innovation).

To simplify slightly, the majority of innovation consortia can be divided into two types of project:

- Development of a new base technology (generic technology) with a substantial research content. Smaller enterprises rarely take part in this type of project, and in the specific cases where they do, the SMEs in question are typically hi-tech enterprises that build their entire strategy on the base technologies in question.
- Enhanced use of new technologies in specific product areas (e.g. through the development of new test systems, etc.). More smaller enterprises participate in this type of project. On the other hand, these projects often involve more limited interaction between enterprises and research incubators. Either the level of research is lower or the researchers have defined self-contained projects that are relatively independent of the business-oriented projects.

Many project managers are of the opinion that the continuing modest level of participation by smaller enterprises does not represent a problem. They believe that the programme's most important objective is to develop groundbreaking new technology, and that it is in the subsequent dissemination phase that smaller enterprises will reap the benefits of the programme. See textbox 4.6.

Textbox 4.6. Smaller enterprises not considered until the communication phase

"It is important for the participating firms to be well-resourced frontrunners in the field. We've sought instead to involve SMEs via the communication of results from the consortium, including in the form of experience exchange groups." (CEMIP – Centre for Effective Environmental Communication in Product Chains)

"It proved difficult to find smaller firms that could participate in the actual development process – but smaller firms will be involved to a greater extent in the subsequent product maturation and production phase." (SeaSense – Centre for Safety-Critical Maritime Sensors)

"The idea in our consortium is that we should use the results to advise SMEs later on." (Centre for Network and Service Convergence)

As chapter 7 shows, the evaluator is also of the opinion that the greatest benefit of the present programme for smaller enterprises lies in the phase where knowledge from the consortia is disseminated through consultancy services, courses, testing, experience exchange groups, etc.

At the same time, however, many smaller enterprises face the challenge of having to raise their level of knowledge substantially and so work with innovation and technology development in a more systematic and targeted way. In this context there is great value in enterprises being involved in cooperation projects and alliances with knowledge institutions. Since the Innovation Consortium Programme is currently very much the dominant instrument in the government's framework conditions for innovation cooperation, it is worth considering how the programme can be made more attractive for smaller enterprises.

The evaluator does not believe that the present opportunity to participate in parts of a project will change the picture much in the future for the reasons mentioned above.

On the other hand, the evaluator can see two other channels for increasing participation by smaller enterprises.

Firstly, the high-technology networks and future technology centres may be an important icebreaker. As already mentioned, the programme is aimed in its design at consortia made up of players who already trust each other and have worked together before. The aforementioned initiatives will provide an opportunity for new networks to be built up and smaller enterprises to join existing networks. They may also facilitate smaller cooperation projects in which trying out new cooperative configurations will be less risky.

Secondly, the Ministry of Science, Technology and Innovation and the Council for Technology and Innovation should consider making adjustments to the programme guidelines to make them more attractive to small and medium-sized enterprises.

It is important to stress, however, that the programme has been successful so far precisely because it has managed to bring hi-tech enterprises and strong knowledge incubators together in promising projects. The solution is not therefore a general focus on making the majority of consortia attractive to SMEs. This would have a negative impact on the quality of the consortia and lead to fewer technological breakthroughs.

As we will say in chapter 10 (on recommendations), greater SME participation can be achieved by clearly differentiating in the administration of the programme between projects involving the development of new base technology and projects with a more application-oriented aim. It is in this latter area that it is relevant to work for greater SME participation. In the first area the aim should be to involve the most competent enterprises in the consortia irrespective of their size.

5. Triangular cooperation during the project

5.1 Integrated cooperation

The project should contribute to knowledge and competence development, and help to bring the three parties closer together in that an "innovation consortium should be based on integrated cooperation in which the parties work together closely," as the programme guidelines put it.

The evaluation of the 30 consortia shows that the participants generally perceive cooperation to be good, cf. table 5.1, but also that there are large differences in how integrated cooperation is. In some consortia there is close cooperation, while in others it is more fragmented.

In a handful of the consortia the participants, according to the questionnaire survey backed up by the interviews with project managers, are extremely satisfied with cooperation[13]. In some of the consortia where cooperation is less successful, the failure is often due to one or more parties not being sufficiently committed. The research party might have had its own agenda, for example. Inadequate project management is another explanation.

Table 5.1: How did the participant perceive cooperation in the centre contract/innovation consortium?

	Very poor	Poor	Neither/nor	Good	Very good
Technological service parties	0%	0%	18%	61%	21%
Enterprises	0%	7%	24%	53%	15%
Research inst.	0%	4%	30%	43%	22%

Source: Questionnaire survey

Generally speaking, the technological service party is most satisfied with cooperation. A total of 82% of the technological service parties perceive cooperation to be good or very good, cf. table 5.1.

It is not surprising that the technological service party in particular perceives cooperation to be positive. It is typically the technological service party who initiates the project and acts as project manager. It also has plenty of backup in its own organisation and, of the three parties, is the one that puts the most man-hours into the project[14]. The technological service party is therefore central to the project in every respect.

There are several examples of the technological service party being important in terms of cooperation by acting as a bridge builder between the research party and the participating enterprises. As one enterprise put it in connection with the case studies: "Getting basic research out to the businesses worked well, and the

[13] The participants were asked to evaluate cooperation on a scale of 1 to 5, with 5 corresponding to very good. In the consortium with the highest level of satisfaction everyone answered 4 or 5. In the consortium with the least satisfaction, the evaluations are between 2 and 5. This dissatisfaction is, incidentally, due in particular to the project manager's handling of the project.

[14] The questionnaire survey shows that it is not unusual for the technological service party to have up to ten people involved in the work, while the other parties typically only have between two and four people involved.

technological service party in particular played an important role in making knowledge accessible to them."

However, there are also examples of the reverse: "The technological service party was a good administrator, but I think we lacked a professional manager who could bind us and the subprojects closer together."

The central role of the technological service party can also hamper integrated cooperation to some extent. As one project manager puts it: "I feel they're looking at me and expecting me to take care of things despite the fact that right at the beginning they shook hands on our being equal when it comes to moving things forward."

Whereas the technological service party assumes a central role in this way, it is typically more of a challenge to bind the research party and the enterprises closer together. It is also rarer for the enterprises to enter into bilateral cooperation with each other, cf. textbox 5.1.

Textbox 5.1. Cooperation

"The only problem was cooperation between the researchers and the businesses. It's difficult to see what concrete cooperation there was between the two parties, and the businesses did not embrace the research results directly." (KEMI – Centre for Chemicals in Industrial Production)

"The businesses were interested, but they had trouble understanding that the researchers and even the consultants did not have a ready answer. Differences in expectations and pace were a big challenge." (Centre for Organisational Learning)

"Many of the relationships will probably continue afterwards. But not really between the businesses. They're too different for that." (Centre for Biofilm in Technical Systems)

"The cooperation is between the technological service party, the university and the individual business – not between the businesses." (CEMOST – Centre for Microoptical Structures)

Cooperation between the researchers and enterprises often comes about when the enterprise has research and development competence to match that of the research party. This is typically the case with large enterprises and in hi-tech projects. Cooperation between hi-tech SMEs and researchers can also work well, however, particularly if the enterprise is a spin-out from a university. But in some cases the technological service party is a more natural cooperation partner for SMEs.

The field of research also seems to be of some significance. In some of the projects to do with management and organisation there can easily be a rush to take on the role of consultant, possibly with the result that the enterprises enter into very close dialogue with the technological service party, while the researchers play more of an observing role.

Close cooperation between enterprises is less frequent. This may be because many of the consortia primarily work organisationally to integrate the three parties in the project organisation and only then to integrate the enterprises. The project is also often organised in such a way that each enterprise takes part in its own enterprise-specific subproject and only rarely in interdisciplinary activities.

The way in which relations typically fan out from the technological service party to the research party and the enterprises, together with the relative rarity of relations between the enterprises, is also illustrated by table 5.2. The enterprises are in more frequent contact with the technological service party than with the research party. It is also interesting that the enterprises are not frequently in contact with each other. One in five enterprises say that they are in contact with the other enterprises less than once a quarter.

Table 5.2: How often has the enterprise been in contact with other participants in the consortium?

	Small enterprises (< 50 employees)	Large enterprises (> 50 employees)	Technological service parties	Research institutions
Daily	1%	0%	2%	0%
Weekly	2%	9%	20%	14%
Monthly	18%	20%	47%	43%
Quarterly	30%	44%	25%	26%
Less frequently	18%	20%	4%	13%
Don't know	2%	1%	1%	1%
Irrelevant	28%	6%	0%	2%
Total	100%	100%	100%	100%

Source: Questionnaire survey

Despite such "asymmetrical" cooperation, however, the impression given by the interviews with project managers is clearly that the consortia create a framework for more and better cooperation between the parties. New parties meet each other, the enterprises have neutral ground on which to meet, and trust is built up between the parties, cf. the examples in textbox 5.2.

Textbox 5.2. Enhanced cooperation as a result of the Centre Contract/Innovation Consortium Programme

"There are already considerable synergies. A couple of the businesses have started to have extra meetings because they have some problems in common. It looks like it might provide the necessary breakthrough. The research party and the technological service party are now cooperating much more because of the project." (CEMIP – Centre for Effective Environmental Communication in Product Chains)

"A relationship of trust has been built up between all the parties, and constant consideration is being given to whether new projects could be set up in this forum. There's also been knowledge transfer between the parties, particularly in areas where they are not in direct competition." (SeaSense – Centre for Safety-Critical Maritime Sensors)

"The department at the Danish Technological Institute did not previously cooperate with Aalborg University. Now there's great synergy. From nothing to cooperation in a number of areas." (Centre for Network and Service Convergence)

"It's positive to see how the consortium has given the businesses a neutral platform on which to meet. This has led to more trusting cooperation, and it's also brought about new bilateral cooperation between the businesses." (Centre for Extremophile Microorganisms and Enzymes)

"I think the network has been enhanced, but it's a slow business because it takes time to build up the necessary trust." (CNP – Centre for Nanostructured Polymer Surfaces for Medical Use)

One way of assessing the strength of three-party cooperation is also to investigate whether the parties expect to continue their cooperation when the money from the Ministry of Science, Technology and Innovation runs out. The results summarised in table 5.3 indicate that some of the relations that have been built up are expected to continue.

Table 5.3: What does the participant expect to happen to the activities that have been worked on in the centre contract/innovation consortium when the grant from the Ministry of Science, Technology and Innovation runs out?

	Research institutions	Technological service parties	Enterprises
We will stop the activities	8%	0%	7%
We will continue the activities with the same partners, but with other funding	11%	24%	7%
We will continue the activities, but with other partners and other funding.	24%	26%	5%
We will scale the activities down and/or involve fewer partners	17%	8%	7%
We will continue independently with our own funds	0%	26%	44%
We have not decided yet	38%	16%	31%
Don't know	2%	0%	0%
Total	100%	100%	101%
Note: Research n = 53, ATS n = 38, enterprise n = 91			

The most positive answers are from the technological service parties, which have great expectations that the activities will continue. It is interesting, however, that the enterprises largely either expect to "abandon" cooperation in the consortium in order to continue independently or have not taken a decision on the matter yet, and so do not have very great expectations with regard to future cooperation. Once again the technological service party is at the centre of cooperation.

5.2 Success factors in integrated cooperation

Based on the interviews and round table discussions, the evaluator is of the opinion that several factors are important when it comes to establishing integrated cooperation between the three parties in the course of the project:

- Overall control and managerial integration within the organisation
- An organisation of the activities in the consortium that supports integrated cooperation between the three parties
- Good communication and mutual trust between the parties

5.2.1 Overall control and managerial integration

The appointment of a steering group with representatives from the various parties is regarded as important when it comes to establishing integrated cooperation. The steering group should set out the overall guidelines for cooperation, discuss

concrete problems in the consortium on an ongoing basis and ensure organisational integration with the parties involved in the consortium.

Based on the interviews, the evaluator is of the opinion that this can best be ensured if the parties are represented by people with the authority to make decisions. This commits the individual parties to cooperation and ensures better anchorage of the knowledge and competence developed within the organisations of the individual parties.

One of the project managers also points out that the steering groups could be given greater influence on progress by giving them greater authority with regard to administering the budget framework for the consortium as a whole, enabling them to allocate funds within that framework to the individual subsidiary activities based on documented progress and project milestones. All 30 consortia use steering groups, but there are major differences in how they are put together, what authority they have and how active a role they play.

The challenge faced by the steering groups seems to be to balance strategic/long-term and specialist insight. In the majority of cases this is achieved by having a steering group with both managerial and specialist representatives. In a small number of cases the steering group is made up primarily of specialist human resources. In some cases the steering group is divided into a managerial group and a specialist group, or specialist groups are appointed as part of the steering group.

The enterprises and technological service parties are typically represented by managers in the steering groups, while the research institutions are typically represented by professors and associate professors. There seems to be a preponderance of specialists from the research institutions, but there are also examples of management at the research institutions participating, e.g. the manager of the Department of Micro and Nanotechnology at the Technical University of Denmark and the rector of the Danish University of Pharmaceutical Sciences. This is regarded as positive, as it increases the likelihood of the work of the consortium being included in the overall strategy of the institution.

Textbox 5.3. The steering group

"The steering group consists of development directors, professors, etc. In other words, there is full decision-making authority, and it's worked well." (MiNaP – Micro- and Nanoproducts)

"The steering group is made up of the core partners at director/manager level. The steering group sets out the overall guidelines, looks after communication and can decide how to handle sensitive information." (The SCC Consortium – Self-Compacting Concrete)

"The steering group is made up of managers close to the top. It's important for them to have decision-making authority so that it commits the participants." (Centre for Network and Service Convergence)

"We have a director with financial responsibility on the steering group. It's important to have managerial anchorage. Partly because we have 30-50 people who are affected by the project, and partly because organisational changes are only to be expected over three

years." (PBS, Talent@IT)

The interviews with project managers show that the steering groups, apart from laying down overall guidelines for the project, are used to:

- Discuss general guidelines surrounding IPRs and specific questions concerning IPRs as they arise
- Handle changes in the circle of participants, e.g. if an enterprise withdraws from cooperation
- Monitor development in subprojects and discuss technical problems that arise in this connection
- Discuss ongoing reporting to the Ministry of Science, Technology and Innovation

The steering groups typically meet between one and four times a year, and seem in particularly to have made their mark in those consortia where the objectives had to be modified or there was a change in the circle of participants.

In other cases the steering group has been relatively passive, as the following quotes show: "The steering group was not very important, as the project ended up consisting of a number of subprojects that were implemented with the individual businesses." And: "We're now adding two extra projects to the consortium and they've been approved by the steering group, but it's pretty much a case of rubber stamping. The project manager has a lot of authority in day-to-day matters."

Whereas the steering group has overall managerial responsibility, the project manager has an important role as administrator. In many of the consortia the project managers is also able to facilitate progress and cooperation by virtue of his personal and professional qualifications. The impression from the interviews, which is further supported by the questionnaire survey, is that the project mangers are experienced and generally do a good job.

In the questionnaire survey eight out of ten say that the project manager has largely handled administration satisfactorily. This is also important, since in those cases where the project manager lacked competence, the parties perceived the project as disjointed and cooperation as poor.

5.2.2 Organisation of the consortium's activities

The activities of the consortia are organised in very different ways. There are large differences in how the consortia have sought to integrate both participants and concrete activities through organisation. Put simply, each consortium has its own model.

Three models recur in many of the consortia, however (see also textbox 5.4):

- Organisation into subprojects that are conducted in parallel, with the individual subprojects involving one or a small number of enterprises plus the technological service party and the research party. The enterprises do not meet as part of the concrete work, but possibly through participation in the steering group or at interdisciplinary seminars, etc.

- Organisation into feasibility/research/technology projects and industry/product/demonstration projects in a sequential model, with the research party and technological service party doing most of the work at the start and the enterprises not taking part in any substantial way until later in the project.
- Organisation in a matrix model, with interdisciplinary generic projects interacting with more specific, business-related projects. The business-related projects will typically involve an enterprise and one or two of the other parties, but the circle of participants in the interdisciplinary projects can be more heterogeneous.

The first model has been used in several projects. The advantage of this model is that the consultants and researchers, together with the enterprises, can concentrate on the needs of the individual enterprise and so make the work as relevant to it as possible. The disadvantage, on the other hand, is that relatively little work is done between the enterprises, and so it is the technological service party in particular and the research party to some extent who will bind the project together laterally.

Textbox 5.4. Examples of consortium organisation

Machine Acoustics – Analysis and Optimisation of Industrial Components and Systems is organised on the matrix model, with all the enterprises participating in one enterprise project and a number of interdisciplinary projects running at the same time. Grundfos, for example, is participating in both a specific enterprise project and several of the interdisciplinary projects, while York is just participating in a project involving cooperation with DELTA. Concrete cooperation between the enterprises is modest, and cooperation is mainly advanced through the work on the steering group and interdisciplinary events. Cooperation is described as positive, but could have been enhanced by further integration.

In MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers the fulcrum is provided by the individual enterprises, which typically work together with one of the technological service parties and one of the research institutions in enterprise-specific subprojects. The enterprises do not work together in the subprojects. A number of interdisciplinary activities do, however, support interdisciplinary cooperation, while the initiative has been taken for a number of joint demonstrators, who will also bind the participants closer together.

In the Centre for Organisational Learning a number of subprojects ran in parallel, with each subproject involving one enterprise, two consultants from the Danish Technological Institute and a researcher. Some interdisciplinary network meetings were also held. Cooperation between the researchers and the consultants was good. This was also true of cooperation between the consultants and enterprises, while the researchers and enterprises remained slightly more at arm's length.

The second model is typically used when the aim is to develop generic technologies that can then be implemented in the enterprises by means of demonstration projects. With this model there are some examples of the enterprises not joining the project seriously until a relatively late stage. The path that the technological service party and possibly the research party set out in the application therefore has a tendency to be reinforced further. In consortia of this

type there is, not surprisingly, a certain amount of variation in how close cooperation is perceived to be by the parties.

The third model tries to combine the advantages of the first two models by both including projects that are very relevant to the individual enterprises and at the same time opening the way for more interdisciplinary cooperation. The model also offers good opportunities for some enterprises to participate a lot and others less.

There can scarcely be an organisational model that would suit all consortia, but, all other things being equal, integrated cooperation is encouraged by:

- An efficient steering group, see above.
- It being possible for all the parties to meet each other in concrete cooperation projects, including the enterprises meeting the researchers and the enterprises meeting each other.
- All parties being involved in the development process from the outset. The sequential model, in which the enterprises are not involved until a late stage, does not seem appropriate with regard to promoting cooperation.
- Interdisciplinary activities that bind the consortium's subsidiary activities and participating individuals together.

It is also a good idea for the consortium not to have too many participants. According to the project managers interviewed, this entails substantial administrative costs, it is difficult to bring all the parties in close to the project, and it is impossible for all the parties to work with each other. The optimum size seems to be about six or seven participants.

5.2.3 Communication and trust

The interviews and round table discussions leave a clear impression that it is important to take communication and mutual trust seriously in a project.

As one of the project managers puts it: "Culture differences and communication represented a major challenge. It would probably have been a good idea to start with a seminar or workshop so that we could get to know each other and so start to establish a sense of trust." Or as another says: "It takes six months to a year to establish the necessary trust." In several of the consortia that went well, most of the parties already knew each other and so had the necessary trust.

The problems that arise in the course of a project are mainly due to the parties having different goals and time frames. When it comes down to it, the enterprises would like to see results instantly, while the researchers are still getting literature together, as one of the participants in Talent@IT put it, cf. textbox 5.5.

Textbox 5.5. Different goals and time frames

The start-up of Talent@IT was marked by frustration on the part of the enterprises in particular. They wanted to get on with it, and they found it difficult to wait until the initial research had been completed. In order to solve the problem, the decision was taken to run a pilot project with a model that was not even half ready so that the enterprises could get started. A meeting was then held at which everybody was of the opinion that

things were going really well. The enterprises could see that it was a good thing that they had been held back, and the researchers thought it was good that they had been forced into action. The pilot project had not been planned, but it proved very useful.

In MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers the different time frames were not a big problem. According to the enterprises it was appreciated in the project that the parties were working with different time frames and that product development was of no particular interest to the researchers. The relative lack of friction may, according to the enterprises, also be due to the fact that both the Department of Micro and Nanotechnology and the Department of Production and Management are research institutions with great experience of commercial cooperation. Incidentally, the enterprises do not perceive there to be a sharp distinction between the Department of Micro and Nanotechnology and the Department of Production and Management as the research party and the Danish Technological Institute as the technological service party.

The interviews offer various examples of measures that can support mutual trust between participants:

- *Team building*. In MiNaP – Micro and Nanoproducts a great deal of importance was attached to getting the participants together from the outset. Among other things, a two-day event was held, with participants having to stay overnight. There was also the advantage that the project involved a number of young PhD students, who quickly became the fulcrum and then established good relations with some of the younger members of staff in the enterprises.
- *Interdisciplinary social arrangements.* By far the majority of the consortia hold courses, seminars, workshops, etc., with a view to an exchange of specialist knowledge between the participants and between subprojects. This also gives participants the chance to meet each other in more informal surroundings.
- *Creative organisation of administrative routines*. WANDA, for example, gave the project's four PhD students the task of organising joint project meetings, i.e. they call the meetings, chair them, take minutes and see to the follow-up. This works well, and the enterprises are very active with regard to the meetings, provide feedback, etc., while the PhD students acquire new skills to complement their research training.
- *Knowledge sharing solutions.* In several of the consortia work has been done on setting up a joint space on the Internet, consortium websites, etc., with a view to making central information available to participants and possibly external partners as well. As one of the project managers puts it, it is important for all the relevant information to be centrally available so that participants don't have to go looking for it and no one feels that they are short of information.
- *Mobility of personnel.* The consortium structure is essentially virtual, but in around one in three consortia the participants had full or partial access to each other's facilities, or had the opportunity to be posted with each other for short or extended periods. This is judged by many to be professionally and personally enriching for the consortium. With regard to

posting, it is usually the technological service party and research party who are given postings with each other and/or one of the enterprises, while it is rare for anyone from the enterprises to be given a posting.

Consideration might be given to whether the Ministry of Science, Technology and Innovation could support more integrated cooperation to a greater extent than is the case today, e.g. by stressing the importance of the following in the guidelines:

- Projects/subprojects involving all parties
- Physical facilities for cooperation
- Mobility of personnel with skills
- Time being set aside at the start of the project for the parties to develop ideas jointly with a view to promoting knowledge sharing, team building, etc.

In addition to this, the Ministry of Science, Technology and Innovation might also take the initiative for experience exchange between the consortia and/or a "start-up pack" containing good advice and examples of integrated cooperation.

6. Results

Knowledge and competence development in the Centre Contract/Innovation Consortium Programme has a time frame of five to ten years. The participants covered by this evaluation cannot therefore be expected to have realised all the potential results of their involvement yet.

Of the 30 consortia covered by the evaluation, only eight have been completed. The rest are in progress, and some are only about a third of the way through the project. This should be borne in mind with regard to what follows.

It should also be noted that the results discussed below are results achieved by the parties involved. A large proportion of the results arising from the programme, presumably the majority, will happen outside the consortium as a result of dissemination of the knowledge and competence developed. Such results are examined in more detail in chapter 7.

6.1 Fulfilment of own expectations

The interviews with project managers show general satisfaction with the results achieved so far. The project plan may have slipped a bit, and unforeseen technical problems may have arisen, making it difficult to achieve goals, but by and large their expectations have been fulfilled.

The general satisfaction of the project managers is supported by the questionnaire survey, in which 18% of participants from the technological service parties are of the opinion that their expectations have been more than fulfilled, 49% that they have been fulfilled, 33% that they have been partially fulfilled and none that they have not been fulfilled at all, cf. table 6.1. Whether expectations have been fulfilled or not depends on how long the consortia have been going.

Table 6.1: To what extent have the participant's expectations of the centre contract/innovation consortium been fulfilled so far?

	More than fulfilled	Fulfilled	Partially fulfilled	Not fulfilled at all	Don't know
Technological service party	18%	49%	33%	0%	0%
Enterprise	4%	40%	46%	9%	1%
Research inst.	9%	43%	42%	4%	2%

Source: Questionnaire survey

As table 6.1 also shows, the technological service party perceives its expectations as having been fulfilled to a greater extent than the other parties. By far the majority of enterprises and research institutions reply that their expectations have been fulfilled or partially fulfilled. Some reply that their expectations have not been fulfilled at all.

According to the case studies, the possible reasons for the expectations of the enterprises not been completely fulfilled include:

- The project was not sufficiently well defined from the outset, so it took time to clarify the aims and content.
- The enterprises expected to obtain concrete returns on their participation in the work sooner.
- Unforeseen technical problems made it difficult to pursue and achieve the original objective.
- The research party was expected to be more of a driving force with regard to the enterprises' needs and play a more active role in cooperation.
- From the outset there were expectations of greater interaction with the other enterprises in the consortium.

6.2 The strategic importance of competence and knowledge development

One of the main purposes of the programme is the development of competence and knowledge within the consortium by its participants. The interviews with project managers and the round table discussions document that this is actually happening and the returns are substantial.

In the questionnaire survey participants were asked to assess the *strategic* importance of such knowledge and competence development for their own organisation. The result confirms the picture of the programme so far. The strategic importance is greatest for the technological service party, followed by the research party and then the enterprises, cf. table 6.2. The technological service party helps to initiate the consortium and uses participation as an important instrument in the development of new and existing business areas.

Table 6.2: Seen from ... how would you describe the nature of competence and knowledge development in the centre contract/innovation consortium?

	Of little strategic importance (1)	(2)	(3)	(4)	Of great strategic importance (5)	Don't know	Mean
Enterprise	8%	14%	31%	39%	7%	1%	3.24
Technological service party	0%	0%	13%	39%	49%	0%	4.36
Research inst.	0%	6%	15%	42%	37%	0%	4.10

Source: Questionnaire survey

The researchers rate the strategic importance nearly as high as the technological service parties, underlining the fact that they typically join the consortia with a view to further developing research that enjoys a high priority in their own institution.

The picture is different for the enterprises. Very few enterprises find the work in the consortium to be of great strategic importance, and some find the work quite simply to be of little strategic importance. The majority of enterprises are somewhere in the middle and find competence and knowledge development to be of some importance for them.

The enterprises also say the following in the questionnaire survey:

- Participation is typically part of a long-term R&D initiative. This applies to 52% of the enterprises, while 21% say that it is part of a medium-term R&D initiative and 14% that it is part of a short-term R&D initiative. The remaining 13% were unable to provide an answer.
- Technological novelty value was giving a relatively high rating, with 57% considering it to be high, 22% medium and 16% low[15]. The rest do not know.
- Distance to market varies quite a lot. On the one hand, 27% of the enterprises perceive the project to be a long way from market, while, on the other hand, 37% perceive the project to be close to market. A total of 33% answer neither/nor and 3% did not reply[16].

Seen overall, this indicates that the returns on participation for enterprises are of significance to their knowledge and competence development in areas where they are already working, and that this is of some strategic importance to them. In a way this measures up very well to the programme's intentions of developing generic knowledge.

At the same time, however, there may well be a need to look at the possibilities for increasing the strategic returns of the enterprises so that they are on a par with those enjoyed by the technological service parties and research parties.

The reasons for the returns not being of greater strategic importance for the enterprises than is currently the case might be as follows:

- The consortia are typically initiated by the technological service party, possibly aided by the research party, while the enterprises typically do not become involved in the project generation until slightly later.
- The way in which the consortia focus on the development of generic knowledge and competence may not be very compatible with the enterprises' desire for input for concrete innovation projects.
- The enterprises may be reluctant to join consortia where competence and knowledge development is of very great strategic importance for them because they want to keep their own knowledge secret and because there might be problems with IPRs.

If the strategic returns of the enterprises are to be increased, it will be important to find models that support both the development of generic content and the specific returns for enterprises. There may be a need, for example, to consider easing the existing requirements in the guidelines with regard to the work of the consortium not supporting product development by enterprises.

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[15] These figures do, however, include enterprises participating in projects without any technological content as such, e.g. those to do with organisational learning.

[16] It must be remembered that some of the projects involve process innovation and so are not particularly close to market by definition.

6.2.1 Actual and expected results

The technological service party

The consortia play an important role with regard to developing competence and knowledge in the technological service parties (at present mainly in the ATS system) that can benefit trade and industry. Thus the technological service party uses the programme to a large extent to support business development.

The technological service party was asked to assess whether its contribution to the consortium was primarily intended to develop new business areas or strengthen existing ones. In reply 61% say that they develop new business areas and 39% that they strengthen existing areas. The first evaluation of the programme also documented that the ATSs use the programme to develop new business areas. The programme is therefore of importance for ongoing innovation in the ATS system (see also chapter 8 for a discussion of this, however). The knowledge and competence developed manifest themselves in many different forms of product in the ATS institutes, cf. textbox 6.1.

Textbox 6.1. Results in the ATS system

"There's brilliant correlation between the work in the innovation consortium and FORCE's technical development, future services and business plan. The project contributes to the development of unique products that don't already exist. The results achieved are included in the new courses offered, and concrete services and initiatives are planned for the future." (CEMIP – Centre for Effective Environmental Communication in Product Chains)

"The project has produced new test methods for plastics and new databases, not to mention greater general knowledge about how plastics behave." (Centre for Improved Plastic Products – MONEPOL)

"To be specific, we've built up a materials/process laboratory and competence focusing on micro and nanotechnology. MikroKap has been the springboard for expansion from eight to 20 employees. We've also started an industrial research project, a PhD project under the nano research school, a Marie Curie Industry Host Fellowship and a post doc Talent Project. Our services consist of consultancy, development and production of microcomponents, e.g. microflow systems." (MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers)

"Following the project we can advise businesses on what they should do to reduce the risk of software development projects flopping. We're also expecting to train people outside our own organisation to carry out the evaluation." (DELTA, Talent@IT)

The most frequent outcome is that the technological service party develops consultancy services to do with product development. Half of them have already done so and the remainder expect it to happen. Consultancy services to do with process development and certification are other areas where a major impact is expected, cf. table 6.3.

Table 6.3: Does the technological service party expect the centre contract/innovation consortium will lead to...					
	Already happened	Expected to happen	Not expected to happen	Don't know	Total
Consultancy services to do with product development	50%	42%	3%	5%	100%
Consultancy services to do with process development	29%	53%	18%	0%	100%
Consultancy services to do with management and organisation	11%	14%	64%	11%	100%
Testing	27%	38%	32%	3%	100%
Standardisation	11%	22%	63%	4%	100%
Education and training	22%	32%	39%	7%	100%
Certification	15%	77%	8%	0%	100%
Source: Questionnaire survey					

The research party

The research party typically chooses to cooperate in a consortium in order to obtain inspiration for research through participation in concrete cooperation on development, and sometimes in order to initiate new research. Several of the interviews also point out that participation in consortiums is also an opportunity to strengthen cooperation with external partners and a means of funding research that would otherwise be difficult to finance. The return for participating researchers is therefore, not surprisingly, that the consortia contribute to new results and publications, cf. textboxes 6.2 and 6.3.

Textbox 6.2 Examples from consortia in progress

"We increased our knowledge, which means that we can now see the outline of a new theory. Participation has also brought us more resources, which have made it possible to educate two PhDs. The IT University of Copenhagen aims to educate ten a year, so we're making a big contribution." (IT University of Denmark, Talent@IT)

"We've a post doc on the project, we've written a number of articles, including some together with Danfoss, with whom we've worked a lot, and then we're also involved in two patent applications." (Department of Production and Management, MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers)

"We've a PhD on the project, we've written articles, and I also think the fact that we're open to cooperation with trade and industry is of value in attracting students." (Department of Micro and Nanotechnology, MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers)

"Publication and new teaching materials are important results, and then we also expect the project to generate patents, royalties and possibly spin-outs in the long term. We attach great importance to combining theory and practice." (Technical University of Denmark – The SCC Consortium – Self-Compacting Concrete)

"We've strengthened research into acoustics, which was ailing a bit in Denmark before the start-up. The concrete results include articles and conference papers, and we've also been trying to set up a masters' course in acoustics. We've just not succeeded yet." (Aalborg University, Machine Acoustics – Analysis and Optimisation of Industrial Components and Systems).

Textbox 6.3 Examples from completed consortia

"As a result of the cooperation we developed substantial competence in packaging, which we learned from DELTA and the enterprises. One concrete result was that this enabled us to develop microsystems for pressure sensors. Following on from that, we've now started developing multisensors. We're making an indoor climate sensor together with Danfoss, for example. I believe that our participation gave staff a big technical boost." (Department of Micro and Nanosystems, Centre Contract for Cooperation on the Development of Microsystems – SUM)

As textbox 6.3 shows, participation can lead to the development of new research areas and initiate new cooperative relationships that can be traced back to the consortium to a greater or lesser extent. The researchers also obtain credit-earning results such as PhD theses, articles and conference papers, and in many cases new teaching material too, cf. table 6.4.

Table 6.4: Does the research party expect the centre contract/innovation consortium to contribute to

	Already happened	Expected to happen	Not expected to happen	Don't know	Total
PhD theses	8%	49%	39%	4%	100%
Books	10%	10%	67%	14%	100%
Articles	51%	45%	2%	2%	100%
Conference papers	69%	29%	2%	0%	100%
Other papers	48%	35%	6%	11%	100%
Teaching material	25%	33%	31%	11%	100%
Patent applications	12%	28%	37%	23%	100%

Source: Questionnaire survey

The enterprises

Enterprises mainly join the consortia with a view to strengthening their position in existing business areas. This is the motivation for 72% of them. To a lesser extent the enterprises participate in the consortia with a view to entering new business areas. This is the motivation cited by 27%.

This accords well with the fact that enterprises typically take part in the consortia as part of a longer-term initiative, with participation being used to enhance knowledge and competence development, and as a way of gaining access to the competence of the research party in particular.

As table 6.5 shows, 16% of the enterprises strengthened their position in existing business areas as a result of participation in the consortium, and 58% expect this

to happen in the future. On the other hand, only 5% have entered new business areas, and only 26% expect it to happen. There is thus reasonable concordance between what was wanted and is expected.

Table 6.5: Does the enterprise expect the centre contract/innovation consortium to help to

	Already happened	Expected to happen	Not expected to happen	Don't know	Total
Develop knowledge and competence	66%	32%	2%	0%	100%
Improve the enterprise's work and production processes	16%	36%	42%	6%	100%
Improve or develop the enterprise's products or services	18%	58%	18%	6%	100%
Strengthen its position in existing business areas	16%	58%	18%	8%	100%
Enter new business areas	5%	26%	59%	10%	100%

Source: Questionnaire survey

Of the participating enterprises, 18% have improved or developed their products and services, while 58% expect this to happen. The impact realised is on a par with what was revealed in the first evaluation of the programme, when none of the consortia had been completed. There is relatively little innovative impact during the project. This is supported by the interviews and round table discussions, which provide few examples of *realised* innovation, cf. textbox 6.4. Competence and knowledge development is what is important in the short term.

Textbox 6.4. Examples of results in the consortia under evaluation

"As part of the project we are developing a model to optimise control of IT development projects. It's not finished yet, but we've tested a pilot of the model. This has revealed various things, momentum has been given to a process in the organisation, and we've reduced the risk of unsuccessful development projects, but we can't yet see the results on the bottom line." (PBS, Talent@IT)

"We're working on the development of a concrete product. Our involvement has helped us to get some things moving and also to systematise them so that we can do it again. We've made faster progress, and no doubt the commercial impact will materialise, but it hasn't yet." (Danfoss, MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers)

"We expect to achieve a saving of 5-10% on concrete production, and we'll also get fewer complaints, less scrapping and fewer repairs, but we're not quite there yet." (4K, The SCC Consortium – Self-Compacting Concrete)

The question then is what happens next. If we just look at the consortia set up in 2000-2001, which are now either complete or almost complete, 28% are of the opinion that they have improved or developed products and services, while 50% expect this to happen. Even at this stage, therefore, most of the innovative impact of consortium participation has not yet materialised. The impact has to be evaluated in the longer term.

In this evaluation it has been possible to look in more detail at the impact achieved in four completed centre contracts. The examples cannot be expected to be representative of all centre contracts, nor can the three examples in textbox 6.5 below be expected to be representative of all the enterprises that took part. In other words the available data is rather thin.

Textbox 6.5. Examples of results in completed consortia

"We wanted to produce a centralisation strategy, and we also succeeded in putting it in place. The development around us meant, however, that we became unsure whether it was the right strategy. Therefore it has never been implemented, but we enjoyed the process and some parts of the strategy have also been used elsewhere. It might well be termed a moderate success." (enterprise, Management and Control in Small Enterprises – LOS)

"We've developed a pressure sensor that can be built into pumps. Production was recently started with a volume of around two million sensors a year. They're going to be used in our own pumps and sold as components. This result is not completely due to our participation in the project, but it certainly helped." (business, Centre Contract for Cooperation on the Development of Microsystems – SUM)

"The business acquired the patent, but they never chose to exploit it commercially. Presumably because they expected that the market potential of other technologies was greater." (project manager, Centre for Slush Ice)

In all probability the three examples nevertheless illustrate the benefit of participation in a consortium quite well. As with development of the pressure sensor, participation can have a marked innovative impact. But innovative results may also fail to materialise because the market and competition situation change, for example.

This "outcome gap" is a natural consequence of the way in which the programme focuses on the generic and the long-term, not to mention the willingness to take risks that is inherent in the programme. It is likely that some competence and knowledge development will not lead directly to innovation, but that this will be compensated for by striking innovative results. The programme should be evaluated on its successes. In this context the evaluator would encourage the Ministry of Science, Technology and Innovation to carry out a more systematic examination of the results from the first centre contracts.

6.3 Importance of the programme in the impact achieved

An evaluation of the results of a programme such as the Centre Contract/Innovation Consortium Programme with its substantial element of public subsidy also requires an assessment to be made of whether the results could have been achieved without public money.

The programme gives the technological service party the opportunity to obtain funding for development activities in new business areas, cf. section 6.2.1, and the research party the opportunity to obtain funding for research that is relevant both

to the research community and business. For their part, the enterprises gain access to the knowledge and competence of the other parties by investing their time and expertise.

The interviews with project managers, cf. text box 6.6, show that the importance of the programme lies in the following in particular:

- Small or scattered projects are brought together in a large project.
- Development activities are implemented faster and/or given greater momentum.
- The risk to enterprises of initiating development activities is reduced.

Textbox 6.6. Has the consortium made a difference?

"Without the programme some of the participants would have worked on it. It was new to others, and some would surely never have thought of working on it. We wouldn't have stood still if the programme hadn't been there, but it has given us a boost." (Centre Contract for Model-Based Monitoring and Control)

"Each of the parties was working on the subject, but needed a new impetus and new input to make progress. It's a diffuse subject, so a joint development project with lofty ambitions is very important. It has to be at the highest level, and it really has to create new knowledge and concrete, action-oriented tools. A joint approach was needed in order to achieve that." (CEMIP – Centre for Effective Environmental Communication in Product Chains)

"It enabled our energies to be brought together in a large project instead of lots of small projects run by different parties." (Centre for Improved Plastic Products – MONEPOL)

"The work wouldn't have got going so quickly, nor would it have had the same scope without the programme. As a result, other, possibly foreign, environments might have beaten us to it. As it was, we were quick off the mark. That gives us various advantages." (Centre for Network and Service Convergence)

"Even large companies are often slow to initiate risky development projects. Public money is needed to get new areas started." (Centre for Extremophile Microorganisms and Enzymes)

"If no money had been forthcoming for the research in projects here, some of the parties would probably have gone it alone, but if that had happened, the knowledge would not have been disseminated in the way it is here, so it would not, for example, have benefited a lot of businesses in particular." (BioMed – Centre for Diagnosis, Prevention and Control of Biofilm on Medical Equipment)

The importance of the programme is also documented by the questionnaire survey, which indicates that a large part of the results and the projects set up would not have been realised without the programme, cf. table 6.6. Only around one in five of the participants are of the opinion that a project or cooperation to do with the concept on which the consortium is based would have happened whatever the circumstances. In this case, however, it would typically have been smaller in scope.

Table 6.6: Would a project/cooperation to do with the concept on which the centre contract/innovation consortium is based have happened without the programme?			
	Research party	Technological service party	Enterprises
Yes	2%	0%	3%
Yes, but it would have been smaller in scope	23%	21%	19%
No	66%	74%	69%
Don't know	9%	5%	9%
Total	100%	100%	100%
Source: Questionnaire survey			

This finding is confirmed by the interviews. A consortium is such a complex organisation that such cooperation would not naturally happen without a programme. At the same time, however, there are a number of examples to suggest that bilateral or trilateral cooperation between some of the parties could have come about, as well as examples of existing cooperation being directly incorporated in a consortium and of cooperation possibly being continued afterwards.

Even in these cases the programme may have some legitimacy, however, if additional parties are brought in because the programme, or if the knowledge and competence developed are disseminated to other parties inside or outside the consortium. And, in summary, there is reason to ascribe most of the impact achieved by the parties involved to the existence of the programme.

7. Knowledge dissemination

7.1 Introduction

One of the most important rationales behind the Innovation Consortium Programme – and the Centre Contract Programme before it – is that the projects should lead to the development of new knowledge, which can then be disseminated to Danish trade and industry. There is thus an expectation that a large part of the programme's economic impact will be achieved through the dissemination of knowledge to enterprises outside the project.

The present guidelines formulate this as follows in the section on objectives:

- "Cooperation in an innovation consortium should enable the technological service function to build up competences and develop services that can subsequently be disseminated on a broad basis to Danish trade and industry – including small and medium-sized enterprises in particular."
- "The projects should have a generic content that can be used by and disseminated to a wide circle of enterprises."

And the section on organisation and establishment contains the following:

"The technological service function has two tasks…. Secondly, the knowledge developed in the innovation consortium should be anchored in the technological service function so that it can be disseminated and transferred to trade and industry in a broad sense in the form of services sold to the business community on commercial terms."

According to the guidelines, the commercial services of the ATS institutes are therefore the most important source of knowledge dissemination to trade and industry. Similarly, the results from the innovation consortia are expected to be disseminated to other research incubators by means of publications and research reports. This line of reasoning reflects a very clear division of labour between the research institutions and the ATS institutes.

The particular focus of this evaluation has been knowledge dissemination to trade and industry. Firstly, we have tried to identify how knowledge dissemination to the enterprises happens and is expected to happen among the 30 consortia evaluated. Secondly, we have tried to identify by means of interviews the knowledge dissemination in four consortia that were completed at least three years ago. Thirdly, we have tried to chart whether there is potential for further knowledge dissemination from the consortia that is not currently being exploited.
Table 7.1 shows how the participants themselves perceive their role as knowledge disseminators.

Table 7.1: What role is the participant perceived to have with regard to the dissemination of competence and knowledge developed in the contract/consortium to enterprises and institutions outside the consortium? (given as a percentage of all replies)						
	1 (no role)	2	3	4	5 (major role)	Don't know
Technological service party	0%	3%	15%	33%	49%	0%
Enterprise	17%	29%	26%	11%	10%	7%
Research institution	0%	15%	40%	25%	21%	0%
Source: Questionnaire survey						

In light of the guidelines, it is no surprise that the technological service party in particular perceives itself as having a major role as a knowledge disseminator. But half the researchers also say that they have an important role in this area.

Sections 7.2–7.4 examine knowledge dissemination by each of the three main groups with a view to identifying how they each contribute to realising the economic potential of the programme.

7.2 Knowledge dissemination by the technological service party

In the questionnaire survey the technological service parties were asked to state how knowledge from the consortium is expected to be disseminated to enterprises and institutions outside the consortium. The results are given in table 7.2.

Table 7.2: Through which channels will the technological service party's knowledge and competence from the centre contract/innovation consortium be disseminated to enterprises and institutions outside the consortium? (given as a percentage of all replies)	
	%
1. Via services to enterprises in which the new knowledge is crucial	97
2. Via books, reports, journals, etc.	69
3. Via conferences, seminars, etc.	80
4. Via newsletters, Internet, etc.	54
5. Via course and training offerings	31
6. Via experience exchange groups, etc.	56
7. Via demonstration of the new knowledge to enterprises	59
8. Via participation in new/other cooperative configurations	67
Don't know	0
Source: Questionnaire survey	

All of 97% state that they expect to integrate the results in new or existing services. Reports, journals, conferences, seminars, demonstration examples and experience exchange groups are also frequently used to disseminate knowledge from the consortia. Slightly further down the list we find course and training offerings (31%). Finally, the table shows that the ATSs also largely expect to take part in new cooperation projects in the wake of the innovation consortia so that they can continue to build on the developed knowledge in new project activities.
The interview analysis indicates that the various dissemination channels can be divided into two main groups or phases. Firstly, there are broad dissemination

events, which form part of the conclusion of the project and where a wide circle of enterprises and researchers can find out about what the project has produced. Secondly, there is the commercial part, with the ATSs developing specific services, which they sell on ordinary consultancy terms.

The interviews also show that the commercial services cover a broad range of products, including consultancy, testing, analyses, prototyping, certification and lectures. In some cases the consortia develop actual products, which the ATSs can then sell (see chapter 6) – but typically in conjunction with consultancy services.

The increase in commercial sales realised by the institutes as a result of the projects is an important yardstick when it comes to measuring the scope of knowledge dissemination by the ATSs. The ATSs are expected to provide an estimate of this in the application to the Ministry of Science, Technology and Innovation. But the interviews show that estimates of additional turnover before projects start should be taken with a large pinch of salt. Projects often involve brand new business areas and sizeable market research would be needed in order to estimate their potential. And because the projects are all about research and development, their results are very uncertain. A number of statements from the interview study show that it is pointless to start predicting market potential and additional turnover until projects are under way.

Textbox 7.1. Statements by the project managers interviewed regarding market potential

"It's difficult to assess market potential in advance. The Ministry of Science, Technology and Innovation requires projects to be generic and at the same time wants us to be specific about the market. It's an impossible combination." (Living Bacteria for the Administration of Medicine and Vaccines)

"It's difficult to predict the market. It's something you do in an application to keep the Ministry of Science, Technology and Innovation happy." (Living Bacteria for the Administration of Medicine and Vaccines)

"The market for waste incineration will have to mature first. We don't know what the potential is yet." (Centre Contract for Model-Based Monitoring and Control)

"We've focused on developing method and model so far and are only just starting to draw up a business plan." (Talent@IT)

"In a way dissemination is built into how the consortium works, with lots of enterprises taking part. Knowledge has also been disseminated through papers given at conferences, etc. But in the final phase we'll be stepping up our more outward-looking activities, of course. Nothing has been planned in any detail yet." (InnoLink – Product and Process Development in Competence-Based Supply Networks)

"We've drawn up a business plan describing all the areas where the new knowledge can be used, but it will be adjusted many times in the course of the project as new possibilities open up." (Biological Interaction Analysis)

"At the moment knowledge is being developed by means of concrete projects at the enterprises. We'll find out later how the knowledge can be used on a broad scale." (BioMed – Centre for Diagnosis, Prevention and Control of Biofilm on Medical Equipment)

The worthlessness of the estimates contained in the applications is also reflected in the fact that many of the project managers interviewed cannot actually remember what the estimate of market potential was. The interviews show that many ATSs start doing market research and business plans from around halfway through the projects, and that relatively extensive market studies are under way in several projects. Therefore, a credible estimate of market potential can frequently not be made until 18 months to two years into a project.

For the most recent projects, which commenced in 2003, the project managers typically give voice to positive expectations in the interview study. They are kept in broad terms, however, and not many of the project managers want to quantify them. It is frequently also difficult for the project managers to assess what the isolated contributions from innovation consortia will be in relation to the institutes' other development and business activities.

In the interview study barely a handful of project managers gave a quantitative estimate of the market potential of the innovation consortia:

- MikroKAP has been going for a good two years. Its market potential is estimated to be DKK 10 million in additional turnover per annum. The expectation is that it will be possible to realise additional turnover of DKK 2 million in 2005.
- The SCC Consortium is just over halfway there, and the Danish Technological Institute expects additional turnover of DKK 2 million per annum in the building sector in Denmark and abroad.
- In connection with the Monitoring and Restriction of Bacterial Growth innovation consortium, which started in early 2004, the Danish Technological Institute expects additional turnover of DKK 7 million per annum in the drinking water sector within three years, but it is difficult to put a figure on the contribution made by the innovation consortium.

Interviews were also conducted with four selected centre contracts that finished before 2003 as part of the evaluation. One of the main purposes of these interviews was precisely to identify the longer-term impact of the projects in terms of knowledge dissemination.

Firstly, the interviews indicate that extensive knowledge dissemination does in fact take place in the wake of the projects. Secondly, they confirm the picture that there are enormous differences in the way knowledge dissemination is planned before and during the projects and how it actually happens.

Textbox 7.2 goes into knowledge dissemination by the ATSs in two of the four "old" contracts.

Textbox 7.2 Knowledge dissemination from completed centre contracts
Centre Contract for Cooperation on the Development of Microsystems (SUM)

The SUM centre contract was initiated in 1999 and involved the Department of Micro and Nanotechnology at the Technical University of Denmark and DELTA together with

Grundfos, Danfoss, NKT and SonionMEMS. Capres joined the project at a later date. The aims were 1) to promote realisation of the first Danish microsystem products (in the form of sensors in all cases) and 2) to establish a knowledge and technology database for the development and prototyping of future microsystem products. SUM was based on a technology platform developed in connection with the Materials Technology Development Programme (MUP). What DELTA wanted from the project was to develop a test system for microsystem products and build up competence in packaging microsystems for use in industrial production. It therefore developed test and packaging facilities aimed at microsystem manufacturers. Turnover in this area is only DKK 2-3 million per annum, however, whereas it costs DKK 3 million per annum to run the facility. DELTA has instead chosen to set up a development house that is to be used to develop and produce sensor products (intelligent products). In the development house DELTA will offer to help industrial firms in sectors such as wind turbines, agricultural machinery, iron/metal, furniture, sports equipment, etc., to develop specific sensor products. The starting point will be DELTA's knowledge of sensor technology combined with the packaging and testing knowledge developed through the centre contract. The target is turnover of DKK 50-100 million per annum in the course of five years. The development house will also offer start-ups in the IT and medical industries facilities for developing new products

Centre for the Use of Slush Ice as a Refrigerant

This centre contract commenced in 1999 and involved the Energy Division at the Danish Technological Institute and the Department of Applied Chemistry at the Technical University of Denmark together with around 15 enterprises. Dresden University subsequently joined the consortium because the Technical University of Denmark did not know enough about the field. The aim was to develop a new technology platform for the refrigeration industry. Among other things, the project was intended to solve technical/mechanical problems in slush ice generators.

The project itself was not a great success. The Danish Technological Institute follows the field on an ad hoc basis at conference, etc., but no resources have been earmarked for development and there is still no commercial revenue. The result is that knowledge has been developed, there are a couple of engineers who can work things out and there is a prototype system plus a single example of the technology being used by a farmer. Part of the plant has, incidentally, been sold to a German university. Although the project went quite a long way and solved many of the technical problems, some things have still not be clarified and market development has also been much slower than expected. Many firms have chosen other refrigeration technologies, including CO_2.

The real return on the project was not slush ice, therefore, but finding out more about surfaces through the PhD project (Dresden University). Even during the project it was obvious that there was great commercial potential in working on repellent surfaces (e.g. ice-repellent surfaces on planes and wind turbines). The Danish Technological Institute now has a team consisting of a manager and three members of staff working on this full time. The Institute has great expectations of the commercial potential. The department hopes to have ten or 12 people working on it in the long term. On the research side Dresden University has continued working on the technology and has, among other things, received two large government grants. In Denmark the Danish Technological Institute has recently entered into cooperation with iNano, who are also interested in surface technology, a reflection of the fact that the Institute currently has the best research competence in Denmark when it comes to ice-repellent surfaces.

The above examples of knowledge dissemination with the ATSs as the fulcrum are all about the ATSs developing new business areas or strengthening existing business areas themselves in the wake of the projects.

There are, on the other hand, few examples of the ATSs, in their role as project facilitators, working (or planning to work) together with other institutions that have a broad commercial target group and so could contribute to knowledge dissemination. The following are the only examples from the 30 projects evaluated:

- In the SCC Consortium the Danish Technological Institute cooperates with the Road Directorate on demonstrating the results of the project. The Road Director has a function as a demonstrator of new technology and is the normative body for concrete standards.
- In connection with the Talent@IT innovation consortium DELTA has entered into an informal agreement with the Centre for Software Innovation in Sønderborg on use of the centre contract's results in practical cooperation projects, courses, etc.
- In MikroKAP there has been cooperation with, among others, the Polymer Technology Society and the Mechanical Engineering Society under the Danish Society of Engineers with a view to disseminating the results to a broader target group.

The interested parties analysis (see chapter 8) suggests that vocational schools, technical academies and centres for higher education might be natural channels for knowledge dissemination. Several educational establishments are already involved in cooperation projects with research institutions and have experience of turning research results into practical expertise. Units that are geared to taking knowledge and turning it into courses and consultancy services for trade and industry are also being set up in affiliation with the educational establishments:

- Seventeen regional growth incubators have been set up under the Ministry of Science, Technology and Innovation's programme of the same name, which aims to strengthen cooperative relations between educational establishments, research institutions, technological knowledge disseminators and business, for example, with regard to the development of special regional strengths. An evaluation of the regional growth incubators suggests that one of their weaknesses is lack of synergy for research incubators.[17]
- Several educational establishments are setting up what are called "knowledge centres", which aim to turn cutting-edge knowledge from vocational schools, centres for higher education and medium-cycle higher education into regional growth and innovation.

[17] Oxford Research (2004): "Evaluering af ordningen regionale vækstmiljøer" (Evaluation of the Regional Growth Incubators Programme)

The evaluation shows that the project managers for the evaluated consortia can be divided into three groups when it comes to cooperation with educational establishments.

The first group, and the largest by far, has not considered the possibility of cooperation. There are several project managers in this group who recognise that knowledge from the innovation consortia might be relevant to business-oriented courses, for example, but they have no plans or thoughts with regard to following this lead up.

The second group rejects possible cooperation on the grounds of unfair competition and lower hourly rates in educational establishments owing to large public subsidies.

The third group takes a positive view of the idea and expresses the opinion that it might be socially beneficial to involve educational establishments in the consortia. Some project managers even say that the economic impact of involving vocational schools, for example, along the way in consortia would be greater than that of involving small enterprises along the way.

The overall picture is therefore as follows:

- There is a certain amount of knowledge dissemination at the conclusion of the consortia in the form of project days, seminars, etc., where the results are communicated to a wide circle of interested parties.
- The ATSs in many consortia contribute to a high level of knowledge dissemination through ordinary ATS services, though often with a content different to what the institutes expected at the start of the project.
- In their role as facilitators the ATSs do very little to involve environments outside the consortia in knowledge dissemination activities.

7.3 Knowledge dissemination by the research party

The traditional picture of knowledge dissemination by research institutions is that it is all about articles, research conferences and research reports, so that it is only ever from researcher to researcher. The evaluation reveals a far subtler picture, however, with the researchers contributing to knowledge dissemination on many fronts. Table 7.3 shows how the researchers themselves say that they contribute to knowledge dissemination in the questionnaire survey.

Table 7.3: Through which channels are the research party's knowledge and competence disseminated to enterprises and institutions outside the consortium?

	To a small extent (1)	(2)	(3)	(4)	To a large extent (5)	Don't know	Mean
Via books, reports, journals, etc.	0%	8%	8%	36%	49%	0%	4.26
Via research conferences	8%	2%	19%	29%	39%	4%	3.92
Via conferences,	2%	4%	19%	48%	19%	8%	3.85

Table 7.3: Through which channels are the research party's knowledge and competence disseminated to enterprises and institutions outside the consortium?							
	To a small extent (1)	(2)	(3)	(4)	To a large extent (5)	Don't know	Mean
seminars, etc., attended by business							
Via teaching on ordinary courses	16%	14%	22%	28%	20%	0%	3.22
Via teaching on master's and continuing education/training courses	20%	16%	24%	20%	14%	4%	2.91
Via contract research	37%	12%	14%	12%	7%	19%	2.26
Via participation in new/other cooperative configurations	16%	6%	30%	26%	8%	14%	3.05
Source: Questionnaire survey							

Not surprisingly, the most widespread channels are books, reports, journals and research reports. But it is interesting that ordinary teaching and continuing education/training play an important role for more than 50% of the researchers. The results have also led to, or are expected to lead to, contract research for a substantial minority.

In addition to this, 9% of the researchers state that the consortium contributed to spin-offs from research institutions, with all of 61% stating that they expect spin-offs to be a result of the consortium.

The interview study thus shows that the ATSs are far from the only ones to play a role when it comes to disseminating knowledge from the consortia to enterprises outside the consortia. Several of the participating researchers are helping to develop actual business-oriented services in the wake of the projects or expect to do so. The researchers also contribute to knowledge dissemination through new teaching material that benefits trade and industry via courses or later, when enterprises employ graduates from the educational establishments in question.

There are considerable differences between the various consortia, however. In a small majority of the consortia the project managers (ATSs) are of the opinion that the researchers mostly focus on the traditional channels for knowledge dissemination and so only make a very indirect contribution to putting new knowledge from the consortia to commercial use.

On the other hand, there are also several examples of very concrete, business-oriented services being developed by the participating researchers. Textbox 7.3 gives some examples.

Textbox 7.3. Examples of research institutions contributing to commercial knowledge dissemination

Centre for Organisational Learning
"The participating researchers have developed a new system of concepts and some new methods that have been published, and they've taken part in concrete business projects for the first time. As part of the project the researchers have prepared a number of cases that are now being used in teaching. The researchers have started to do contract research and consultancy work, and are basically in the same market as the Danish Technological Institute. They're not seen as a close competitor, however, partly because the researchers would rather work with the big companies."

Machine Acoustics – Analysis and Optimisation of Industrial Components and Systems
"As part of the project Aalborg University has developed a course in machine acoustics that will be offered to both students and businesses in the coming semester. The participating researchers are also aiming to a certain extent to sell services through commercial activities to Grundfos, for example."

InnoLink – Product and Process Development in Competence-Based Supply Networks
"The researchers from the University of Southern Denmark and the Aarhus School of Business bring their research competence to the projects…. The great advantage for the researchers is that they get very direct access to the businesses over an extended period. The two universities in the project are very active in relation to businesses and are also active in the public debate. In addition to their research applications, the results will be used in teaching, and a PhD project has been set up as part of the project."

The four case studies carried out among "old" centre contracts also paint a picture of some of the participating researchers being very active in disseminating knowledge from the projects to trade and industry after the project has ended. The examples also show that the development of new teaching material plays an important role in disseminating the results of the projects, and that this benefits trade and industry. See textbox 7.4.

Textbox 7.4. Examples of knowledge dissemination from old projects
Centre Contract for Management and Control in Small Enterprises (LOS)
This centre contract commenced in 1999 and had the overall aim of adapting management theories and methods to the needs of small business. The contract involved the Danish Technological Institute, the Centre for Small Business Studies at the University of Southern Denmark and a large number of small enterprises.

Following on from the project the University of Southern Denmark wrote an anthology (published through the Association of Danish Lawyers and Economists), and a book is currently being produced with case material from, among other things, the LOS project, which is also included in teaching at the University.

The project was supposed to have resulted in a Documentation Centre (active research information aimed at consultants in particular), but in practice it has mainly become an extended library search tool. It did not quite work as hoped or intended.

Research at the Centre for Small Business Studies has never been very empirically based, and LOS contributed further to this. The Centre has a good network of small and medium-sized enterprises that are used in connection with teaching and research. A couple of the firms from the LOS project are now acting as hosts for a new BSc course in

entrepreneurship, for example. The Centre has also entered into cooperation with the County of Vejle to provide training, organised by one of the research assistants from the project, for local-government trade promotion officers. This has been a great success.

Centre Contract for Cooperation on the Development of Microsystems (SUM)
The Department of Micro and Nanotechnology is involved in several projects together with enterprises and the DELTA ATS institution as a follow-up to SUM. There is the PhD project with Grundfos, for example, and the "Fish and Chips" project with DELTA, which aims to develop a sensor that can be put in fish to enable their migration patterns to be monitored.

A large part of the knowledge dissemination from SUM takes place through the students. Firstly, students were involved in SUM and, among other things, used the centre contract's facilities to test microsystems. Secondly the results have been implemented in ordinary teaching. The Department has set up a new course for students in nano and microtechnology that focuses on how chips are produced. Teaching in the department focuses strongly on putting theory into practice. There are several hundred engineers employed in Denmark's microtechnology business cluster, most of whom were educated by the Department. In this way the results from SUM are being spread to trade and industry through ordinary teaching to a large extent. The Department does not yet offer business-oriented courses, but believes that there is growing potential.

SUM has resulted in a strong network with broad business participation. The knowledge developed by the Department of Micro and Nanotechnology is being made available to other enterprises through concrete cooperation projects and via spin-offs to which the Department is committed.

It is a recurrent feature of many of the above examples that the research institutions are primarily contributing to knowledge dissemination through interaction with larger enterprises. There are few examples of services (mainly courses) that include smaller enterprises in their target group. This indicates that the research institutions are complementing the efforts of the ATS institutes with regard to knowledge dissemination, but also that they are not currently reaching the broad group of enterprises that the ATSs are servicing.

This latter fact is very much linked to the differences in incentives and focus described in chapter 5. Whereas the ATSs live by being able to sell the same service to the same enterprises several times over, many of the knowledge dissemination channels described for the research institutions are driven by they way in which the researchers focus on generating new knowledge.

It is possible to strengthen the role of the research institutions as knowledge disseminators

The evaluation shows that researchers in around half the projects make an active contribution to disseminating knowledge to trade and industry, but also that they do not reach such a broad spectrum of enterprises as the ATSs.

The question is whether the potential will be greater in the next few years. As described in chapter 8, several research institutions have taken new initiatives that will enhance their possibilities for disseminating knowledge to SMEs:

- Aalborg University is planning to set up service units at department level where enterprises can have concrete problems solved.
- Aalborg University's network centre brings the institution's researchers together with more than a thousand enterprises on practice-oriented problems.
- The Department of Product Development at the Technological University of Denmark has been offering a raft of commercial services aimed at trade and industry for several years.
- Alexandra Instituttet and Crossroads Copenhagen are acting as bridge builders between the University of Aarhus, the IT University of Copenhagen and Copenhagen University on the one hand and trade and industry on the other, and can provide a connecting link through projects, courses and consultancy services with regard to turning knowledge from the innovation consortia to account.
- Risø is showing interest in developing new business units in the fields of wind and materials in cooperation with ATS institutes.

Several initiatives have also been taken at government level to prepare the way for research institutions to extend cooperation beyond large enterprises. These involve:

- The development of continuing education/training units at the universities to increase the range of research-based continuing education/training on offer
- High-technology networks that will bring together research institutions and a broad spectrum of enterprises in specific specialist areas.
- Regional technology centres that will act as a connecting link with regard to turning new knowledge to account in a broad spectrum of enterprises.

In other words, a raft of initiatives is in place that will give researchers and institutions a better framework in which to disseminate knowledge from the innovation consortia to a broad spectrum of enterprises, both on their own and in cooperation with ATS institutes, for example.

At the same time, it is important to stress that the programme guidelines make no mention of knowledge dissemination from the research party to enterprises outside the consortium. It is therefore difficult to know what the picture would have been if this had been a competition parameter for the consortia evaluated.

7.4 Knowledge dissemination from enterprises

As section 7.1 shows, relatively few enterprises believe that they play a large role in knowledge dissemination. The formal role of the enterprises is typically limited to taking part in project days, workshops, etc., where the results of the projects are made available to a wider circle of players.

The case studies also give examples of the logical conflict that can exist between the enterprises participating in a consortium and the desire to make the results available to other enterprises. See textbox 7.5.

Textbox 7.5. The enterprises and knowledge dissemination

"We basically had to keep our traps shut! In this field it's all about keeping your cards close to your chest. It's bad enough having a finished product copied quickly. Letting something slip along the way is out of the question."

"DELTA was very much focused on developing commercial services, which made cooperation difficult. The fact that solutions that might benefit our competitors were being developed within the framework of the centre contract conflicted with our interests."

There are also examples of enterprises contributing to knowledge dissemination, however. For example, one of the enterprise representatives from the SCC Consortium teaches at Aalborg Technical School and aims to include results and cases from the project in lessons.

There is scarcely any doubt that a great deal of knowledge dissemination between enterprises takes place in the wake of the projects. This happens through the sale of products, mobility of staff, cooperation on development and other networks involving other enterprises. The impact of this is very difficult to assess, and the potential is often not realised until long after the projects have ended.

As regards the programme guidelines, it is in practice impossible to draw up formal criteria in this area.

8. The technological service function

8.1 Introduction

The changeover from centre contracts to innovation consortia opened the way for the role of technological service provider to be performed by other institutions as well as ATS institutes. The guidelines read as follows:

> "…a technological service function that is non-profit and social in purpose. The institution must also have high specialist standards and competences in technology transfer, including broad commercial contacts with Danish enterprises."
>
> "The 'technological service function' has two tasks. Firstly it should help to implement what is often fundamental technology so that the technology can have a wide field of application. Secondly, the knowledge developed in the innovation consortium should be anchored in the technological service function so that it can be disseminated and transferred to trade and industry in a broad sense in the form of services sold to the business community on commercial terms."

The guidelines do not therefore make it clear which types of institution and enterprise can perform the technological service function. It is apparent, however, that the organisation will have to operate on ATS-like terms in that it has to both be active in technology transfer and have broad *commercial* contacts with trade and industry.

The ATS-oriented wording of the guidelines is further strengthened by the introduction to the programme provided on the Ministry of Science, Technology and Innovation's website, which is worded as follows:

> "Innovation consortia are concrete cooperation projects between enterprises, research institutions and *technological service institutes*. The aim of the consortia is for the parties to develop knowledge or technology jointly with a view to benefiting not just individual enterprises but also whole branches of Danish trade and industry.
>
> An innovation consortium must consist of at least two enterprises, a research institution and *a technological service institute*. The cooperation should last between two and four years. Small enterprises (1-100 employees) can participate in parts of the project, but must do so for at least six months.

Officials from the Ministry of Science, Technology and Innovation also state in an interview conducted as part of the evaluation that the new guidelines have not be marketed systematically through other presentation marketing material. The marketing has mainly consisted in senior staff from the Ministry giving presentations of the programme in response to concrete demand from the programme's most important interested parties.

In other words, the programme does not appear from the written material to be one in which institutions other than ATS institutes are natural candidates for the role of technological service party.

This picture is supported by the evaluation, which covers a total of 15 innovation consortia (and 15 centre contracts). None of the 15 consortia has anyone other than ATS institutes performing the technological service function[18].

Partly with a view to charting the potential for other institutions to go in and perform the technological service function in future, we carried out an "interested party analysis" as part of the evaluation. In the analysis we gauged the interest of 11 institutions in performing the function – and their capacity to do so[19].

In the interviews we tried to clarify the following problems:

- The institutions' knowledge of the programme, their interest in implementing projects under the programme in future and their capacity to do so
- The institutions' present contacts with trade and industry, the potential for expanding these contacts and their interest in doing so
- Whether the institutions operate in areas where there are no ATS institutes, and whether they can therefore help to increase the specialist breadth of the programme
- Whether the programme guidelines would have to be adjusted to make the programme attractive to the institutions in question.

We also interviewed the Confederation of Danish Industries, Danish Commerce and Services, and ITEX with a view to finding out what these central organisations think about the programme and the possibilities for making it more attractive to their members.

Sections 8.2-8.5 deal with the four problems one by one.

8.2 How the interested parties perceive the programme

The recurrent theme is that the players are not aware of the opportunities offered by the present guidelines. Knowledge of the programme is patchy or the programme is perceived as an "ATS programme".

Some of the organisations had not even heard about the programme, despite the fact that they are presumably qualified to join an innovation consortium, and that the programme is doubtlessly relevant to these players.

Among those who are aware of the programme there is a perception that it is primarily aimed at ATSs. Even if they know that it is open to other interested parties, the perception is that it is still an ATS programme, with both the rules and communication/administration by the Ministry of Science, Technology and

[18] The consortia approved in 2004 include a single example of the function being performed by a non-ATS institute.

[19] The Technical University of Denmark, Aalborg University, Risø, the Mads Clausen Institute, Alexandra Instituttet, Crossroads Copenhagen, Vitus Bering, the Herning Institute of Business Administration and Technology, the Academy of Professional Higher Education NOEA, the Danish Design Centre and the Danish Centre for Management.

Innovation being geared towards ATSs. Textbox 8.1 gives some examples of how the programme is perceived.

Textbox 8.1. Examples of how the interested parties perceive the programme and what they know about it

Risø

Most people at Risø perceive the programme as a formal ATS concept and not as a programme in which the research institution is the initiator and facilitator. Risø has been very satisfied with the consortia in which it has participated.

Centre for Business Development at the Academy of Professional Higher Education NOEA

Staff are not aware of the programme. The person interviewed has asked around the organisation prior to the interview and nobody had heard of the programme.

Aalborg University

Until now Aalborg University has perceived the programme as one that had to involve ATSs. It was not aware of the opportunities for research institutions to take on the ATS function. In general the University would like to have the ATSs on board in many of the innovation consortia in which it participates, but Aalborg University also stresses that ATS involvement is not a requirement.

The Herning Institute of Business Administration and Technology

It seems to the Herning Institute of Business Administration and Technology that the programme is still geared towards the ATS institutes. The Institute highlights the information on the Ministry of Science, Technology and Innovation's website as an example of it seeming difficult for others to get into the programme. It has previously had a centre contract together with DELTA turned down on the grounds that it was not a university. It is therefore affected by its bad experiences of applying under the programme. It feels that the administrators are not really open to anyone apart from ATS institutions.

Danish Centre for Management

Has never heard of the programme. During the interview the programme was described as relevant, as the Centre has been wanting to start up development activities that would need co-funding for a couple of years now. It has spent some of its own money, but could have stepped up its activities substantially with government funding.

Danish Design Centre

Has heard of the programme and looked into it at a general level, but immediately decided that joining it would demand too many resources. During the interview the Centre expressed the opinion that the programme was a relevant one that it might well see some potential in using in the future.

Confederation of Danish Industries

"The ATSs are often an important specialist contributor and bridge builder in the individual consortia. But it has been the experience of some businesses that the institutes were involved because "that's just the way the concept's supposed to be". The programme was originally set up for the ATS institutes, so they may feel that it's their money. But we could well imagine the "dissemination function" being performed in another way. By private enterprises, for example. There should be an end to the idea that only public and semi-public institutions can disseminate knowledge for the benefit of everyone."

If the ATS function is to be performed by new players, it is therefore imperative for the programme to be marketed far better than it is today. The evaluator also recommends that the title of the function should be changed, as the term "technological service function" in itself prevents non-ATS institutes from using the programme.

Only one of the institutions interviewed had concrete plans to apply for funds under the programme. In this instance the institution would be performing the technological service function together with an ATS institute. It is worth mentioning in this connection, however, that the facilitator from the institution in question came from a job with a research institution where he personally worked together with the same ATS institute in a centre contract! This example is further confirmation of the fact that the majority of innovation consortia are based on existing networks between research institutions and ATS institutes (see also chapter 3).

All the institutions interviewed showed interest in participating in projects under the programme on ATS-like terms.

As regards the educational establishments interviewed, the Danish Centre for Management, Alexandra Instituttet and Crossroads Copenhagen, their capacity to take charge of matchmaking, application and facilitation is documented by the fact that the majority of institutions are already initiators of cooperation projects that are similar to the innovation consortia in form and duration. In most cases the budget is well below that of the average innovation consortium, however.

- *Crossroads Copenhagen* is a member organisation that arranges cooperation projects in the field of IT-based, user-driven innovation. With "What can digital technology be used for?" as the common denominator, four projects involving research incubators and enterprises are currently being initiated each year. One of the projects has a budget in excess of DKK 1 million, but the number of "big" projects is expected to rise.
- *Vitus Bering* (a centre for higher education in Horsens) has been the initiator of a large number of projects involving research institutions and enterprises over the last 10 years. For example, a project with a budget of DKK 4 million is currently looking at "IT on the Building Site". It is being financed under the Jutland-Funen IT Corridor programme and involves, among others, Aalborg University and a number of enterprises from the building industry.
- *The Centre for Business Development at the Academy of Professional Higher Education NOEA* is acting as project manager for a number of Social Fund projects. It is involved in cooperation projects with Aalborg University and North Jutland firms in areas such as process optimisation.
- *The Herning Institute of Business Administration and Technology* is conducting a number of projects that are reminiscent of innovation consortia and include both research institutions and enterprises. It has a large network of enterprises consisting of local SMEs and large companies from all over Denmark.
- *Alexandra Instituttet* has a large network of researchers and enterprises. It has developed a model that is suitable for finding projects with both a business

angle and a research angle. The Institute contributes matchmaking, overall project management and administrative support, as well as making facilities available if necessary. On the business side the project participants include both small and large enterprises. The projects last between three months and three years, with the enterprises financing half the costs. Alexandra Instituttet is acting as facilitator for 20-25 projects in connection with the Jutland-Funen IT cooperation programme.

- *The Danish Centre for Management* has invested its own money in development activities. Through project activities the Centre aims to lead the way, spot trends and encourage enterprises to take the necessary steps. It employs three commerce PhDs.
- *The Danish Design Centre* is conducting a number of design and innovation projects. One example is "design:PARTNER", which the Centre initiated in collaboration with the Confederation of Danish Industries. Eight large, design-oriented enterprises took part in the pilot phase, and the product is now being offered to a wider circle on a chargeable basis. The project is working on preparation of design, which is about equipping enterprises to use design more professionally.

The research institutions in the interested party analysis do not have the same experience of acting as connecting links and matchmakers for extended projects.
At Aalborg University matchmaking is decentralised and informal, with a number of specialist network groups having been set up. They involve researchers and enterprises, and the Network Centre at the university acts as facilitator, but concrete projects are agreed between researchers and enterprises without central financing or control.

At Risø the researchers have taken part in several innovation consortia. The institution has generally been satisfied with the division of labour with the ATS institutes and does not particularly want to take on the administrative burdens of the technological service function on its own.

Some of the interviewees in the interested party analysis touch on the possibility of having the ATS function performed by engineering consultants, see the quote from the interview with the Confederation of Danish Industries in textbox 8.1 above. The Department of Product Development at the Technological University of Denmark also touches on this. In the two interviews importance is attached to focusing on formal requirements with regard to competences and services rather that designating which organisations are relevant.

In the evaluator's opinion there would be both pros and cons involved in allowing private consultants to act as the ATS party.

One thing that speaks in favour of this approach is the fact that the ATSs' commitment to knowledge dissemination, as described in chapter 7, is primarily about selling services on market terms. In principle the ATSs are therefore not very different from other private enterprises on this important point.

What might speak against it is the fact that the general non-profit competence development that takes place in the ATSs and public knowledge institutions is very important with regard to the results of the innovation consortia. The evaluation gives examples of areas in which the ATSs very much lead the way in terms of research and technology in Denmark because they invest in research and development in those areas using basic funding and funds from the innovation consortia.

When the ATSs themselves are asked, there is a widespread attitude that it would be difficult to entrust the ATS function to other bodies. The project managers from the evaluated consortia attach importance to the large networks of the ATSs, the fact that the researchers do not want a lot of administration, and the fact that, in the areas in question, the ATSs typically represent the largest business environments in Denmark. Textbox 8.2 gives some examples of quotes from the interviews.

Textbox 8.2. The ATSs on their own role

"We have the largest centre in Denmark in this field. The centre is unique in its specialist field and has far more members of staff than the largest university departments. We also have the biggest network and know the industry."

"Other institutions could quite happily perform our role in principle. But the ATSs have an advantage in that they are able to adapt more quickly and move into new areas. Universities also have lots of other obligations and a longer time frame than the ATSs."

"The universities are the only ones with the specialist competence to take on the role, but they're not interested because they're driven by publication."

"It would probably have been possible to replace us, but several parties would have been needed to ensure that the competences were in place."

"The ATSs have a very important role. They're the connecting link between researchers and businesses, and they couldn't be replaced by anybody else. It's a positive thing that the Ministry of Science, Technology and Innovation values ATS in the role of project manager."

"The ATSs' role of pushing new technology over into businesses couldn't be performed by anybody else."

"The technological service function might well be performed by a research institution. But they're not interested or geared up for it. We have a good mix of non-profit and business that fits in well with the role."

"The ATSs are the people who know how to apply and access research at a practical level. We enable the parties to understand and talk to each other. If the ATS party wasn't there, a lot of businesses would be lost and it would become elite cooperation between leading businesses and the universities. It would be possible to name about 20 businesses who could enter into cooperation without the ATSs."

8.3 Interaction with trade and industry

One of the most important purposes of the innovation consortia is to contribute to knowledge dissemination. The conclusion of both this and previous evaluations is

that the programme has a large economic impact precisely because extensive knowledge dissemination takes place in the wake of the projects (cf. chapter 7).

If the technological service function is to be opened up to other players, it is therefore vital that they can take responsibility for knowledge dissemination being at least as effective as that currently provided by the ATSs.

Proper clarification of this question will require an assessment of both how the players in question currently disseminate knowledge and how they can be envisaged doing it in future. In the following we have attempted to assess both points for research institutions, educational establishments and "bridge builders" respectively on the basis of the interested party analysis.

This section does not go into how private consultants could contribute in this area. When it comes to knowledge dissemination channels, straightforward private enterprises are not very different from ATS institutes. Whether or not they can contribute to knowledge dissemination at the same level as the ATSs depends on their circle of customers, whether they have critical mass, and whether they have the capacity to absorb and realise new knowledge in the organisation. These factors vary widely from enterprise to enterprise and an individual assessment would be required.

Research institutions as knowledge disseminators

There are major differences in how the institutions perceive themselves on this point.

Risø does not see itself as an organisation that can disseminate knowledge to small and medium-sized enterprises at the same level as the ATS institutes. It regards the transaction costs as being too high for that. Risø stresses that it is interested in selling the same service many times as a research institution and not as an ATS institute. The researchers only want to get involved in activities that are of a certain relevance to research. Risø is therefore becoming increasingly aware that the sale of services can represent an important source of finance for research. But the management does not expect to build up sales channels of the same order of magnitude as those of the ATSs.

The Department of Product Development at the Technical University of Denmark has a different attitude. Here the interviewee says straight out that the universities are better at communicating than the ATSs because the latter are too business-oriented and so uninterested in broader communication.

The Department of Product Development was the first non-ATS institution to put in an application and obtain approval for a project in which it performs the technological service function (in 2004, so it is not covered by this evaluation). In this contract the Department of Production and Management at the Technical University of Denmark is the research party.

The Department of Product Development offers a broad spectrum of courses and arranges commissioned research for the Technical University of Denmark. This

means that the Department has already set up the infrastructure needed to disseminate knowledge through business-oriented channels.

The view expressed by the Department of Product Development is backed up by, among others, Alexandra Instituttet, which is of the opinion that effective knowledge dissemination is about tailoring knowledge to the specific requirements of individual enterprises. Whereas the ATSs have an incentive to develop relatively uniform services for a broad target group, research institutions and affiliated bridge-building institutions (such as Alexandra Instituttet) may focus more on producing innovation for the individual customer because this is more in line with their objectives of research-related relevance and novelty value.

The point here is perhaps that the two forms of knowledge dissemination complement each other, and that volume should not be the only consideration when the economic benefits of knowledge dissemination are being evaluated.

Aalborg University is of the opinion that it does not currently have the same knowledge dissemination channels as the ATSs. Its ambition, on the other hand, is to build up stronger infrastructure in this area, and the interviewees also highlight a substantial improvement in knowledge dissemination. The scope of commercial activities has, for example, grown by 30% per annum over a four-year period.

Aalborg University is also in the process of implementing several organisational innovations that will enhance its ability to disseminate results from research projects to trade and industry. In particular, the establishment of centres specialising on commercial problems and service access points at department level sounds interesting in this connection, cf. textbox 8.3.

Textbox 8.3. Organisational innovations at Aalborg University should increase knowledge dissemination

The management at Aalborg University has decided to set up between three and five new interdisciplinary research centres. The centres will cut across existing specialist environments and focus on developing solutions to social problems. The centres could, for example, focus on areas such as wind turbine technology, "Clean Limfjord", traffic conditions, the appearance of new 4G mobile phones, etc. The centres will be able to offer socially oriented services such as consultancy, prototyping, continuing education/training, as well as providing incubator facilities to test ideas commercially.

Aalborg University is also going to set up service access points at department level. The idea is that an enterprise should be able to have a concrete problem solved quickly by approaching these service units, which will be financed by revenue from the enterprises.

Finally, Aalborg University is developing a broad network of both large and small enterprises through the "Network Centre". The aim is to bring researchers together with experts from the enterprises. So far 2500 enterprises are members of the centre, with around 1200 of them being active.

At both Risø and Aalborg University the interviewees consider innovation consortia to be a relevant instrument when it comes to building up functions to handle knowledge dissemination.

Risø suggests a model in which the institution develops a new business area – e.g. wind energy – *together* with an ATS institute in an innovation consortium. Risø could, for example, perform the technological service function together with an ATS institute and develop a business plan for knowledge dissemination in cooperation. This model is more attractive to Risø than going it alone because it could draw on the experience and interests of an APS institute in order to develop business. It is stressed, however, that this approach is difficult at present owing to mutual competition and the fact that developing a culture of cooperation around commercially oriented services is a big managerial task.

The interviewee at Aalborg University sees innovation consortia as a good instrument for developing business strategies in areas on which the new centres will focus. It will ensure from the outset that the enterprises are involved in setting the agenda for what the university is to work on. In the interview prominence was therefore given to innovation consortia as a very relevant means for developing the planned centre structure at the university. Attention was also drawn to the programme as a possible means of expanding the facilities that the centres will need for commercial purposes, e.g. cleanroom facilities.

The interviews thus indicate that innovation consortia could be the means of developing an infrastructure that could increase the dissemination of knowledge from research to trade and industry on a broader front.

Educational establishments as knowledge disseminators

The educational establishments interviewed are generally fairly well qualified to disseminate knowledge from an innovation consortium. They are typically experienced providers of courses, seminars and customised continuing education/training. And they have a broad portfolio of services aimed at trade and industry that also includes development projects, cf. section 8.2.

In the institutions in questions – which without a doubt are among the front runners in Denmark – it is also possible to observe a sharp rise in activity levels when it comes to services that relate to knowledge dissemination.

- Vitus Bering has moved actively into the area of continuing and further education/training. The institution has engaged education and training consultants in a number of specialist areas with the same profile as HR managers in private enterprises. The institution currently has 600-700 people from 200 enterprises on 1-year courses, which is double what it was three or four years ago.
- "The Centre for Business Development" is a consultancy at the Academy of Professional Higher Education NOEA. In just a few years the centre has increased its staff from six to 23. The centre offers HR services, i.e. organisation development, manager and employee development, and process development. At present the centre's target group is primarily enterprises in North Jutland, but the aim is to increase sales in the rest of Denmark.

Like the research institutions, the educational establishments see innovation consortia and similar programmes as a way of strengthening business development.

Vitus Bering has decided to concentrate further on developing commercially oriented business areas in future. It attaches importance to focusing on competence development, however, as the educational establishments are perceived by trade and industry as competence providers rather than advisors/consultants. Vitus Bering believes it important to retain this profile while pursuing competence development in many ways. These include seminars, processes in enterprises, courses and, in some cases perhaps, consultancy.

Danish Commerce and Services also sees the educational establishments as an important player in taking the Innovation Consortium Programme into specialist areas that are not covered at present. The organisation cites business schools, centres for higher education and technical academies as examples of institutions that could perform the role of facilitator and knowledge disseminator.

Danish Commerce and Services also highlights innovation consortia as a means of building up business units at the institutions to sell services on commercial terms. According to the organisation, this would require the institutions to have marketing competence, which could, for example, be developed together with private consultants as part of an innovation consortium.

Bridge-building institutions as knowledge disseminators

Alexandra Instituttet and Crossroads Copenhagen are just two examples of a number of bridge-building institutions that have been set up in recent years with a view to building bridges between research institutions and the business community.

Both Alexandra Instituttet and Crossroads Copenhagen have an IT background, but they also have considerable competence when it comes to combining IT with other specialist areas. The two institutions are of different vintages, as is reflected in their portfolio of services.

As mentioned in section 8.2, Alexandra Instituttet is the initiator of a large number of projects involving researchers and enterprises. The institute provides matchmaking, overall project management and administrative support, but the researchers and enterprises are largely responsible for the technical content of the projects.

The institute has also been the initiator in the development of new IT courses aimed at trade and industry, and so, in its role as facilitator for development projects, can help to implement new knowledge in services aimed at a large number of enterprises. Alexandra Instituttet also offers a number of services of its own in the form of courses, seminars, conferences and consultancy. Revenue in these areas is modest at present, but will be given a higher priority in future. Like many of the other institutions interviewed, the institute sees innovation consortia as a tool for developing new knowledge dissemination activities. The institute currently has modest funds to invest in this area, but, according to the interviewee, participation in an innovation consortium, could teach the institute a lot, open up opportunities for development and so be a channel for future sources of income.

Crossroads Copenhagen currently carries out assignments of an ATS-like nature only to a very limited extent. The organisation acts as a matchmaker and initiator, but not as a regular project manager and facilitator. At present, knowledge dissemination currently consists of organising seminars. The ambition in the long term is to develop a business area that includes courses and possibly consultancy. Crossroads Copenhagen is also working to establish a large-scale testing environment for wireless technology where members will be able to research, develop and test content services. Like many of the other institutions interviewed, Crossroads Copenhagen highlighted innovation consortia as a means of building up a business area.

The Danish Centre for Management also functions as a sort of bridge builder between management research, new management trends and the Danish business community. As much as 80% of the Centre's budget of nearly DKK 100 million comes from commercial activities such as consultancy, courses and network activities. In other words the Centre has commercial activities that exceed those of many medium-sized ATS departments and so could perform the task of knowledge disseminator without difficulty.

8.4 The possibilities for involving new specialist areas in the consortia

One of the considerations behind allowing parties other than ATS institutions to perform the technological functions is that the ATSs do not cover all the relevant specialist areas. The players interviewed in the interested party analysis were therefore asked to say what leading specialist competences they have that differ from those of the ATSs.

- Crossroads Copenhagen highlights its focus on developing knowledge at the crossover between communication technology, culture (a number of cultural institutions are members) and media.
- Vitus Bering cites special competence in combining different specialist areas, including sociology, technology and cultural/market understanding. Intercultural communication is an important area of focus for Vitus Bering.
- Aalborg University also stresses its great specialist breadth, which enables it to develop ATS-like services in the interspace between different specialist areas. For example, architecture/design, user interaction, psychoacoustics (new course at Aalborg University), healthcare and multimedia are mentioned as areas that could complement Aalborg University's traditional technical/scientific expertise. With the development of new centres, Aalborg University wants to focus on developing business areas that draw on knowledge in areas such as materials, design, market understanding and management.
- Risø highlights wind energy and materials technology as areas in which there is currently no cutting-edge competence in the ATS sector.

- The Herning Institute of Business Administration and Technology is a leader in niche areas within wind energy and powerline technology. It is the only place in Denmark where business development engineers are trained.
- The Mads Clausen Institute has special technological competences in sensors, actuators and mechatronics.
- The Danish Centre for Management offers a broad spectrum of management products and works closely with the Aarhus School of Business, for example. The Centre could contribute to knowledge development in areas not covered by the Danish Technological Institute, which mainly focuses on industrial management.
- Among other things, the Danish Design Centre could contribute to knowledge development in the area of design management, design as an innovation method and user-driven design, where there are currently very few Danish enterprises working professionally.

It is worth noting that, in response to the question of cutting-edge specialist areas, several players highlight the ability to develop knowledge and business in areas at the crossover between different specialist fields. Several players are thus of the opinion that one of the principal ways in which they differ from the ATSs is in their ability to bring a broader specialist profile to their services.

It is precisely this ability to combine technological know-how with knowledge of design, trends, markets and sociological factors that will be a very important competitive factor in future[20]. It is therefore interesting that many of the institutions interviewed attach importance to developing services in this particular area.

Textbox 8.4 gives a concrete example of a project that could be implemented within the framework of the Innovation Consortium Programme.

Textbox 8.4. Globalisation and outsourcing project

The Danish Centre for Management has been working on a globalisation and outsourcing project. A lot of projects focus on the consequences of globalisation, but, according to the Danish Centre for Management their conclusions are too broad/generic. This means that the discussions are too black and white: you can either move abroad or stay put.

There is no tool to help the individual enterprise make the right decisions. Therefore the Danish Centre for Management is working on an analysis model that will help enterprises decide whether to move abroad or stay put: What is the right decision for the individual enterprise?

They have taken on a couple of researchers for the project. The project is making progress, but, according to the Danish Centre for Management, they could go further with the right funding. It would be relevant if the analysis model could be adapted to

[20] See Inside Consulting and Oxford Research (2004): "Brugerdreven innovation in dansk erhvervsliv" (User-Driven Innovation in Danish Trade and Industry). Produced for the Danish Council for Trade and Industry.

different types of business in detail. There is a need to involve enterprises in the work in order to test, fine-tune and enlarge.

The right answer to the question is presumably complex: it may be relevant to move some activities abroad and not others. One option would be to move production abroad and keep development in Denmark (good communication between the two parts would be required – difficult). Another option would be to have centres of excellence, with development and production for one area being located together in China, for example, and for another area in the USA, etc. It might be appropriate to keep areas with a high level of automation in Denmark together with the development function (and management).

According to the Danish Centre for Management, such a project could be realised with Grundfos, among others. Enterprises in the plastics and timber industries would also be interested. The Danish Centre for Management is very interested in whether the Innovation Consortium Programme could be a lever for realising the project.

8.5 The need for adjustments to the programme

Finally, it is relevant to consider whether there is a need for adjustments to the programme if parties other than the ATSs are to be able to perform the technological service function.

One of the most important points for several of the institutions interviewed is co-financing. Many of the interviewees do not receive basic funding from government that could be used for self-financing this form of project. The educational establishments, for example, would have to use what are already modest value added funds for development activities. This means that there is a major risk of projects turning into a financial whammy if participation is financed on the same terms as those currently used for the ATSs.

It would also be a problem for the educational establishments if financing were to be at cost plus a 20% overhead as it is today. The research institutions and educational establishments typically have to hand over more than 20% in administration to the institutions, in addition to which they have to meet the costs of application, preparation, matchmaking, etc.

It is difficult to assess these reservations, since all the finances are largely dependent on whether the institutions in question can use the programme to develop services on which they can make money. For the ATSs the programme is attractive, of course, as the projects offer great commercial potential. The same should be the case for the projects that educational establishments and research institutions might be involved in. On the other hand, there will be some cultural difficulties for the institutions in question in charging very high hourly rates at the same time as having access to knowledge dissemination that is more broadly based than purely commercial channels compared with the ATSs.

The evaluator recommends a detailed analysis of the financial terms in different project types involving research institutions and educational establishments as the technological service party before a decision is taken on whether the financial terms should be different to those for the ATSs.

The programme generally accords extremely well with the wishes of the interviewees with regard to duration and circle of participants. Several of the players point out, however, that smaller enterprises and service enterprises in particular rarely become involved in projects lasting longer than a year to 18 months. This tallies with the picture provided by the ATSs, cf. chapter 3.

It should be stressed in this connection that many of the players interviewed have a relatively large network of smaller enterprises that they involve in R&D projects lasting as little as three months. It seems unlikely that many of these enterprises would want to take part in innovation consortia with the requirements as they currently stand. It is also clear that very short projects are not sufficient to enable the players to develop the commercial competences and units needed to handle the commercial aspects of knowledge dissemination later on.

One of the educational establishments suggests that the projects could be longer, but that the individual activities must not be too long out of consideration for the smaller enterprises. Common to several of the institutions – including the research institutions – is the fact that they do not necessarily see knowledge development as taking the form of long projects that ultimately lead to new technology platforms, for example. Several of the institutions, for example, focus on finding new applications for new technology, an area in which several smaller projects aimed at product development may well be an effective way of developing generic knowledge.

Further to this, several institutions are critical of the requirement in the guidelines that projects must not be in the nature of product development.

9. Administration of the programme

Since the change of government in 2001 the responsibility for administration of the programme has lain with the Ministry of Science, Technology and Innovation, having previously come under what was then the Danish Agency for Trade and Industry.

The most important change in the administration of the programme during the period under evaluation was the changeover in 2002 from processing applications for the programme on a first-come-first-served basis to dealing with them on the basis of fixed application deadlines.

The reasons for changing the administrative routine were as follows:

- The first-come-first-served method sometimes resulted in a relatively long application process, with the final application often being approved only after an iterative process between the Ministry and the applicant.
- Nor did the first-come-first-served method give the Ministry much opportunity to prioritise applications on the basis of criteria such as specialist area, level of research, etc. With the first-come-first-served method the Ministry was forced to approve applications if they met the formal criteria.
- The first-come-first-served method led to applications piling up on the "waiting list" for next year once the money for a given year had run out.

The change in 2002 enhanced the Ministry of Science, Technology and Innovation's opportunities for prioritising programme funds and increased competition between applicants. On the other hand, the change has – at least in theory – reduced the chances of applications succeeding in non-prioritised specialist areas.

9.1 The application and approval process

The evaluator asked the project managers to given an assessment of the Ministry of Science, Technology and Innovation's administration of the programme with regard to the application and approval process.

We wanted to know about the following in particular:

- The efforts made by the Ministry to increase awareness of the programme among potential applicants.
- The opportunities for applicants to enter into a dialogue with the Ministry during the application process and to obtain information from the Ministry on the programme's possibilities and guidelines.
- The Ministry's administrative procedures in connection with processing and approval of applications received, including establishing cooperation agreements.

9.1.1 Marketing of the programme and its possibilities

According to interviews with case officers at the Ministry of Science, Technology and Innovation, the Ministry has put relatively few resources into marketing the programme. The primary tool has been a special website for the programme combined with ongoing and more informal marketing of the possibilities offered by the programme as part of the Ministry's external activities. Since 2002 the application deadlines have also been posted on the website and sent directly to relevant institutions such as ATSs, research institutions and trade associations.

The impression from the interviews with project managers is that this is sufficient as far as the technological service parties are concerned. They are very aware of the programme and many of them have taken part in it several times. No further marketing to this group is needed.

But the Ministry has an important marketing task with regard to signalling to participants outside the ATS system that the technological service function can be performed by non-ATS players. It might be asked in this connection whether the Ministry could help to increase enterprises' awareness of the programme more actively than it does today. This might be done by highlighting success stories in the press and trade journals, for example, as suggested by one of the project managers.

9.1.2 Information prior to application

As regards the actual application phase, the project managers fall into two groups. One group consists of project managers who had very little contact with the Ministry during the application process. They are typically very familiar with the programme and may also have people in their own organisation who know the ins and outs of the programme after many years of participating in it.

As one of the technological service parties puts it: "We have a chap in the organisation who deals with it. All contact with the Ministry of Science, Technology and Innovation goes through him." And as another one says: "We're very familiar with the programme, and then we have lawyers to look after that side of things. So all we have to do is write a good application."

The other group consists of project managers who had a close dialogue with the Ministry, which they generally perceive as readily accessible and good at providing feedback, cf. textbox 9.1. The four examples are taken from the period both before and after the introduction of fixed application deadlines.

Textbox 9.1. The application dialogue

"The Ministry of Science, Technology and Innovation is readily accessible and good at answering questions." (Monitoring and Restriction of Bacterial Growth)

"The application went in twice. The first application wasn't well defined enough. The Ministry of Science, Technology and Innovation commented on it and we reapplied. We found it to be a good, close dialogue." (Centre for Organisational Learning)

"We got good feedback from the Ministry of Science, Technology and Innovation on

setting up and how to apply. It was a good iterative process." (Chitosan-Based Nanoparticles and Membranes for Biomedicine)

"The Ministry of Science, Technology and Innovation was amazing flexible about arranging explanatory meetings. This resulted in good interaction." (KEMI – Centre for Chemicals in Industrial Production)

There is also some criticism of the dialogue, however. The experience of one project manager was, as he put it, that "the bar was moved several times along the way. We tried three times before we got a bite." This was with the first-come-first-served method. Also, the professional interest of case officers seems to play a role: "I felt there was much better cooperation with the Ministry of Science, Technology and Innovation this time. They were far more interested in the subject than last time."

Relatively few of the project managers have specific comments on the guidelines, but some want clearer information on what the Ministry wants to support and what the requirements are for obtaining support. Several project managers say that they feel the Ministry goes for specific specialist areas and that it is currently difficult to make headway in low-tech areas, for example, but that this is not made clear.

One project manager also wants more precise information on what is meant by generic knowledge, dissemination, etc. The same project manager also says that, in his opinion, there is an inherent contradiction in the programme in that it expects cooperation to lead to new products while knowledge development must be generic in nature and not distort competition.

Overall, however, the evaluator has the impression that the level of information currently available from the Ministry of Science, Technology and Innovation on the possibilities offered by the programme is satisfactory. The questionnaire survey shows that 71% of the technological service parties are either satisfied or very satisfied with the information they received prior to application, while very few are downright dissatisfied, cf. table 9.1. There are no significant differences between consortia set up in 2000-2001 and 2002-2003.

Table 9.1: How satisfactory was information from the Ministry of Science, Technology and Innovation on the possibilities offered by the programme before the application was submitted?

	Research institution	Technological service party	Enterprises
Not at all satisfactory	0%	0%	4%
Unsatisfactory	2%	3%	4%
Partly unsatisfactory	19%	18%	19%
Satisfactory	24%	56%	16%
Very satisfactory	7%	15%	4%
Don't know	47%	8%	52%
Total	100%	100%	100%

Source: Questionnaire survey

9.1.3 Approval and preparation of the agreement complex

The requirements with regard to applications and the subsequent administrative procedure are perceived by the project managers as relatively unbureaucratic, but several make the comment that it takes a while to get final approval in place and get moving.

Preparation of the agreement complex is an area that, according to the project managers, often gives rise to problems. Finding the balance between the enterprises' need to keep knowledge more or less secret and the programme's intention of disseminating knowledge outside the consortium is a difficult task. As one of the interviewees puts it, it is especially difficult if the enterprises have not taken part in the programme before. The growing interest of the universities in patenting that has been seen in recent years is also said to have taken the situation to another level.

For example, the evaluation has found several examples of consortia nearly falling apart owing to legal matters surrounding the agreement complex. It was revealed in the round table discussions, for example, that there were protracted discussions between the lawyers of the enterprises and the technological service party in particular in Machine Acoustics – Analysis and Optimisation of Industrial Components and Systems. Negotiations in which the specialists were largely left on the sidelines. The parties were so far apart in the negotiations that the contract very nearly didn't come about.

The problems are most pronounced in consortia where the knowledge built up is of importance to the enterprises' product development, whereas it is easier to reach agreement if it is a matter of process development, or of knowledge development of a more generic nature.

The examples of difficulties revealed by the interviews and round table discussions are supported by the questionnaire survey, with by far the majority of participants saying that they had problems when it came to drawing up the agreement complex. A relatively large number even experience quite a few or a lot of problems. For example, 38% of the technological service parties experience quite a few or a lot problems, cf. table 9.2.

Table 9.2: To what extent did the participant experience problems in connection with preparation of the agreement complex for the centre contract/innovation consortium?

	Research party	Technological service party	Enterprises
No problems	28%	15%	20%
The odd problem	23%	15%	27%
A few problems	23%	23%	29%
Quite a few problems	19%	28%	14%
A lot of problems	5%	10%	3%
Don't know	2%	8%	7%
Total	100%	100%	100%

Source: Questionnaire survey

There would seem, therefore, to be a need for initiatives to minimise the problems with regard to drawing up the agreement complex. The evaluator suggests in this connection that the Ministry of Science, Technology and Innovation should, as also suggested by several of the interviewees, take the initiative to draw up standard contracts or templates such as those used in the EU's framework programmes.

9.2 During the project

The interviews with project managers show that the project managers perceive contact with the Ministry of Science, Technology and Innovation during the project as frictionless and flexible, but also that they do not generally have very much contact with the Ministry.

During the project the contact between the project manager and the Ministry mainly concerns changes to the projects, such as the replacement of enterprises or extensions to the project. In such cases the message from the project managers is that the Ministry is very understanding and flexible, cf. textbox 9.2.

Textbox 9.2. Statements on ongoing administration

"Very understanding and flexible. Such as when it became necessary to replace one of the enterprises at the start."

"Once the application was in place and had been approved, everything went smoothly."

"Ongoing administration worked fine."

"There's not much interaction, but the Ministry is quick to answer questions."

"We had a good relationship, and they were very understanding when an enterprise had to be replaced owing to insolvency."

"We didn't have very much to do with the Ministry of Science, Technology and Innovation. I spoke to them briefly about postponing deadlines, etc., and got good feedback."

Some of the project managers, however, miss there being greater interest on the part of the Ministry with regard to the technical return on work, including feedback on ongoing reporting, and some would like more opportunities to exchange experiences between the consortia.

Close technical follow-up of the individual consortia on the part of the Ministry would be relatively resource intensive. But the Ministry might perhaps consider holding regular conferences, etc., at which consortium participants would be allowed to present technical results and, even more importantly, have the opportunity to exchange experiences with a view to ensuring progress, generating results and then disseminating them outside the consortium. This might also, perhaps, take the form of a kick-off meeting for new consortia once the application round was complete.

The Ministry's current reporting requirements are perceived by the project managers to be reasonable, unlike the requirements for EU projects, for example, which many of the project managers have experience of.

With regard to the enterprises, some project managers believe that the administrative burdens of project participation are large for enterprises, especially SMEs. The results from the questionnaire survey support such statements to only a small extent, however, cf. table 9.3.

Table 9.3: How does the participant see the administrative burdens connected with work in the centre contract/innovation consortium?

	Research party	Technological service party	Enterprises
Very small	9%	8%	16%
Small	45%	33%	57%
Medium	33%	41%	20%
Large	11%	13%	8%
Very large	2%	5%	0%
Don't know	0%	0%	0%
Total	100%	100%	100%

Source: Questionnaire survey

As table 9.3 shows, the enterprises are actually the one party of the three who perceive the fewest administrative burdens in participation. Not surprisingly, it is among the technological service parties, who typically perform the role of project manager, that the most participants who experience the administrative burdens as medium or large are found. Overall, however, the answers support the project managers' statements to the effect that the administrative burdens during the project are reasonable at present.

10. Recommendations

To conclude the report, this section brings together the most important recommendations for the Ministry of Science, Technology and Innovation and the Council for Technology and Innovation.

The starting point is that the programme is a success and should therefore be continued, but many things have changed with regard to innovation and knowledge development since the programme started in 1995.

- There are now far more institutions acting as bridge builders between research and the business community than just the ATS institutes. They include the research institutions themselves, vocational schools, centres for higher education, technical academies and a number of new bridge-building institutions affiliated to the research institutions.
- The demands on innovation are increasing sharply in SMEs, which means that innovation policy has to take a broader approach to innovation in this target group than just facilitating knowledge dissemination through the ATSs. There is a need to promote cooperation projects between knowledge institutions and SMEs.
- Technical innovation is still important, but groundbreaking innovation is happening to an increasing extent at the crossover between technology and other forms of knowledge. The programme has not contributed much to this last area – largely, it is to be supposed, owing to the technological focus of the ATSs.

This means that there is both a need for the guidelines to be adjusted and a need for better utilisation of the changes made to the guidelines in connection with the changeover from centre contracts to innovation consortia.

10.1 Two windows in the programme

The evaluator recommends that in future the administration of the programme should be divided into two windows, each with its own set of criteria.
It is recommended that the first window should relate to the development of new base technologies (technology platforms). In this window the emphasis would be on specialisation. In other words, the participants on the enterprise side would typically be large and technology-intensive. And it would frequently be relevant to consider involving leading foreign knowledge incubators and enterprises. In these projects there would typically be a need for participation by an ATS institute to handle the task of making the technologies usable for a broad circle of enterprises. It is not unrealistic to expect that universities such as Aalborg University and the Technical University of Denmark would be able to perform this function in time, however.

It is recommended that the other window should be aimed at projects of a more applied nature, with SMEs and educational establishments being more frequent participants. Product development could form an element in the projects if it

would help to clarify the possible applications of technologies, for example. In this area we would recommend maintaining a duration of at least two years so as to give new institution types the opportunity to use the consortia to develop new commercial services, among other things. But there should be greater flexibility with regard to consortia being able to consist of several part projects, which would allow smaller enterprises, for example, to participate in activities of shorter duration. This should make it possible for some of the enterprise financing to be realised along the way.

Table 10.1 shows the main differences between the two types of project.

Table 1.1: Two types of innovation consortium		
	Development of base technologies	Innovation projects
Nature	Generic knowledge and high research content	Experimental projects in which knowledge is applied and various specialist fields are combined
Duration	At least three years	At least two years, with it being possible for a consortium to involve several projects of shorter duration
Research party	Top international level, involvement of foreign incubators encouraged	Researchers with an understanding of innovation and the application of knowledge
Enterprises	The best in the business and typically from existing networks.	A broad spectrum, with the involvement of enterprises from outside existing networks being encouraged
Technological service party (the name of this category should be changed)	Typically an ATS institution, but it would also be possible for a research institution to perform the task	ATS institutes, educational institutions and other bridge builders.

The division into two windows is intended to ensure that projects that are difficult to compare do not compete for the same funds, and that the individual projects do not compete on factors that could adversely affect quality:

- Consortia aimed at developing technological breakthroughs should not compete on the involvement of SMEs, but on their specialist quality and relevance. The SME relevance of such projects should be ensured in the dissemination phase, so this type of project should also compete on ability to think in terms of dissemination channels.
- Consortia that involve SMEs and focus on finding new applications for existing knowledge should compete less on the level of specialist research in the project itself and more on ability to produce innovation. The same applies to projects with educational establishments, for example, as the "technological service party".

10.2. Specific recommendations

The proposed change in the programme described in section 10.1 gives rise to a number of specific recommendations with regard to the programme guidelines and marketing of the programme. First and foremost, the Ministry of Science,

Technology and Innovation should, of course, develop two sets of criteria to reflect that the programme operates with two types of project, cf. table 10.1 above. In addition to this the evaluator proposes the following changes in the guidelines in consequence of the proposal in section 10.1:

- The title "technological service function" should be changed to send a clear signal that institution types other than ATSs can perform the role. The categories "knowledge development" and "knowledge dissemination" could be used instead of "research party" and "technological service party", for example. The introduction to the programme on the Ministry of Science, Technology and Innovation's website should also be changed accordingly.
- It should be made clear under "Innovation Projects" that it is possible for projects to be in the nature of product development as long as it contributes to general knowledge development.

There is also a need for the following in consequence of the change proposed in section 10.1:

- Much stronger and broader marketing of the changes than was the case with the changeover to innovation consortia. Experience shows that it is very difficult to change the players' perceptions of the programme's possibilities and limitations.
- A detailed analysis of the financial terms and incentives if institutions other than ATSs are to perform "the technological service function". The analysis should look into whether the existing subsidy options are sufficiently attractive (see section 8.5).
- Clarification in the guidelines of when a consortium satisfies the conditions for participation by foreign institutions and enterprises. Here too there is a need for strong marketing, as many players still perceive the involvement of foreign partners as impossible or at least as making a negative impression on the Ministry of Science, Technology and Innovation.

In addition to this there is a need to support stronger knowledge dissemination from the projects by means of the following:

- Competition between projects on the research/knowledge party's plans for knowledge dissemination to trade and industry as well as other factors.
- Clarification in the guidelines to the effect that the Ministry of Science, Technology and Innovation would like to see the project parties starting cooperation with other players who can help with handling knowledge dissemination during and after projects, e.g. educational establishments.

As mentioned in section 9.1.3, there are several examples of projects nearly falling apart owing to legal matters surrounding the agreement complex. The parties in many projects also spend a lot of time on rights and legal matters, a development that has accelerated as the research institutions have focused more on rights and commercialisation.

- The evaluator recommends that the Ministry of Science, Technology and Innovation should take the initiative to prepare standard contracts or templates such as those used for the EU's framework programmes.

Finally, the evaluator is of the opinion that the Ministry of Science, Technology and Innovation could do more to strengthen experience exchange and knowledge sharing between projects. The evaluation shows that in specific areas there are good examples of best practice that could be made available to new consortia and consortia with advantage in the start-up phase. These areas include:

- How to use the steering group and the level at which the parties should participate in the steering group
- Organisation of cooperation with a view to ensuring the greatest possible interaction and knowledge sharing
- Team building and other types of initiative to create a good framework for successful cooperation.

More consideration could also be giving to making these factors competitive parameters in applications, because a good performance in these areas will help to improve a project's chances of success.

Appendix 1: List of interviewees

Table 1: Interviews with project managers	
CEMIP – Centre for Effective Environmental Communication in Product Chains	Kirsten Schmidt
Centre Contract for Model-Based Monitoring and Control	Helge Didriksen
DaMF – The Danish MicroFactory	Lars Lading
Centre for Improved Plastic Products - MONEPOL	Tenna Brandt Nielsen
SeaSense – Centre for Safety-Critical Maritime Sensors	John Koch Nielsen
MikroKAP – Centre for Microsystems for Chemical and Biochemical Analysis Based on Polymers	Leif Højslet Christensen
Centre for Network and Service Convergence	Esben Wolf
Development of Transport Concepts of the Future	Finn Olesen Zoega
Chitosan-Based Nanoparticles and Membranes for Biomedicine	Mads Johnsen
The SCC Consortium – Self-Compacting Concrete	Mette Glavind
Centre for Extremophile Microorganisms and Enzymes	Ole C Hansen
Devices on the Internet	Michael Holbech
KEMI – Centre for Chemicals in Industrial Production	Torben Madsen
The Importance of Structure for Aroma Release in Food – Measurement and Perception	Anne Maria Hansen
Centre for Ex Vivo Cultivation of Human Cells in a Medical Context	Holger Riemann
Centre for Organisational Learning	Anne Marie Holsbo
Machine Acoustics – Analysis and Optimisation of Industrial Components and Systems	Aage Damgaard
Centre for Optical Sensors – Interaction between Light and Biomolecules	Lars H. Pedersen
Centre for Biofilm in Technical Systems	Jan Lorentzen
MALARIA – Methods for the Effective Development of Drugs in Small and Medium-Sized Enterprises – exemplified by the development of chalcons for antimalarial drugs	Vibeke Hatorp
Living Bacteria for the Administration of Medicine and Vaccines	Jacob Glenting
CNP – Centre for Nanostructured Polymer Surfaces for Medical Use	Lars H. Pedersen
Talent @ IT – A Better Improvement and Innovation Ability	Jørn Johansen
CEMOST – Centre for Microoptical Structures	Jørgen Garnæs
MiNaP – Micro & Nano Products	Jørgen Kejlberg
InnoLink – Product and Process Development in Competence-Based Supply Networks	Peter Dam
Biological Interaction Analysis	Anne Maria Hansen
BioMed – Centre for Diagnosis, Prevention and Control of Biofilm on Medical Equipment	Anne-Lise Høg Lejre
WANDA – Wireless Access Network Devices & Applications	Esben Wolf
Monitoring and Restriction of Bacterial Growth	Bo Frølund

Table 2: Interviews for interested party analysis	
Department of Product Development	Professor Leo Alting
Aalborg University	Niels Maarbjerg Olsen, Secretariat Director
Risø	Jon Wulff Pedersen, Deputy Director
Mads Clausen Institute	Frands Voss, Director
Alexandra Instituttet	Ole Lehrmann Madsen, Director
Crossroads Copenhagen	Pouline Middleton
Vitus Bering	Hans Jørgen Hansen, Director of Studies
Herning Institute of Business Administration and Technology	Erik Ernø-Kjølhede, Pro-Rector
Centre for Business Development at the Academy of Professional Higher Education NOEA	Søren Samuelsen, Centre Manager
Confederation of Danish Industries	Morten Ørnsholt
Danish Commerce and Services	Per Godtfredsen
ITEK	John Sarborg Pedersen

Table 3: Interviews regarding the four completed centre contracts	
Kim Christensen, Danish Technological Institute	Centre for Slush Ice
Thomas Zwieg, Danish Technological Institute (also formerly of Dresden University)	Centre for Slush Ice
Poul Rind Christensen, formerly of Centre for Small Business Studies	LOS
Peter Hvejsel, CBC	LOS
Finn Zoega, Danish Technological Institute	LOS
Heins Kart Pedersen, Grundfos	SUM
Jens Branebjerg, DELTA	SUM
Erik Thomsen, Department of Micro and Nanotechnology/Technical University of Denmark	SUM
Jan Hansen, DELTA	Centre for Sensor Technology
Torben, Sevel, FORCE	Centre for Sensor Technology
Per Halkjær Nielsen, Aalborg University	Centre for Sensor Technology
Steen Dueholm, Wesser & Dueholm	Centre for Sensor Technology