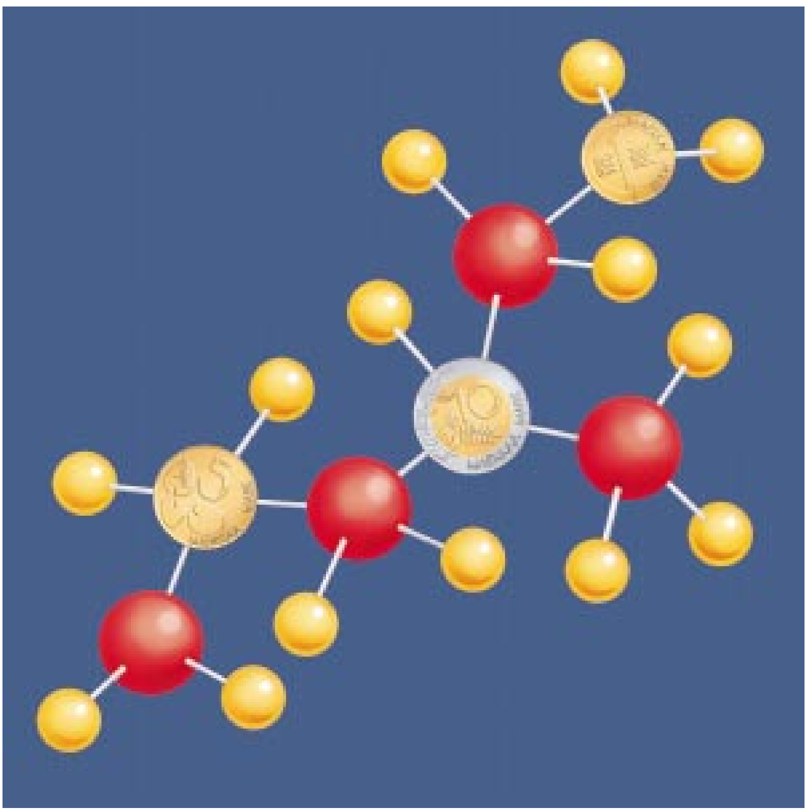
Marketing Molecules Technology Programme 1997–2000

John Brophy, James Clark

Technology Programme Report 13/2000 Evaluation Report



TEKES

Marketing Molecules
Technology Programme 1997–2000

Evaluation Report

Dr John H. Brophy
Professor James H. Clark

TEKES

Technology Programme Report 13/2000
Helsinki 2000

Tekes – Your contact for Finnish technology

Tekes' primary objective is to promote the competitiveness of Finnish industry and the service sector by technological means. Activities should diversify production structures, increase production and exports, and create a foundation for employment and social well-being.

Tekes supports applied and industrial R&D in Finland with about two billion Finnish marks annually. Tekes offers excellent channels for technological co-operation with Finnish companies, universities and research institutes.

Technology programmes – part of the innovation chain

The technology programmes for developing innovative products and processes, are an essential part of the Finnish innovation system. These programmes are characterised by close co-operation between industry, the universities and research institutes. The programmes also form a solid basis for international co-operation. Currently there are more than 60 technology programmes.

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Preface

In 1995, on the initiative of the Chemical Industry Federation of Finland, Tekes started to plan new chemical technology programmes. During spring 1996, all the important chemical companies in Finland were visited and meetings were also held with the key professors. The programme developed from these discussions was planned for 1997-2000 and named Marketing Molecules.

The concept of this programme is different from that of previous chemical technology programmes. The programme is industry based, i.e. the main proposers have been industrial companies, but it has also required the involvement of academic partners in the projects. The main target for the programme is to increase renewal in the chemical industry in the form of either new or significantly better products. The aim has also been to encourage companies to undertake long term research together with other companies and universities. Altogether, 14 projects in which industrial and academic researchers work together have started. A substantial sum of money (about half of the total budget) has been directed to academics through industrial projects.

It was decided to carry out a mid-term evaluation in 1999. One of the most important and interesting objectives was to obtain comments on the totally new programme concept. Although the industrial projects are confidential, they were still evaluated at a general level. Due to the nature of the programme a peer review evaluation, as undertaken in previous chemical technology programmes, was inappropriate in this case. As a whole, the evaluation provides valuable information that will aid in the planning and management of future technology programmes.

The evaluation was carried out by Dr. John Brophy from JB Consultants and Prof. James Clark from the Department of Chemistry, University of York. The evaluators were briefed beforehand and also received written material about the projects and the innovation system in Finland. The evaluation was performed by interviewing representatives from all industrial projects. Some academics taking part in projects were also interviewed. Questionnaires were sent beforehand to the industrial participants and academics to ensure that the discussions had similar structure and content.

Tekes would like to thank everybody who participated in the evaluation, especially Dr. John Brophy and Prof. James Clark. Their opinions and valuable comments have been gratefully accepted and will be used to benefit chemical research and the chemical industry in Finland.

Helsinki, March 2000

Tekes, the National Technology Agency

Executive Summary

The Marketing Molecules programme aims to extend collaborative research between industry and academia on high risk, high reward innovative chemicals and related projects. Mid-term evaluation of the Programme took place in 3Q 99 with detailed questionnaires followed by interviews with all 9 participating companies as well as selected academic researchers.

Evaluation results show that the programme is working well to achieve its aims with good progress in most, but not all, projects. Projects are higher risk than normally acceptable to the companies and without this programme the projects would not have started. In total, the programme has the potential for generating significant new business amounting to over 400 million FIM/a within 5 years. Other key outputs include 10 new jobs already created and over 20 PhDs and 49 MScs likely to be produced by the end of the programme.

Participating companies are mainly large firms with only 2 SMEs involved. More ‘high tech’ SMEs might have been expected to be active in chemicals, materials, pharmaceuticals and related sectors as in other countries.

The most successful projects are those where both partners have experience of working together in collaborative research. New partnerships need more time, especially since the academic researchers have little knowledge of industrial R&D, product and process development and business priorities.

Recommendations for improving the programme include allowing more time for companies to identify the appropriate academic expertise, agree roles and objectives and familiarise academic staff and students with the company and its business objectives. Most if not all of the projects would benefit from more multidisciplinary academic research teams and more of the companies’ customers involved in the projects. Smaller companies need more help in finding academic expertise and partners and academics in general would benefit from short training courses on business R&D management.

Tekes’s flexible approach to setting up and managing the programme with a light touch is generally acknowledged by companies and universities as a very strong point.

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1 Introduction

1.1 Background

Governments everywhere are looking for ways to link their investments in science, engineering and technology (SET) to industrial outcomes that generate wealth, employment and quality of life. Most countries have established technology transfer programmes that enable collaboration between industry and universities. Many of these are industry led.

The Marketing Molecules programme is a new Tekes programme designed to stimulate universities and companies to leverage the SET base in Finland to produce industrially significant results in the chemicals and related sectors. The programme is intended to promote technology transfer by bridging the gap between university scientific programmes which are primarily directed by academic interest and the narrower focused industry programmes.

The programme grew out of consultations with the chemicals industry and academic groups that identified the need for a new type of programme that enabled higher risk collaborative research which was market led and managed by the companies involved.

Key customer markets were identified as important for the chemicals Finnish chemicals industry including forest industries, pharmaceuticals, plastics and the chemicals industry itself, together with strategic technology areas. After interviewing 19 chemical companies and over 60 university professors, the programme was launched in 1997.

1.2 Programme Aims

To qualify for the programme, projects had to fulfil the following criteria,

- chemically based
- higher risk projects than industry normally funded
- aimed at generating new business or significantly improving existing business
- collaborative with academic groups
- real co-operation between industry and academia

Fourteen projects were selected and the programme began in 1997 with most projects scheduled to run for 3-4 years.

Expected outputs from the programme were,

- technology transfer
- new processes
- new products
- industrial exploitation
- new companies
- new jobs
- training
- increased collaboration between industry and universities
- alignment of the SET base with the chemical industry's needs

1.3 Programme Evaluation

Following Tekes practice, the programme was evaluated at mid term. The programme criteria and expected outcomes were the basis of the evaluation together with several important programme issues including the programme concept, programme management and how far the programme has met the participants' and Tekes expectations.

To achieve this the evaluators received progress reports and background material on the companies and their academic partners for each project in January 1999. This was followed in August 1999 by detailed interviews with all of the companies and a selection of the university groups. To structure the interviews and maximise their value, questionnaires were sent to all participants several months before the interviews covering all of the important evaluation issues. Different questionnaires were tailored for industry and academics and examples of both are given in Appendix 1. All but one of the companies and most of the academics interviewed had prepared detailed written answers that enabled the interviews to focus on a more thorough understanding of the more important issues.

2 Evaluation Results

Evaluation reports for each of the individual projects based on the questionnaire structure and interviews with the companies are detailed in Appendix 2. The views of the university partners are summarised as an 'academic overview' in Appendix 3. The results are summarised below in terms of,

- general observations on the strengths and weaknesses of projects
- how far the programme is achieving its aims
- recommendations for improving projects and the overall programme.

2.1 General Observations

In no particular order of priority, the following general observations were made.

Tekes flexible approach and hands on involvement in setting up the programme was a strong point and appreciated by all of the companies involved.

Most of the projects are higher risk than the companies would normally find acceptable and Tekes funding has been instrumental in enabling them to start.

The most successful projects are those where both industry and academic partners have experience of collaborative research, know their partners and where the companies have taken care to select those with relevant expertise.

Established networks work best in the short term and are best suited to the 3-4 year time-scale of this programme. New partnerships take longer to generate results.

Identifying partners and agreeing roles and objectives takes time. Some of the companies would have appreciated more time than was available to identify new academic partners. In several cases companies chose the academics they already knew rather than looking for new partners.

Academic partners in general have little knowledge of industrial R&D, marketing and business priorities. For smaller companies where time to market is critical for survival, the longer term academic approach to R&D can be a major problem.

The degree of student placement and industrial training varies from very little through to very extensive. Those students who had had little contact with the company felt less involved in the project although long placements did not seem necessary.

Of the 14 projects and 9 companies there are only 2 small companies involved. Since companies must have an income to contribute their share of the costs it is understandably more difficult for smaller companies to participate. However, it is surprising that there are not more small chemical companies involved in high tech areas including materials, biotech and pharmaceutical related technology.

Multidisciplinarity is key to industrial R&D yet few of the MM projects involve disciplines other than chemistry. There is also little evidence that the academic groups collaborate in their own projects.

Many companies commented that their academics have little real interest or commitment to the MM projects and do not set up supporting research in their own Tekes funded research programmes.

Business leadership can take the academic groups into new and higher risk areas of science and technology that have potential for both new business potential and new world class science. New polymerisation catalysts and activators is a good example.

Projects with the strongest links to business strategy and plans are most likely to generate significant results that will be commercialised. However, changes in business plans and project objectives can cause problems for the academic partners. Business commitment to the full 3-4 years of the project, rather than annual budgeting, allows longer term project planning and involvement of more substantial PhD projects rather than MScs which are more limited in impact.

The most well managed projects are those where the project manager is a senior R&D manager in the company with experience of project management.

Only 2 of the projects involve the company's (external) customers in testing their potential products. This is a weakness for a programme aiming at new chemical products where customer involvement can reduce both business and technical risks.

In the view of some of the companies interviewed, there are weaknesses in the SET base within Finnish Universities which are worth exploring further in polymer science, NMR spectroscopy and biosynthesis/biocatalysis.

The 'silo' company structures favoured by management in the 1990's can result in business divisions being isolated from each other and becoming effectively 'pseudo SMEs' lacking technical synergies with other divisions and the more favourable grant support available to true SMEs. This is common to most European countries.

2.2 Progress to Programme Aims

Appendix 3 summarises progress towards the programme aims.

2.2.1 Technology Transfer

The MM programme was intended to be a new model for increasing technology transfer between industry and academia. Channelling the funding through companies has been a success in this respect. Many of the companies commented that their involvement in previous Tekes programmes, where universities were funded directly, was limited because of their degree of control over the project and uncertainties on IPR ownership and confidentiality. They had preferred to collaborate in more limited projects even when this meant paying a higher proportion of the costs. MM has been instrumental in persuading companies to extend their collaborations with universities to include higher risk strategic R&D.

Some of the projects have already achieved results in terms of transferring technology and introducing new products. However, at this stage in the programme evidence of significant technology transfer is limited and companies and universities are, in many projects, still learning to collaborate in longer term projects.

2.2.2 New Business

New business turnover was specifically estimated by most companies. In those where it was not estimated or where no analysis of reasonable expectations were made it has been ignored. Projects which have stopped are treated as having zero direct financial benefit. The results show a potential total of over 400 million FIM of new business could be generated from the programme within 5 years if all the remaining projects are successful.

At the time of the review, a total of 10 new jobs have been created as a direct result of the programme with the potential for significantly more if projects are successful.

2.2.3 New Technology

The majority of projects are likely to produce new products as well as new processes and almost all are generating new technical information and basic understanding that can be used in existing or future business projects.

2.2.4 Training

Training is also delivering in line with expectations with a total of 49 MScs already completed and a further 20 PhDs expected by the end of the programme.

Most of the industrially relevant training is in the form of MScs where the work is carried out in the company and company staff supervise the students. This is a good mechanism for familiarising students with industrial R&D but there are several potential problems in over reliance on short term MSc students. Loss of continuity over the 3-4 years of the projects and superficiality in the projects are not a good basis for R&D that is intended to make significant advances.

2.2.5 Industry/University Collaboration

As noted above, most companies have chosen academic partners that they already knew and in this respect the programme has not significantly extended the links between industry and academia. However, the quality of the collaboration has been increased considerably by funding the university groups via the companies. This has given the companies the degree of control necessary to collaborate with universities on higher risk projects than previously.

3 Recommendations

More time should be allowed for companies to set up the projects with particular emphasis on finding academic partners with the relevant expertise, agreeing all of the partners roles and objectives. An incubation period for academics at the start would help to familiarise staff and students with the company and ensure a proper appreciation of the project objectives, assignment of tasks and time-scales.

To assist companies to find the relevant expertise and academic collaborators, Tekes should consider better publicising the summaries of the outcomes of all of its programmes as well as publishing a directory of expertise in Finnish universities.

Project managers from the companies should be experienced R&D managers. Companies should be encouraged to adopt the Fortum management model as an example of best practice. This should be a topic for discussion at the annual seminar.

Short courses on 'Business R&D Management' should be considered for academic staff and students before they start collaborative projects especially where they are collaborating with smaller companies.

To enable more continuity and longer term projects more suited to PhDs companies should commit to funding for the full 3 to 4 year term of the project rather than limit their funding to annual planning cycles.

Companies should consider including customers and suppliers in their supply chains in projects aimed at new products.

Companies should be encouraged to build the appropriate multidisciplinary mix of academic disciplines into projects, especially in projects involving catalysis and new process development where chemical engineering and process technology are critical.

Academic groups should be encouraged to align their other 100% Tekes funded research to support their industry collaborative projects.

University supervisors of MSc and PhD students in the programme should be required to spend more time in the company supervising their students and familiarising themselves with the companies aims and objectives. The UK Teaching Company Scheme is an example of good practice in involving academic supervisors in research projects and is recommended as a model.

Appendix 1

Marketing Molecules – Questions for Companies

1 Impact of MM on creating new business for your company

- Is the project aimed at generating a completely new business(es) or defending/improving an established business(es)?
- What will be the impact on the company's turnover, profits and return on investment, jobs?
- Is there a plan for commercialisation and is this an accepted part of the overall business plan?
- What is the level of risk associated with the business objectives and would your company normally accept this level of risk?

2 Impact of MM on creating new technology

- Is the project aimed at new process technology, new products or new services?
- Is the research aimed at completely new technology or an improvement on existing technology?
- If successful, will this project create sustainable competitive advantage for your company?
- Have you filed patents or do you expect to file patents?
- What is the level of risk associated with the technical objectives and would your company normally accept this level of risk?
- Are you satisfied with the competence of the Finnish university groups?
- How do the Finnish groups compare with the world leaders in their fields?

3 Impact of MM on the production of trained people

- How many advanced degrees (Masters, PhD) are employed and will be produced as a result of MM?
- Have you employed, or do you expect to employ, any of the graduatesin the MM programme?
- As an employer, does MM have any advantages over normal graduate training programmes?
- Do you provide any in company technical and/or management training for MM students?

4 MM project management process

- Is there an overall project manager?
- Were the technical and business objectives clearly defined and understood at the start and does everyone understand their respective roles?
- Is there a well defined and clear project plan e.g. Gant charts, milestones,
- Does the project have all the necessary technical inputs?
- Is the project meeting its technical objectives?

5 The MM programme concept

- How do you rate MM as a mechanism for industry/university collaboration?
- Has MM increased the extent and/or quality of collaboration with university research groups?
- How could the process and criteria for project selection and overallprogramme management be improved?
- Is MM more or less likely to benefit Finnish industry than other forms of Government funding?

6 Impact of MM on the Finnish SET base

- What has your project(s) achieved in terms of enhancing the science, engineering and technology base in Finland?
- Are the investments in MM big enough, and are the benefits likely to affect company decisions on inward investment and location of R&D?

Marketing Molecules – Questions for Academics

1 Impact of MM on creating new business

- Do you understand the business objectives and context for your MM project(s)?

2 Impact of MM on creating new technology

- Is the project aimed at new process technology, new products or new services?
- Is the research aimed at completely new technology or an improvement on existing technology?
- What is your contribution - fundamental or applied research?
- How many papers do you expect to publish as a direct result of MM?
- Do you have a clear agreement with the company on IPR?
- What is the level of risk associated with your scientific/technical objectives?
- Are you satisfied that you have the necessary resources and equipment to achieve your objectives?

3 Impact of MM on the production of trained people

- How many advanced degrees (Masters, PhD) are employed and will be produced as a result of MM?
- Does MM have any advantages over normal graduate training programmes for potential industry employers?
- Do the MM students receive any management or industry related training ?
- Do the students spend time in the company's labs/facilities in their training?
- Do the students understand the business context and objectives?

4 MM project management process

- Is there an overall project manager?
- Were the technical and business objectives clearly defined and understood at the start and does everyone understand their respective roles?
- Is there a well defined and clear project plan e.g. Gant charts, milestones,
- Do the project reports and review meetings meet your requirements?
- Does the project have all the necessary technical inputs?
- Is the project meeting its technical objectives?

5 MM programme concept

- How do you rate MM as a mechanism for university/industry collaboration?
- Has MM increased the extent and/or quality of collaboration with university research groups?
- How could the process and criteria for project selection and overallprogramme management be improved?
- Is MM more or less likely to benefit Finnish universities than other forms of Government funding?

6 Impact of MM on the Finnish SET base

- What has your project(s) achieved in terms of enhancing the science, engineering and technology base in Finland?

Appendix 2

Marketing Molecules – Project Evaluation Reports

1 Borealis Polymers Oyj – Proprietary Single Site Catalyst Technology for Polyethylene

1.1 Impact on creating new business

This project is a very good fit with business strategy which is to build on European leadership in polyolefins to become a global player. It is aimed at new products for accessing new business estimated at 120 kt/a in Europe and 535 kt/a world-wide in 1997 growing to 450 kt/a and 2030 kt/a by 2001. In addition, new catalyst and process technology will provide opportunities for the Borealis licensing business world-wide.

Net present value of the project is estimated to be highly positive.

The project is part of the Borealis business plan and an important element of the overall R&D programme and strategy.

The business risk is medium and accepted although the challenge in developing proprietary catalysts in this area should not be underestimated.

1.2 Impact on creating new technology

This project will create new proprietary catalysts and extend the range of the Borealis Borstar Process to include completely new higher performance polyethylene products.

If successful the project will create competitive advantage in a global market for products and technology licensing. Borealis has already filed 16 patent applications. It will also provide additional opportunities for Finnish technology and engineering companies to provide equipment and engineering services to support the Borealis polymer and licensing businesses.

Marketing Molecules has been important in building the relationships and directing universities to new higher risk research areas where others are not working. Without the leadership from the company, it was believed that the university groups tend to focus their research on well known catalyst systems that builds understanding but is unlikely to discover new systems. Company leadership in this project has encouraged the university groups to focus on discovering completely new catalyst systems that are likely to be free of competitor's patents and key to creating a proprietary position for the company. *This is an important feature of Marketing Molecules and is a lesson for other programmes aimed at industry relevant research.*

Academic partners also see new fundamental understanding of metallocene catalysis coming out of this project. A substantial number of publications resulting directly from the project are in the pipeline. On the evidence available the quality of the academic work seems high.

1.3 Impact on the production of trained people

It is anticipated that this project will produce a total of 4 PhDs in chemistry and technology with 7 MSc theses completed.

Borealis sees this programme as a very effective way of training graduates in a core competence area for the company, evaluating them as potential recruits and improving their understanding of the industry and the company.

There is no formal programme for graduates to work in the company as part of their research and most of the graduates work in university labs except where they need access to the company's specialised equipment. *A more formal scheme for industry work experience might be worthwhile in terms of increasing academics awareness of industrial R&D and commercial scale plants.*

Borealis has already employed 4 graduates from the project and plans to employ a 5th. Although it mainly recruits locally, it is now looking further afield. In particular it would prefer graduates to do post-doctoral research in a leading overseas university before joining the company for a research career.

1.4 Project management process

The project set up was made easier by being able to build on a network of academic partners already in place through the Synthesis Programme.

The project is well managed with an overall steering group with all of the university groups represented. Confidentiality agreements are in place for all academic groups funded by this project and are important for open technical discussion. In other more fundamental programmes such as the synthesis programme which was 100% Tekes funded, there were no confidentiality agreements. Here, the company was not able to share technical information to the same extent which limited the industrial relevance and value.

Borealis chair the steering group and there is a Borealis manager responsible for linking into the Borealis business units on product development issues. There are meetings with each academic group every 2 months and regular joint meetings with the modelling group and the others. The whole team meets for an annual project seminar in addition to the annual Marketing Molecules Programme Seminar organised by Tekes. The effectiveness of the team-working and strong involvement of academics was confirmed in a separate academic interview.

Use of an established and proven network has greatly facilitated the management of this project

1.5 Marketing Molecules Programme Management

The programme was set up quickly with minimal paperwork and with industry in the lead role in terms of project definition.

Flexibility in the project to date could have been improved if the company had realised that it could reallocate resources as the project progressed and the priorities become clearer. For example, the work is going well and more resources are needed at the University of Joensuu for the synthesis of new activators.

One academic involved in the project believes that this project has done more to improve academic-academic collaboration than other mechanisms.

1.6 Impact on Finnish SET base

Single site catalysts and polymers technology is a major and high growth area for the chemicals and materials industries world-wide. This project is key to establishing Finland as a player and is building the skills base for industry including Borstar and other chemicals and polymer users.

If successful, the increased business and number of Borstar plants world-wide will increase R&D in Finland with increased opportunities for Finnish universities, technology and engineering companies in supporting and supplying Borealis.

There will be other opportunities for downstream polymer processing companies in terms of new products based on the skills base and product families coming from this technology.

2 Cultor Oyj – Utilisation of Cultor Sidestreams

There was no academic input to this evaluation either in the form of written reports or oral interviews.

2.1 Impact on creating new business

Since this project started in 1997 the business focus of Cultor Oyj has changed several times.

The Danish company Danisco has now acquired Cultor Oyj and is still in the process of integrating the former Cultor businesses into the Danisco sectors. However, the project is likely to remain a good fit with the new food and feed ingredients and the sugar and sweeteners businesses. The target is to extract valuable sugars from side streams of large-scale processes both of which are likely to be continuing core business.

If successful, the project will provide several new high value products. The group has already commercialised one product (l-arabinose) from an earlier Tekes project and clearly has the competence to commercialise further products from this project.

This is firmly within the business area of the company and the only commercial risk is that associated with the regulatory procedures for food ingredients. However, in the past Cultor business units have not been willing to fund collaborative research with universities for projects longer than 1year. *This has limited the scope of the project and it would be more productive if future Tekes funding was made clearly conditional on a business commitment for funding for 3 years.*

This project would not have happened without Tekes funding.

2.2 Impact on creating new technology

The project is aiming to develop new separation technologies for extracting rare sugars from process side streams and to provide several new products. To date, the project has developed a new hydrolysis/liquid chromatography process for separating l-arabinose from sugar beet side streams which is being scaled up. New products include l-rhamnose aimed at the food ingredient sector and l-fucose, a potential pharmaceutical intermediate.

3 patent applications have been filed and 2 more are in draft. The apparent publications resulting from the project are limited to theses.

The original team of university collaborators has changed as the project has progressed. The main role of the universities has been in the nutrition and health

areas where they are considered to be world class. In chemistry and chemical technology, including crystallisation, adsorption and other separation technology important here, the Finnish universities are considered average.

Main collaborations have been with Helsinki for analytical, medical biotechnology and food technology, Jyvaskyla for carbohydrate chemistry, Turku in biomedicine and Kuopio and VTT in nutrition. These were all known to Cultor before Marketing Molecules began

This project is one of the few that have an international collaboration, with Newcastle University in the UK where PhD student is due to finish next year. Not surprisingly, this has been more difficult to manage than with the local contacts.

2.3 Impact on the production of trained people

So far the project has produced 5 MSc and 1 PhD will be finished next year. One of the MSc students is now employed by the company. Cultor staff already knew the university groups involved and this has been useful in getting the best MSc students to work in the project.

All of the MSc students carried out their research in Cultor's laboratories. Although they were not given any formal industrial training they all participated in project meetings.

The 1-year funding limit from Cultor businesses has limited the project to MSc students in Finland. *A longer term funding commitment would enable longer term sub-projects more sustained contacts and more PhD students with benefits for both the University and the company.*

2.4 Project management process

There is one overall project manager responsible for reporting to Tekes and for overall budgets. The project is divided into 2 sub-projects each with a group manager.

Project groups hold regular monthly meetings with input from the MSc students University Supervisors when needed. The interaction with the university academic staff appears to be variable and reflects that Cultor research staff are the experts in the technology.

As noted above, this project has changed direction as the Cultor business focus changed. Technical objectives have also had to change and this has made it impossible to undertake longer term collaborations with university groups.

2.5 Marketing Molecules Programme Management

Here again the project was set up quickly with minimal bureaucracy. The survey of companies and their requirements beforehand was considered very positive and has resulted in the first programme that is focused on products for the chemicals industry. Other Tekes programmes that are designed to support more fundamental science are considered to be less suited to industry where frequent changes in direction might have to be made.

The company staff believed that due to the wide scope of the programme, the projects are all very different and there is little synergy. However, the Annual Seminar is again valued as an opportunity for the students to network. Tekes Seminars combining relevant projects from different Tekes programmes where there are obvious overlaps and synergies would be of more value to universities and to the companies e.g. a joint seminar between Marketing Molecules and Biotechnology.

This project has re-applied for funding every year with changes in business direction. Tekes has been very flexible on this but the Cultor researchers felt that it would be more productive if companies had to commit to 3 years funding to qualify for Tekes funding in these higher risk projects.

2.6 Impact on Finnish SET base

Due to the short term (annual) changes in the project plans, no new contacts have been made with Finnish universities beyond those groups already known to Cultor staff. Despite this the project has been very successful and important for the future. Functional foods, fine chemicals for pharmaceutical intermediates and other high value products derived from renewable resources are growth areas. The range of science and technologies involved in this project are likely to be very important in the future and the Finnish university expertise in chemistry and process technology need to be developed to support future industry.

3 Kemira Chemicals Oy – Polymeric Ferric Coagulant

3.1 Impact on creating new business

The aim of this project was to develop a new high activity iron based coagulant for water for the existing Kemwater business world-wide. Conventional systems are based on aluminium and market demand for an iron based product for water treatment applications is high. An iron product would also be an opportunity to use the copperas by product from titanium dioxide manufacture and from pickling liquors.

Demand for a new iron product was estimated to rise strongly and most of it would be exported.

This was clearly a strategic product for the Kemwater business with an established route to market and relatively low business risk.

3.2 Impact on creating new technology

If successful this project would have provided a major new product technology for Kemwater. It would extend the company's existing product range with very new technology with the potential for sustainable competitive advantage.

The requirements for high activity and stability make this a high technical risk. This was understood from the start since the company had tried before and failed to make the target product. Tekes funding was, therefore, important in enabling the company to commit more resources and work with universities to understand the chemistry.

No patents have been filed because the project was not successful in developing a product with the required activity and stability. However, the work has increased technical knowledge and experience in iron based systems in terms of synthesis, characterisation and flocculation behaviour. It has also generated new ideas for new products based on mixed iron-aluminium systems.

The project ended in March 1999 "as planned" although in our view the new ideas for iron-aluminium blends might have justified continuing work.

The competence of the two academic groups involved is judged to be high by the Kemira staff. The Laboratory of Industrial Chemistry at Abo Academi University in particular highly regarded for its expertise in catalysis, kinetics and rector modelling. It was noted from their very informative report that Abo Academi has submitted three papers for publication, while Oulu reported no publications. There seemed to have been no problems over publication rights or unreasonable delays in publication.

3.3 Impact on the production of trained people

Output from this project has been limited to one Lic. Phil and one Lic. Tech.

Kemira see the programme as a good way to train graduates on their specific topic in depth, to broaden their expertise by interacting with groups in other disciplines and/or universities and to experience an industrial research environment. However, the value to both the company and the student depends on the level of involvement of the academic supervisor and their interest in the project. The Licentiate student from Oulu university, for example, had spent most of his time in the Kemira labs and the Kemira staff thought that both the student and the project would have benefited from more direct involvement with the academic supervisor.

None of the graduates working on the project have been employed by the company although the company has recruited from elsewhere.

3.4 Project management process

There was an overall project manager and management group with representatives of the three partners, which met every 2-3 months. Technical and business objectives were well defined and adjusted as the project progressed.

Tekes were not represented at the management meetings and it might have been helpful if they had been consulted during the project to find other university groups with expertise in analysis and characterisation.

The presence of an independent challenge mechanism within the project review system might also have prompted and encouraged the project to continue with the iron-aluminium blends.

3.5 Marketing Molecules Programme Concept and Management

Water treatment is a relatively new area for the Finnish universities and Marketing Molecules has been a good opportunity to involve them in an industrially important area.

Kemira already had separate contacts with the University of Oulu and Abo Academi. This project allowed them to build a new network involving both chemistry and process technology, which has deepened their relationship with Abo Academi University significantly.

Kemira had previously contacted a leading academic in the field at Imperial College London with a view to collaboration. Despite their interest in collaborating with groups outside of Finland, Kemira staff were not aware that this was possible in the Tekes programmes.

Once they had identified their project, the programme started very quickly with less than 4 months between the application and the formal acceptance by Tekes. Informal feedback before then gave the company the confidence to start the work even earlier. The speed in setting up the programme was again noted as a very positive feature of the programme. More Tekes involvement during the project would have been welcomed.

Overall this type of Tekes funded programme is more likely to produce results since it enables industry to commit resources to higher technical risk projects that would otherwise not be funded by the company.

3.6 Impact on Finnish SET base

Overall this was a relatively small part of the programme and as such will have limited impact on the SET base. However, it has established new awareness and new contacts between universities in the water treatment area. To have a major impact would require a separate programme dedicated to water treatment.

4 Kemira Chemicals Oy – The Synthesis and Use of Chiral Chelating Agents

4.1 Impact on creating new business

This project follows an earlier Tekes funded project that started in 1995 and developed new greener chelating agents for pulp and paper applications (Code name Rake 12). These products are now in development in Kemira Chemicals (KC).

The original aims of the current project were to develop understanding of the relationships between chirality, biodegradability and chelating ability to support development of new products for two different businesses, KC and Kemira Agro (KA), both aimed at extending existing businesses.

New profitable business for KC and KA is seen to be generated from these types of products.

For KC the project is an accepted part of business plans to develop their own chelating agents to complement their existing beaching package for pulp and paper, detergents and cleaning applications. However, knowledge of competitor technology in detergent and cleaning markets appears to be limited.

KC business units contribute only minority funding of 20% compared to Kemira Corporate funding (45%) and Tekes (30%). The funding reflects both the high risks associated with this project and the short term nature of the business units’ R&D. Without Tekes funding, the project would not have started. Without clearer involvement of the business units, the project might not generate business value.

For KA it is now clear that the high costs of introducing new niche products into a small and fragmented market against established competitors makes the project unattractive and KA are now only keeping a watching brief. An earlier analysis of the business opportunity would have been helpful here.

4.2 Impact on creating new technology

As stated above, the project is aimed at understanding the relationships between chirality, biodegradability and chelating ability to support development of new more efficient, low nitrogen and biodegradable chelating agents. The project is not explicitly aimed at new products. It is very much basic research and appears also to be supporting other product developments within KC.

This could explain the low level of business unit funding, since in most companies they usually prefer to fund product developments rather than development of understanding.

Note that KC already have a new product (Rake 12) for which commercialisation is already underway according to the KC interim report.

This product and even more advantaged products developed as a result of the understanding gained in this project would bring competitive advantage in a strategic area for Finnish industry.

There are 5 collaborating academic groups, making this one of the most complex projects in the Marketing Molecules programme. Of these the enzyme group at Turku (where the academic partner seems to very isolated in terms of biocatalysis/biosynthesis research) and the inorganic group at Helsinki are considered to be very competent and comparable with the best in the world. The agriculture group at Helsinki and the environmental group at Kuopio were relatively new to the field of chelating agents when they joined the project. The organic group at Helsinki has not made much impact on the project.

Overall there appears to be a lack of commitment from some of the university groups to the project. Here again, the MSc students spend their time in the KC labs. Their university supervisors do not get involved in the work or support it by setting up their own related projects, preferring to pursue their own research interests. There seemed to be little interaction between the University groups involved in the project.

4.3 Impact on the production of trained people

A total of 9 MSc students are involved in the programme, 4 of whom are working in KC labs. It is expected that eventually there will be 3 or 4 PhDs produced.

While KC see the project is a good way of giving students experience of industrial research, one problem with such a large number of MScs is that they have to be trained to use relevant techniques and this is inefficient. KC would prefer to employ post-docs or more PhDs to improve continuity and efficiency. Those students not based in the KC labs had limited opportunities to work at the company. Distance was seen to be a problem in some cases. Generally however, it was believed that their regular attendance at project meetings helped to make the students feel part of the project team.

KC gets to see a lot of potential recruits and to promote itself in the universities.

None of the graduates have been employed by the company.

4.4 Project management process

Clarity of roles and responsibility is critical in a project as complex as this one. In this case, there is a nominated project manager but it is not clear how much his line manager is involved in running the project. The academic perception was that the project did not have a dedicated project manager.

Although the objectives might have been clear at the start to the KC staff, the KA objectives were not clear and their role is now a watching brief looking for spin-offs.

Despite frequent project meetings and lots of results KC staff are not happy with reporting from the university groups. However, the problem is probably in the KC project management. Project plans and targets were not clear in the presentation and this could be a contributing factor in the reporting. Even though there has been a high proportion of basic research and new ideas, it should be possible to agree deliverables, milestones etc with KC and university groups in a suitable format.

Overall this project would benefit from more clearly accountable project manager and more systematic project management.

4.5 Marketing Molecules Programme Concept and Management

The programme was considered to be a very good mechanism for facilitating industry/academic collaboration and this project has increased and extended the links between KC and Finnish university groups.

Here the speed of setting up the new programme had caused problems. The requirement for higher risk projects and more university involvement was different to other Tekes programmes where KC had funded a higher proportion and had lower university involvement. Specifying detailed work programmes and contacting universities to discuss and agree their roles and objectives had been difficult. In some cases university groups claimed not to have been aware that they were part of the final proposal.

It would be helpful here for Tekes to require all partners to sign off on the proposal before accepting it.

Flexibility in allocating funds to university groups during the project was another issue raised by KC, arguing that annual budgeting within a 4 year project was too in-flexible and prevented them changing direction as soon as it was required..

On balance, however, it was clear that without this programme the longer term R&D would not get business funding. The industry leadership was important and could be extended to other Tekes fundamental research programmes.

4.6 Impact on Finnish SET base

Although it has not yet achieved technical success this project has brought several academic research groups together for the first time to focus on a strategic area for Finland. With the exception of the enzyme group who clearly need more collaborations within Finland there is little evidence that this particular project has really engaged their interest or stimulated collaboration between academic groups.

5 Kemira Metalkat Oy – New Exhaust Catalysts

5.1 Impact on creating new business

Kemira Metalkat (KM) is a small division of Kemira and in many ways operates as a small company within Kemira. The project is aimed at developing new technology for the next generation exhaust catalysts for gasoline engine cars to meet increasingly tight emission standards. New products are essential for the business. Success in this project would defend and grow KM's existing business against strong competition. New products could contribute mostly exports as well as create up to 20 new jobs in KM.

This project is a key part of KM's business strategy to attract new customers and grow the business. Business risk is high since this is a very competitive market with much bigger players. However, KM is working with customers to develop their products. This is an important way of reducing their business and technical risks.

Within the MM programme, KM appear to be the only company working closely with their customers. This is something for the other companies to seriously consider in future programmes as a way of reducing costs, risks and time to market with new products.

Tekes funding is an important element in reducing financial risk for KM considering its position within the Kemira Group.

5.2 Impact on creating new technology

The aim is to develop new products using new processes for adding precious metals and coating the exhaust catalyst supports to give higher thermal stability, lower light off temperatures and access the small engine market. New technology developed here would bring KM up to the level of their competitor's products. KM would become competitive in a fast changing market.

Technical risks are high since there are strong competitors and changing legislation requiring increasingly demanding performance. Although technical targets have not yet been met, the project is generating useful know how and potentially new directions for next generation exhaust catalysts. In particular the NOPS technology could reduce manufacturing costs and access new customers.

As a 'small company' KM collaborates with academic groups to access expertise from different disciplines. Here, Oulu University (Chemistry) specialises in the preparation of raw materials and analysis while Tampere University of Technology (Physics) specialise in surface science and characterisation of the catalysts. Most of the modern characterisation techniques are available in the university groups or in KM's labs. However, the academic experts were not experienced in working with real catalyst systems and KM staff have provided the training here.

Here again, KM felt that the project would have benefited from higher commitment of the academic supervisors. In some sub-projects "KM have started the ball rolling in terms of new ideas and directions for research but the academics have not kept it rolling". They would like to see more direct involvement of the Professors with the project, their best students allocated to applied research rather than academic projects and their setting up their own research projects on related topics. This would make a big difference. KM see this as a particular problem for smaller companies and is now discussing collaboration with Chalmers University in Sweden where they feel they would have a real and more productive collaboration.

One of the (younger) academic partners had little previous experience of working with industry and was initially concerned at the applied nature of the project. The project has been an academic success however with some high quality publications as well as usefully engaging the students in “real world” projects. He now appreciated the benefits of industrial collaboration and intends to have a balance between pure and applied research in the future.

There is added benefit from such programmes to younger academic staff near the beginning of their academic careers

Note that in this project the 2 collaborating universities are funded directly via Tekes rather than by the company.

5.3 Impact on the production of trained people

The project has generated 4 MScs, is expected to generate 2 PhDs and one of the graduates has been subsequently employed by the company.

Most of these have experienced industrial research in the KM labs and been trained in application of various characterisation techniques to real catalysts. The students are very appreciative of their industrial placements and felt part of the project team.

During the project the technical direction has changed several times for technical reasons as the work has progressed. While this is an accepted part of industrial R&D, it can cause problems for PhD students who require continuity over a longer term. A combination of MSc and PhD students is the best balance, provided the PhD students have the appropriate expertise, some business orientation and can guide the MSc students.

5.4 Project management process

The project is well managed with clear targets and feedback loops from the external customers. All three members of the team have clear roles and project meetings to review overall progress three times a year. KM would like to see more contact between Oulu and Tampere university groups outside these meetings on issues related to this project.

Although the project has not met its technical objectives it is close to achieving customer approval for Euro 3 and Euro 4 with their technology.

5.5 Marketing Molecules Programme Concept and Management

KM see Marketing Molecules as similar to other Tekes programmes in terms of industrial training.

They see a difference in the higher risk objectives and greater academic involvement than other Tekes programmes. They definitely need access to academia to extend their R&D capability but from their position as a ‘small company’, they have difficulty influencing their academic partners to work on business targets. They are also under pressure to perform from their management and cannot afford to fund research that does not help them achieve their targets. Within the programme KM are regarded as a large company and subject to the same limits on funding, 39% maximum from Tekes, compared to the 50% limit for small companies. This is a problem common to other European countries and is a product of the ‘silo’ structures favoured by business management which might make managing the business portfolio easier but can isolate businesses and lose potential technical synergies across business divisions.

KM’s involvement in this programme has improved their know how in analytical and characterisation techniques.

Within the programme there is little technical overlap between this and the other projects. KM do not think this is a problem since the main benefit is for the young researchers to network and find out about R&D in Finnish industry.

5.6 Impact on Finnish SET base

The programme has fostered new collaborations between Oulu and Tampere Universities with joint publications and their own 100% funded Tekes projects. It has encouraged a t least one young academic to seek further collaborations with industry. It has also produced trained people with experience of industrial R&D.

6 Lignotech Finland Oy – Marketing Lignins for a Cleaner Environment

There was no academic input to this evaluation either in the form of written reports or oral interviews.

6.1 Impact on creating new business

This project was aimed at enlarging the raw material base for Lignotech Finland (LTFI), find new technology to isolate and fractionate lignins, find new application areas for these materials while reducing the environmental impact of current processes.

Although no estimates of business value were given, the objectives were very ambitious and clearly represent an opportunity to generate major new business for LTFI and other parts of the Borregaard Group.

The original plans were based around introducing more effective and economical ultrafiltration technology for lignin production, recovering other materials from wastewater for use in products and product developments for drilling fluids and construction materials. All of these were in the mainstream of LTFI's existing business interests and fairly low business risks. However, the world economic downturn in 1998, reduced business profitability and the availability of other raw materials have reduced the business interest in the project which ended after 1 year.

6.2 Impact on creating new technology

The aim was to develop both process and product technology that is already used elsewhere but which would have been new to LTFI. The research was therefore low to medium technical risk. However, since the bulk of the R&D for Lignotech is done in Norway and the USA, with only a very small technical support group at LTFI this was relatively high risk for LTFI. No patents were filed although the work generated new know how and information on ultrafiltration, structure/property relationships which are available within the company for process and product development.

Both of the academic groups collaborating with LFTI are highly regarded by the company.

6.3 Impact on the production of trained people

No degrees have been awarded as a result of the project and no jobs have been created due to the economic downturn. However, several new techniques have been developed and expertise transferred between the partners.

6.4 Project management process

Despite the very broad scope of the project, overall it appears to have been well managed with clear business and technical objectives and regular project meetings and reports. Collaboration between the partners was constructive and productive.

In addition to LTFI, two other businesses were involved, Metsa Serla and Scandinavian Colloids. All three were represented in the project management group which made it top heavy and changing the individuals involved during the project also made it more difficult to manage.

More use could have been made of statistical design of experiments to improve planning of the extensive test programme.

It might have been simpler to manage and more productive to split the project into smaller more focused projects.

6.5 Marketing Molecules Programme Management

This project would not have started without the Tekes MM programme. The LTFI lab is effectively a plant support and quality control lab. Most of the R&D is done in Lignotech labs outside Finland and under normal circumstances LTFI would not start this type of research.

6.6 Impact on Finnish SET base

Overall this project has had minimal impact on the Finnish SET base.

However, in view of the importance of the paper and pulp industry to the Finnish industrial base and the potential growth in natural lignin based products, the chemistry and applications of lignin should be a strategic area for future R&D.

7 Map Medical Technologies Oy – The Commercialisation of Neuroreceptor Affine Radiopharmaceuticals

7.1 Impact on creating new business

MAP Medical Technologies is one of the few small companies, with 25 employees, in the MM programme. Income from existing business, derived in part from previous Tekes projects, enabled MAP to fund this project which is aimed at developing their range of radio-labelled neuroreceptors for diagnosing various diseases and disorders as well as developing new ligands to expand the range of applications.

Turnover from these new products/applications is expected to grow rapidly by 2003 with the bulk being export business to other European countries. The project is part of the MAP business plan, which includes provision for the necessary marketing network.

Competition includes several major players including Nycomed-Amersham, Mallinkrodt and DuPont. MAP's strategy is not to compete in conventional radiopharmaceuticals but to discover and develop exclusive products using expertise in the universities. The business risks are moderately high and well understood by MAP which has worked hard to develop a high profile through international collaborations and scientific publications.

Tekes funding is an important element in enabling the project, especially for this small company, in terms of reducing risk and enabling the company to attract and manage university partners.

7.2 Impact on creating new technology

Outputs from the research will be a new range of products for MAP together with the synthetic routes for production. There is also spin-off potential for molecules that block receptors as anti-cancer drugs. The new molecules and their applications will be good candidates for patents and the basis for MAP's plan to establish an exclusive position in the market. Patents have already been filed on process technology and one application, and two others are expected to follow on the molecules themselves.

Technical risk is relatively low since several target molecules have been identified and MAP and the university partners have the necessary skills and facilities to develop them.

The university partners are vital to this project and considered by MAP to be highly competent. Kuopio Chemistry Department is responsible for synthesis of new ligands and Kuopio University Hospital and Oulu University Hospital perform the clinical trials. It is worth noting that this project has benefited from a previous initiative to develop the appropriate synthetic chemistry expertise in the Departments of Chemistry and Pharmaceutical Chemistry at Kuopio. Both MAP and the Kuopio researchers are collaborating with the leading research groups in Europe through other programmes including Eureka. This project benefits from these links both technically and in terms of developing MAP's international profile. Overall this is a good example of how a small company can leverage the university base at home and abroad.

The project has made a partial contribution to a few publications.

7.3 Impact on the production of trained people

The project has already contributed to 1 PhD thesis and there are currently 2 PhD students working on the project (1 at MAP and1at Kuopio) and 1 MSc at Kuopio.

Although MAP has not employed anyone specifically for this project it has allowed them to employ an MSc chemist who is now working for a PhD at MAP. It has also helped MAP employ a new pharmacist to manage the clinical trials and documentation. If successful MAP is likely to employ a further 2 people in production.

The MM programme has helped in focusing the academic groups on MAP's objectives. Having the PhD student in the company is good value for MAP compared to the cost of hiring a qualified MSc or PhD. Universities also benefit in terms of attracting further funding from their own Universities.

7.4 Project management process

MAP's President is the project manager with one of the academics occasionally acting as secretary. Business and technical objectives are very clear and were written down and given to all of the partners at the start. Judging by the written reports from the university groups, the objectives appear to be understood by all the partners. However, as noted in other MM projects, the academic partners in this project focus on the scientific part of the project and do not show any real interest in the business objectives or the work done at MAP.

The technical programme is regularly reviewed and the goals refocused and re-emphasised each time. Minutes are distributed to all partners.

Technical progress appears to be good with clinical trials progressing towards their objective of gaining authorisation for the first target molecules in approximately 3 years. At the moment MAP can only sell products at the request of Hospitals. When the products are authorised, MAP will be literally marketing molecules. Other new targets look promising in in-vitro trials.

7.5 Marketing Molecules Programme Concept and Management

The MM programme has enabled MAP to extend its R&D beyond simple clinical trials

into developing new products with increased leverage from university collaboration.. Involvement of Tekes has given MAP credibility in attracting academic partners and funding via the company has increased its ability to direct and manage the academic components of the project.

Like other companies in the programme, MAP reported that the programme was set up quickly with only 3 months between MAP's proposal and a decision from Tekes. Even before this Tekes had notified successful applicants. *This rapid response is particularly important for small companies that have clear objectives and need to minimise time to market for new products.*

In the overall MM programme, this project has little in common with the other projects and therefore did not gain much from the other participants.

MAP were not aware that they could involve universities outside Finland and were fully funding a project at the University of Karolinas, Stockholm.

7.6 Impact on Finnish SET base

This project has contributed to strengthening the research groups in Oulu and Kuopio in an important growth area. Involvement in this Tekes funded project has enabled Oulu to attract further funding for new equipment. At Kuopio, both the University and the University Hospital have both committed significant additional funds to support the project and grow the University's expertise.

MAP was surprised that there were so few small companies in the programme and asked why the chemists were not doing more to start-up new companies in for example surface chemistry, biotech and pharmaceuticals?

Since these smaller high technology companies are likely to contribute to real growth in the SET base and in employment this question is worth following up.

8 Neste Chemicals Oy – Modelling of Functional Oligomers and Polymers

8.1 Impact on creating new business

This project is not aimed directly at any specific new business opportunity but is intended to introduce the modelling capability into the Neste business groups around the world and to enable the development of new products in resins, polyesters, polyolesters and paper chemicals.

Neste Chemicals' business strategy includes new business development. This project is led from the new business development group at Porvoo and involves 1 or 2 people from each of the individual business units, all of which are linked in a global network. In this respect it is closely linked to business plans and is structured well for delivering.

Project is generating a series of new products of which already some are in the pipeline.

Neste senior management remain sceptical of the value of this project. Technical staff are however, convinced and without Tekes funding the project would probably not have started. *The attitude of senior management is probably due to the difficulty in analysing the cost/benefit of modelling. This is common in the industry and only the most technically advanced chemical companies exploit the potential of modelling.*

The academic partners had little appreciation of the business objectives of the project and would have preferred clearer guidance from the company on the perceived business and technical objectives at project start-up.

8.2 Impact on creating new technology

The impact of this project is likely to be in increasing R&D efficiency and reducing costs and time to market for new products and processes. Specific goals are to support and speed up lab experiments, systemise experiments, analyse results and understand phenomena.

The focus is on finding improvements to existing technologies to generate new products with sustainable competitive advantage. As noted above, the project has already delivered one new product, which has been patented with 4 more potential new products in development and patented. Overall the project has been very productive in terms of patents and publications.

Academic partners include VTT's modelling group and the University of Jyväskylä. Both are very highly regarded by Neste. The VTT group is considered to be world class and gives Neste the opportunity to access the MSI Polymer Consortium, which includes some of Neste's competitors, and evaluate and use the best available modelling software. The supramolecular chemistry group at Jyväskylä is considered to be at a good European level in a rapidly growing field. This group is also well networked into some of the best supramolecular chemistry groups around the world including Jean Marie Lehn, the most well known. Their role is to synthesis target molecules to support the modelling and product development and although the chemistry involved is not particularly novel, their contribution has been very productive in terms of patents.

8.3 Impact on the production of trained people

This project is having a significant impact on post-graduate training. A total of 10 people are involved outside Neste.

As a result of MM, 2 PhDs, 3 Lic Phils and 5 MSc degrees are expected by the end of 2000. Some of these have been located at Neste facilities where they have access to specialised equipment including larger scale reactors for synthesis of model molecules. Close co-operation between graduates and Neste people has given the graduates good experience in industrial research. The academic partners were satisfied with the level of student-industry contact although they believe that their courses should include management training. *Students who are not based on the company premises can gain valuable experience and feel more closely involved in the project through quite short industrial placements.*

Neste staff have also spent time at VTT. Training the Neste business people in the potential of modelling has been equally or more important.

8.4 Project management process

Neste Chemicals provides the overall project management, co-ordinating the activities of the 4 Neste business units around the world and 2 academic partners. There are 4 or 5 large meetings a year plus regular smaller meetings to manage individual business units sub-projects. Each of which has agreed goals and regular reports, which are distributed to the relevant business units. The academic partners were pleased with the project management.

As noted above the project is achieving its objectives. This is a very good example of how to manage a complex project and a complex subject.

In contrast to some other academic groups in the MM programme, the group at the University of Jyväskylä appears to be highly committed to this project and have been recognised as inventors on several patents. Neste staff felt that the degree of commitment of the academic partners depended on how well the company staff knew them before the project.

Neste already knew the Jyväskylä group.

We also noted that inventors in Finland are rewarded on first filing patents, on granting of the patent and receive a share in the profits from their inventions. This could be a powerful motivator in this and other projects.

8.5 Marketing Molecules Programme Concept and Management

Neste staff felt that the MM programme was an improvement on earlier Tekes programmes. It had allowed longer term projects and generated more commitment form both industry and academia partners. It had also enabled more aggressive projects.

Without MM, we doubt whether Neste management would have supported this project.

There was some confusion about how the 100% Tekes funded projects in universities and the 30% Tekes funded 'product development' projects fitted into the MM programme.

Neste staff understood that the MM programme would include all of these types of projects. There was also a feeling where academic groups have100% Tekes funded projects, the extent to which they use these to support the company projects depends on how well the company knows and can influence the academic.

8.6 Impact on Finnish SET base

As noted above, this project is having a real impact on the SET base within Neste and in the academic partners with over 10 people involved outside Neste.

Modelling is an important technology that has applications across chemicals and most other sectors of industry that involve chemistry or materials science.

9/10 Neste Chemicals Oy – Aldehyde Activation & New Oxidation Technologies

9/10.1 Impact on creating new business

The original aims of these 2 projects were to develop new routes including oxidation processes for converting aldehydes, alkanes and alkenes to higher value products. Neste Corporate Research set up the project after one of the academic partners had taken the initiative of bringing together a research team and making a proposal for the projects to Neste. It was exploratory in nature with no specific target products.

Following the merger of Neste and IVO, Neste Corporate R&D has been restructured and the long term projects, including these 2 projects, became part of the R&D in the business units in Neste Chemicals in January 1999. The targets for both have been refocused with reduced resources.

The aims remain to develop new platforms for generating new business but the market offering, the process technology for manufacturing the products and the costs and returns are not yet clear. However, Neste has an internal target of generating 50% of its turnover through new products in 5 years and these projects could contribute to that target.

There is no plan for commercialisation yet since the projects are in the feasibility stage.

The commercial risk is high. Neste set aside 15-30% of their R&D for longer term projects and these projects are part of that allocation although they are still higher risk than is normally acceptable to the businesses. None of the business units were involved in setting up these projects and without Tekes funding they would not have started.

9/10.2 Impact on creating new technology

The research is aimed at new products and process technologies for Neste although most of the products are likely to be known to the market. Some of the approaches are improvements on existing technology and some completely new concepts are under investigation. All of the work is aimed at creating sustainable competitive advantage and some patents have been filed.

As with the commercial risk, technical risk is high, since both the products and processes are yet to be defined.

The expertise of the academic partners is variable. Some are very familiar with industry but others have little experience of collaborating on applied projects. Previous consultancy links with one of the academic partners facilitated the initial project planning discussions. All of the original academic partners were university chemistry departments with no chemical engineers involved. Some are judged by Neste to be world class scientifically and good collaborators. Others need much more experience of working with industry to make it a worthwhile partnership and this will take time, estimated at 5 years by Neste. This is an important role for the Tekes programme.

A major limitation of these projects is the absence of academic chemical engineers working alongside the chemists. The Neste businesses usually set up their R&D projects with a more process technology oriented mix of chemists and chemical engineers.

A good number of often high quality publications have resulted from the project.

9/10.3 Impact on the production of trained people

Because of the reduction in resources allocated to the projects, some of the academic partners have left the programme. The original plan for 9 PhD students has been reduced to 7 with 1 student switching to Neste Foundation funding (with financial disadvantage to both the student and the University) and another having to leave the University before completion of their PhD. *Premature termination of PhD projects can be very upsetting to students and to their supervisors and can discourage academics from future collaboration with industry.*

In general, involving PhD students in such a speculative project has caused problems when the project has changed direction. PhDs need stability over at least 3 years and Neste would prefer post-doctoral workers to allow faster changes in direction in future. Here again Neste feel that Tekes funding is necessary to justify the slower rate of progress.

Neste has not provided any in-house training for the students and only one has spent a short period in the company to scale up the chemistry using Neste's larger equipment. However, Neste consider the projects to have been a useful way to meet the students although none have been employed. Students were rather unhappy at their lack of industrial experience in the project. There was also a feeling among the academic partners that the projects lacked a clear project plan and that this had led to a overlap of research activities during the project. *An "incubation period" for academics at the beginning of the project would help to familiarise students and staff with the company, and ensure a proper appreciation of the project goals and assignment of tasks.*

The main benefit of the MM programme over others is the industry focus, which is important in training the academic groups in industrial R&D methods. For example, many of the students were unfamiliar with the concept of mass balance, a key issue for process R&D but not important for the science.

9/10.4 Project management process

The project manager and the technical objectives have changed following the restructuring. However, the partners meet every 2 months and review progress to their new objectives. The quality of reporting has improved. Academics found the changes in the company staff during the project disconcerting and would have liked representation from the marketing department.

9/10.5 Marketing Molecules Programme Concept and Management

Once again Tekes is seen as a good user-friendly partner in this programme.

Neste believe that collaboration between industry and academia is needed and see the MM programme as being a good way to increase this collaboration. The longer term nature of the R&D and the requirement to involve more academic partners, however, places a larger burden on the company than other Tekes funded industrial programmes. Although the Tekes funding is lower in the industrial projects, the Neste business unit felt that it had more control over objectives and academic partners.

This is a reflection of the fact that these MM projects were not business and market led from the start. It is a criticism of Neste and not a criticism of the MM programme.

To avoid these problems in future, companies, especially the larger companies with corporate research departments, should be required to involve business units in the early stages of project planning.

9/10.6 Impact on Finnish SET base

Despite the changes in the projects, they have increased the extent, if not the quality, of collaboration between Neste and the university groups. The work has also stimulated some of the academic groups to publish together and encouraged bio-catalysis research in bulk chemicals which must be a strategic area for the future in terms of sustainable production of chemicals.

11/12 Fortum Oil & Gas Oy – The Effect of Molecular Structure on the End Product Properties - Mora Project and Diesel Ethers

These 2 projects were reviewed together with the Fortum staff responsible for both. Most of the comments below are based on the Fortum management of both projects along with the independent views of some of the academic partners.

11/12.1 Impact on creating new business

The Mora project aimed to develop understanding between the structure of lube oils and their performance. Lubricant base oils are a key part of Fortum's business with a turnover of approximately 600 million FIM/a and high growth (15% p/a) for example in poly-alpha olefin synthetic base oils. A second commercial plant is planned in Belgium.

This project is basic research to develop new tools to support business projects and is carried out in the Corporate Research lab. Although no value was assigned, it was planned with the business and there are business staff in the project team. The project was approved by Business Division Management Board and therefore is recognised at a high level. Non technical senior management have difficulty linking the science with potential business outcomes. Here again because of the fundamental nature of the research and the difficulty of assigning a commercial value, it would not have started without Tekes funding.

The project carries a high commercial risk but involving the business in this way is a very effective way of reducing risk and having the results used effectively by the business in current and new product development projects.

The Diesel ethers project was aimed at evaluating the potential of oxygenates as blending components in diesel fuel to reduce particulate emissions without increasing other emissions including NOx. The project was a good fit with Fortum's strategy for developing environmentally sound transport fuels for export and in line with the aims of the MM programme in that it was targeted at specific products and the process technology to manufacture them. The concept was a good one but with increasing concerns over the environmental impact over oxygenates (MTBE) on groundwater and the unfavourable economics of potential manufacturing processes, the project was terminated after 2 years.

The academics were generally well informed about the business objectives had been involved in the initial project planning. Some of the academic partners also had significant relevant industrial experience.

11/12.2 Impact on creating new technology

The Mora project will develop new molecular modelling tools as well as improving the company's expertise in synthesis and analysis of complex hydrocarbon mixtures. New products and processes are likely to be developed as a result in separate business projects.

Six Finnish academic groups are involved in the project together with a modelling group at Brigham Young University in the USA. All of the academic groups involved are assigned well defined roles in synthesis, analysis, modelling. The academic groups were clear about the technical objectives and saw their role as a mixture of pure and applied research.

Three university groups were partners in the diesel ethers project working on catalyst development, reaction kinetics and process evaluation. These were part of a well balanced team with Neste Oil Research, Engine Lab, Catalysis Research and Neste Engineering. Even though the project has stopped, it has generated useful information on oxygenated fuels for use in future projects.

The Mora project was proving to be very productive in terms of, mostly specialised publications as well as higher degrees. The diesel ethers project was somewhat less productive.

Inputs from the university groups are variable depending on their expertise. Those working in their specialist field are comparable to world class university groups elsewhere. They are also more involved in the project. Outside their specialist areas the academic groups need a lot of time to develop their skills in the new areas and in the meantime make less of a contribution. This is not surprising and reinforces the need for collaborative projects that run for several years.

One important characteristic of the Finnish universities that effects their ability to contribute to industrial projects is that the university professors typically have to cover several areas of research. As a result, their technical input to their students' projects is sometimes limited and the company has to provide the technical guidance. This contrasts with other countries where the professors specialise more narrowly and have more technical depth. Co-operation between the university groups could be better with more collaboration rather than competition but this is common to most countries.

11/12.3 Impact on the production of trained people

Mora is a big project and is having a big impact on training with 9 post-graduate students working on the project with 2 post-docs, 7 professors and the VTT modelling group. Some of the students are working in Fortum's labs and supervised by Fortum staff . Company researchers have also spent time in the universities setting up specialised analytical equipment. *The role of the company here is very important in developing the expertise in the academic groups.*

Diesel ethers had a further 5 postgraduate students and 3 professors involved, one of whom used to work for Neste Oil and had the original idea for the project. This mobility of staff from companies to universities is potentially a very powerful way of changing the culture in the universities to become more aligned to industry. One student whose project work was cut short by the project termination has now switched to a related project in the same laboratory.

11/12.4 Project management process

Both projects have a dedicated project Fortum manager using the Fortum Oil model for project management which makes clear the objectives, roles, responsibilities and reporting schedule. *Technical reports are very clear and professional, the best we have seen in the MM programme and a model for other projects.*

The Fortum Management Board approves the plans every year which, as noted earlier, is a good way of keeping the business involved. Review meetings are held regularly with full project meetings every 3 months and sub-groups meting more frequently. The full project meetings bring everyone together 8 professors and all of the students and the project's Fortum staff. Once a year Tekes is invited to participate. Reporting by the universities has improved through this process.

The academic perception of the project management was however rather critical. On the Mora project there was an inconsistency in the level of understanding of the project goals and partner tasks and there were requests for tightening up in both the project start-up procedure (assignment of tasks etc) and the project management. On the diesel ethers project it was felt that the company had not committed enough of their own manpower and that the staff made available were too young and inexperienced. Stricter project management was again requested. It was also believed that a lack of flexibility in the company's attitude to the project led it to be unnecessarily stopped early.

11/12.5 Marketing Molecules Programme Concept and Management

In general the MM programme has provided an opportunity for Fortum to maintain a long and fruitful relationship with several university groups. As noted earlier, there could be more collaboration between the university groups even when they work in different fields such as chemistry and chemical engineering. *This multidisciplinary approach is very important. It is accepted and practised in industry. It is also increasingly important in academic research and universities should be encouraged to collaborate wherever possible in all of the Tekes programmes.*

The projects were set up very quickly with only 2 months between the launch and deadline for proposals. Fortum, were aware that the launch was coming but would have benefited from more time to discuss the projects with more university groups. As a result, they had to rely on their existing university contacts.

Fortum staff were concerned about confidentiality large projects with many individuals involved from the universities such as in the MM programme. They prefer to carry out specific product or process development projects in smaller projects with maybe one university and more perceived control over confidentiality.

They also would have preferred to work with other companies in the supply chain as they did in the 'Mobile' project to develop transportation systems with lower emissions and higher fuel economy. This involved companies from other sectors who were not competitors including engine and truck manufacturers and bus and airline operators. Each had specific expertise and common targets. A similar approach in MM would have been welcome.

This supply chain structure is typical of how the chemical industry operates and is recommended for future Tekes programmes.

11/12.6 Impact on Finnish SET base

These projects have already had a significant impact on the SET base in terms of the large number of professors and students involved and exposed to new areas of industrial importance. It is also developing expertise in several important areas including chemometrics, molecular modelling and reactor modelling. These are all applicable to other areas of the oil, chemicals and other process industries.

13 Optatech Oy – High Purity Speciality Chemicals for the Polymer Industry

13.1 Impact on creating new business

Optatech is small company operating as a virtual enterprise. It has no labs and relies on universities and other organisations for R&D. This project is aimed at developing speciality co-monomers and polymerisation catalyst components for sale to speciality and bulk polymers manufacturers. This would generate completely new business for Optatech and if successful would represent a substantial business opportunity.

The plan for commercialisation involves finding partners with facilities for scale up, process demonstration and customer trials at large scale followed by licensing the technology. Rapid development, short time to market and early income generation are key to the success of this project. The lack of in-house resources for scale up and demonstration make this a very high risk project. This is compounded by Optatech's view that Finland has limited expertise in polymer science.

13.2 Impact on creating new technology

The project is aimed at several potential new products and in this sense is a good fit with the MM programme. However, the company has had major problems collaborating with Finnish university groups and with VTT. There are some important lessons here for the SET base and for the way small companies interact with it.

Optatech has several ideas for new cyclic olefin co-monomers (COCs) that they acquired from Neste chemicals. These might have advantages over existing co-monomers in injection moulding applications and Optatech is developing a patent position but is competing with major chemical companies including Hoecsht. This type of development requires considerable expertise and facilities in polymer technology. Optatech has been collaborating with VTT but they have been unable to scale up the co-monomers for larger scale tests. Optatech has terminated the work with VTT.

The shortage of world class polymer technology expertise in Finland is a major problem for this type of project. Although there are many polymer processing companies there is little teaching or research on applied polymer science apart from the metallocene catalysed polymerisation research with Borealis (Project 1 in the MM programme). As a result, Optatech has sought expertise outside Finland and is now working with New Jersey Institute of Technology (USA) and CNR (Milan) on polymer science and the University of Rome for catalysts for monomer synthesis.

Finding research groups outside Finland is expensive and time consuming, especially for small companies. Here again a directory of university skills and expertise in key technical areas would be of value to the smaller companies.

A similar problem has been experienced in Optatech's liquid crystal blend project where the specialised nmr equipment needed for detailed characterisation of polymer structure was not available in Finland. The company is critical of the lack of collaboration between university groups in catalysis and polymer science, for example, where it is key to developing understanding of the relationships between polymer structure and properties as well as generating new ideas.

The other main aim of the project is to develop a new and lower cost route for production of 2,6 dimethyl naphthalene (DMN), the key monomer in production of polyethylenenaphthalate (PEN) a packaging polymer with potential for high growth if the production costs can be reduced. BP Amoco dominates the business but Optatech has patents on a synthetic route with fewer steps than the BPA technology. Costings have been done but there is no data available on the BPA route for comparison. As with the COCs, the company is competing with a very large and established player that manufactures both DMN and PEN. Optatech has 2 companies interested in the technology but here again progress in demonstrating the technology has been slow because of the lack of in-house resources.

VTT had been clear on the business objectives at project start-up although they saw them as being broad for a single project. They had been concerned at the frequency at which the project plans had changed.

13.3 Impact on the production of trained people

Due to the changes during this project, most of the work is now being performed outside Finland. The only university work is with a group of chemical engineering students who have done the process flowsheeting and costings for the DMN technology as part of their undergraduate project.

In terms of training, Optatech would value chemical engineers with some knowledge of organic chemistry and polymer science. Graduates with these multidisciplinary skills could make a bigger contribution to smaller companies than current graduates who have little knowledge of industrial R&D, marketing or where the value is created in technology development.

Based on Optatech's experiences, the culture of the Finnish university groups and in VTT is not supportive of smaller companies with applied projects that need to be completed quickly. The university professors who are most productive are those with some industry experience and some knowledge of commercial R&D. Their students also benefit through being more employable and attractive to companies, especially the small ones.

Tekes should consider short courses to familiarise academics with commercial technology development issues as part of their industry/academic collaborative programmes to develop a next generation of multidisciplinary risk takers.

13.4 Project management process

VTT had had frequent technical meetings with the company which at times had been as often as weekly.

13.5 Marketing Molecules Programme Concept and Management

Tekes funding and the MM programme are very important in enabling small companies like Optatech to take on these high risk projects.

The MM programme overall is also an opportunity for the small companies involved to network with potential customers, the larger companies, and identify opportunities for future business.

13.6 Impact on Finnish SET base

This project has had minimal impact on the Finnish SET base, although some of the lessons learned in terms of gaps in expertise, equipment and the need for a change of culture could be influential in increasing the value of the SET base for small companies.

14 Raisio Chemicals – Modification of Starch

14.1 Impact on creating new business

This project is aimed at new starch based products for a range of applications in paper manufacturing.

Starch project has relatively high business potential with several new products and 10 new jobs created in the company if all of the products go into production.

The project is very closely aligned to Raisio Chemicals Sizing and Starch business strategy, and plans for commercialisation are accepted by the business. Several products are already in the development stage with pilot trials moving into mill trials.

Commercial risks are high for several reasons. First, it takes 2-3 years to go through mill trials and get feedback from the ultimate customers in the printing houses. Global marketing and product launch costs are very high and competition is intense with the potential for large changes in the market place through competitors' new technology.

However, the risks are well understood and managed.

14.2 Impact on creating new technology

The project is aimed at both new processes and new products. New synthetic methods for modifying starch to extend the existing product range and produce new, environmentally advantaged products are likely to provide sustainable competitive advantage provided they deliver the customer benefits in their applications. So far 7 patents have been filed.

These include a new process for polymer modified starch for paper sizing that has advantages in terms of surface properties, machine cleanliness, printability and retention of tear strength. This is a completely new product and to be successful it must have the same benefits at commercial scale. Raisio is working with one major customer on mill trials. *This is good practice in product development and one of the few projects in the MM programme where customers are involved in product development.*

Progress has also been very good in developing analytical methods for characterising oxidised starches. VTT Biotechnology and Food Research (VTT Bel) have developed a new method involving splitting the oxidised starch with enzymes followed by gel chromatography and nmr on the fragments. This has given important new insights into the relationship between oxidation chemistry, product structure and performance as a coating starch, which will be valuable in product development and scale up.

The academic partners in this project have performed very well and are highly regarded by Raisio. VTT Bel work in enzyme modification and biocatalysis, VTT Chemistry specialise in conventional catalysis, catalytic antibodies and chemical modifications and Abo Academi work on characterisation and structure. Part of the success is due to Raisio's experience in collaborative research projects. Raisio has had several Tekes projects with VTT and VTT has the necessary expertise in paper technology and starch chemistry and commented that with old friends they could start immediately. Outside this project, Raisio collaborates with foreign universities and institutes including UMIST (UK), LeHigh University (USA), CTP in Grenoble (France), PIRA (UK) and in other EU programmes.

Raisio also commented that the University groups need more time to familiarise themselves with new technical projects so that longer projects are more productive.

In setting up this project, Raisio received proposals from several universities but were very careful in selecting only those groups with the necessary expertise.

Experience in collaborative research, knowledge of the partners and care in selecting those with relevant expertise is key to a successful collaboration.

14.3 Impact on the production of trained people

The project will produce 4-5 MScs and 1-2 PhDs. Raisio has already employed 1 graduate, an engineer from Abo Academi Institute of Paper Chemistry, and may take another. Like many other companies, they see these programmes as good way of selecting good students from the universities.

14.4 Project management process

Raisio's Vice President R&D and Technology is the project manager, with product managers from the business leading the sub-projects and ensuring that they are very close to the business. Each of these meets twice a year with an annual project meeting.

Objectives and tasks assigned to the partners appear very clear and Raisio is happy with reporting. VTT are sufficiently familiar with paper technology and Raisio's objectives that they need only minimal management. The university groups need more time from Raisio with for example, students spending time in-house to use specialist equipment.

14.5 Marketing Molecules Programme Concept and Management

This project is a very good fit with both the 'molecules' and 'marketing' elements of MM.

It is business led, linking into the academic base and generating good results.

However it has not led to any new partnerships. It is very much seen as a continuation of the Tekes funded Synthesis programme in which Raisio was also involved but to a lesser extent. Funding the universities via the company is seen as a better way than straight from Tekes. It makes clear that someone, the company, is in charge.

Overall, Tekes is seen as flexible and listens. It is infinitely more productive than the EU in terms of supporting collaborative research.

14.6 Impact on Finnish SET base

This project is helping to maintain and develop areas of expertise important for Forest products and the development of new greener technologies. As well as potential new products, the project has produced some very good science in starch structure/function.

Appendix 3

Marketing Molecules – Academic Overview

1 Background

The 14 industry-led projects involve a total of 10 Finnish Universities plus VTT and over 30 research groups. Several of these University groups also have University-led projects (8 in total) linked to the main projects. The Universities of Oulu and Helsinki along with VTT are particularly well represented in the programme. The areas of chemistry and chemical technology in the programme are diverse and include organic and inorganic synthesis, catalysis, environmental chemistry, polymer chemistry, modelling, oxidation chemistry and alternative feedstocks. These areas are compatible with leading research areas and priority topics internationally although the emerging areas of biosynthesis and biocatalysis seem under-represented by international standards (some academics did comment on the lack of interaction between chemistry and biochemistry departments in Finnish Universities).

2 The Evaluation

Apart from the discussion with all of the companies participating in the programme (when academics were not present), the academic role was evaluated through individual discussions with seven academic group leaders and a visit to Oulu University. In all cases the list of questions that had been sent earlier to academic groups formed the basis of the discussions. The main points to emerge from these discussions are given below.

3 Business Awareness

Many of the academics felt that the companies had not properly briefed them at the beginning of the project on their business objectives.

With the exception of the (small number of) academics who had previously worked in industry, there seemed to be quite little evidence of business awareness within the academic community. The majority of academics interviewed favoured closer involvement with industry and a greater appreciation of business needs within academic institutions. This should apply to staff and students. Indeed some favoured Universities running business awareness courses for students. However, several felt that there was little support or encouragement for closer links with industry within Universities although some signs of improvement were evident such as the creation of industrial liaison offices.

4 Technology and Contractual Arrangements

The academics were in general more confident about the technological opportunities and objectives of their projects. Their knowledge and understanding of these had however, often come at a later stage in the project and as a result of discussions and meetings with their partners, rather than at project start-up. Generally the academics realised that their role in these projects needed to be different to that in “normal” research projects without industrial involvement. They saw the need to apply their expertise to problems identified by the industrial partners although their attitude towards this ranged from appreciative to reluctant acceptance.

They mostly saw their research as being applied but to some extent based on their (fundamental) research expertise although in some cases the work was peripheral to their main research interests. Even when the project was considered peripheral, the academics showed a professional attitude to the work and made appropriate commitments of effort and resources. However, it is unlikely that their intellectual involvement would be as great in such cases. This may link to those companies who reported a rather lower level of interest and involvement from some academic partners. It is clear that the Finish academic community like that in almost any country is heterogeneous and that while some will relish a pure-applied balance in their research where each can benefit from the other, there will be some that will only take on applied projects so as to secure additional funding.

Most of the projects were proving to be productive in terms of publications and patents some have been particularly productive.

The researchers were largely satisfied with the contractual arrangements although some problems had arisen during the projects: A university partner was concerned that the project funding would run out before some of the students had completed their PhDs. In some cases academic partner expressed their concern at the frequency at which the company had changed its plans. It may be appropriate for Tekes to formally check the contractual arrangements for all projects before they start and to ensure that all partners fully understand the contract.

5 Training

The programme is leading to a significant number of advanced degrees although in most cases the project represents only part of the degree course (final year Masters project or part of a PhD programme). There is a critical shortage of young postdoctoral Fellows in Finnish University Chemistry Departments and programmes such as this are seen as providing opportunities to help remedy the problem. Many senior research personnel would benefit the programme by providing additional expertise, international experience (in some cases) and most importantly, could provide day-to-day direction for younger researchers working on the project and act as an additional contact point for the company.

Student-company interactions varied enormously from those who were largely based in the company (and who benefited from close contact with company staff and a good appreciation of company practice but often lacked good academic support) to those who were University-based (benefiting from close academic supervision but generally losing out on industry-related training and awareness of business objectives).

In a number of projects there had been limited opportunities for the students to work on the company premises and the level of industrial experience acquired by the students was considered less than satisfactory. In cases where students had gained significant industrial experience, the students had enjoyed and appreciated their placements. It was generally considered important that students who were not based at the company should have some industrial placement experience although this need not represent a large part of the students' time.

There are some serious concerns over major changes in projects due to shifts in company strategy typically leading to a reduction in the funds available. In at least one case this has led to a student registered for a PhD having to leave the University before the thesis work was completed. It was also noted that a transfer of funding from a programme such as MM to other (typically Foundation) support put the student and Laboratory at significant financial disadvantage. These cases were considered to be very regrettable and worked against encouraging closer academic-industry links.

6 Project Management

Some academics felt that the project manager lacked the seniority and/or experience to co-ordinate and direct the activities of the partners e.g. the academic partner believed that the project did not have a dedicated project manager although otherwise the management structure (work of the steering committee) was considered to be effective. In certain projects some of the academic partners were upset by the changes in company staff attending the project meetings.

Some of the academics recognised that long distances between their workplace and the collaborating company could hinder regular communication and collaboration. It was also evident that at least some of the students who were largely based on the company premises would get less academic supervision and guidance compared to those working at the University.

In some projects some of the academic partners were concerned at what they considered to be rather loose project plans or that the academic partners had not been briefed on the project objectives and no milestones had been agreed. Generally the academics appreciation of the business objectives of the company and the project plans/milestones improved as the project progressed through formal project meetings and through discussions with other partners.

In several cases it seemed that the roles and major activities of the partners within specific projects were not properly explained and agreed at the start of the project leading in some cases to overlap of research work.

Most projects had quite frequent technical meetings although those involving all partners might be more overview in nature with little sharing of technical details. It may be sensible for Tekes to offer advise to project partnerships on project management training at the start of the work.

7 MM Programme concept

Many academics saw real value in the programme ensuring serious industrial interest although some admitted to regarding such activities as secondary to their fundamental research work. Some also valued the opportunity to create multi-partner projects (an added benefit compared to 1:1 Tekes supported projects) whereby academics with different areas of expertise and different interests worked together on a project with common goals. This might help to stimulate new collaborations between academics that could last beyond the TEKES project. It should be remembered however, that there is competition between academic groups and the partners for a project should be carefully selected so as to avoid overlap of interests and so as to encourage cross-disciplinary fertilisation.

The involvement of Tekes staff was widely appreciated and it was believed that their increased role at project start-up would be beneficial. Many of the academics had had little involvement in or knowledge of the selection phase of their project, which they had assumed, was largely a Tekes-Industry matter.

The importance of Tekes funding to Finnish Universities was widely recognised at least among those interviewed, although its actual contribution to the research income of academic groups varied from very significant (>50%) to minor.

The added value of the programme to younger academics seeking to establish contacts and funding streams (as well as being at a critical stage in their career with regard to determining their preferred balance between pure and applied research) was very apparent.

8 Impact on the Finnish SET Base

The importance of Tekes funding is enhancing the technology base of Finland especially through encouraging academic-industrial liaison, increasing the number of trained researchers and promoting collaboration between academic groups was widely appreciated and welcomed.

The impact of the programme has largely been to make, often quite small but significant, technological improvements through better application of scientific knowledge. The level of the scientific challenge in the projects has been variable. In some cases the project required cutting edge research of a quality and level matching the best pure research projects. In other cases however, the degree of scientific challenge has been rather small. Broadening the scope of the programme so as to source and exploit technologies and knowledge from outside of Finland should have a significant impact due the rather small Finnish scientific base, the significant weaknesses in this base (e.g. biocatalysis) and the rapidly changing and demanding requirements of modern science-based industries.

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