SEESAWING BETWEEN SOCIAL SCIENCE AND MANAGERIAL PRACTICE

- on the art of duality in learning partnerships

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Production and transfer of knowledge between social scientists and commercial companies in learning partnerships are filled with misunderstandings and unfulfilled expectations. This paper analyzes the duality of learning partnerships in single case studies. It discusses the two distinct sets of expectations and interests in production and transfer of knowledge, and it suggests how the business partner as well as the social scientist may benefit from a partnership.

To improve the processes and results (for both parties) in learning partnerships we argue that the social scientist must possess skills that distinguish her from the management consultant. We argue that the social scientist¡s primary contribution to her business partner is conceptual framing of organizational phenomena. Finally, we make recommendations for handling duality in learning partnerships within organizational analysis.

In recent years there has been a renewed interest among Danish social scientists and commercial companies for discussing learning partnerships. The reason is the increased emphasis among Danish business schools and universities on raising external funding for research projects. External funding is a common way of financing scientific research in other countries, in particular in the US. In Denmark, the idea has only recently gained attention as an expected decrease in public funding of research will increase researchers' dependence on grants from companies.

Research that is based on commercial contracts is associated with an air of sceptisism and many myths on either side of the learning partnership. The scientist does not want to do controlled research and the company doubts whether the scientific results will be useful. Such myths and prejudice often seem to act as hindrances for engaging in a learning partnership. However, we believe that there is a great deal to learn for social scientists as well as companies from joint

research projects. Many Danish social scientists will be exposed to learning partnerships in the future, and therefore, we present a number of crucial points and suggest how to handle the complex situation related to learning partnerships.

Our own research experiences are based on commercial contracts with private companies. As Ph.D. students we were recruited by companies to analyze organizational phenomena within these companies. The two research projects that we worked on respectively were conducted within the framework of a Ph.D. programme called Industrial Research, in which the social scientist is referred to as an Industrial Researcher. Within this programme Ph.D. projects are jointly funded by the Danish Academy of Technical Sciences and a private company. This set-up implies a double commitment for the industrial researcher: an association with a department at a Danish business school which supports the project's theoretical development, and a recruitment contract with a company which is the prime source of empirical data - and funding.

From its start in 1970, the industrial research programme solely focused on education of researchers within the technical sciences. Hence, the main body of researchers enrolled in the programme held majors in engineering and natural sciences. Yet, from 1989 the Academy started to encourage projects on management and business administration. Thus, the programme became increasingly attractive to MBA's and social scientists within the field of organizational analysis. In our experience this set-up has interesting and serious implications for the research process.

THE DOUBLE-PULL COMPLEX

Inherent in a learning partnership between a social scientist and a company is a dialectical tension.

The two parties represent two different world views (Kreiner & Schultz, 1993), as they have different purposes for entering the learning partnership and separate criteria of priority and relevance. This dilemma is particularly outspelled for the industrial researcher in learning partnerships, where the research project focus on organizational phenomena in the company which funds the research project (Andersen et al., 1992). We discuss the duality of such research projects.

The primary implication is that the company and the business school tend to hold two different sets of rationales for participating in research projects that investigate and examine organizational phenomena. Consequently, the industrial researcher has to balance between these two rationales, which we refer to as the *academic rationale* and the *business rationale*.

The academic rationale mostly flourishes among professors and researchers at universities and business schools, and its main characteristic is its focus on the advancement of science, an often long-term perspective, and the scientific validity of results. Production in this rationale is equivalent to publications, and working is observing, interviewing, reading and writing. The aim of a social scientist is not to reveal reality, but to propose alternative ways of categorizing and describing parts of it. Astley & Zammuto clarify this rationale when they note:

> "Scientists acquire knowledge not by uncovering empirical data to reveal the nature of external

The business rationale blooms among managers in companies and management consultants. Their interest is improvement of organizational performance, and they emphasize the importance of immediate and applicable outcome, i.e., outcome which proposes solutions to managerial problems and identifies "the best way" of organizing a company[1]. Production within this rationale means precisely defined services or products, and working means planning strategies and making decisions. Commercial managers tend to think of social science merely as a means to improvement of their business, and they often view social scientists (here: industrial researchers) as engineers of

[1] Pelz (1978) refers to this position as instrumental utilization of research findings.

technical advice (Chin & Benne, 1969). Ergo, the criterion by which they judge the relevance of a research project is whether it contributes to improvement of organizational performance. Of course not all managers hold this attitude towards research, and we ourselves have met a few who expressed affiliation with the academic rationale. However, we experience that most managers pursue the business rationale.

Working as industrial researchers in learning partnerships we experienced the divergent expectations and tensions between the academic and the business rationale. They represent two different world views, which create a double-pull situation for the industrial researcher. Figure 1 below illustrates this situation:

Figure 1, Two Rationales for Involvement in Research Activities.

The co-existence of these two rationales implies that representatives of each rationale attempt to pull the research process, and thereby, the industrial researcher, in their direction, i.e., the academic pull and the business pull respectively. Thus, the difference between the traditional public funded researcher and the industrial researcher is that the public funded researcher knows the conditions on which her outcome will be judged from the very beginning of the research project, namely, within the academic rationale. As a result, she has only one rationale to concentrate on and adhere to during the research process. In contrast, the industrial researcher faces a far more muddy situation as she has made financial ties and social commitment to both rationales. Therefore, she faces a dilemma concerning how to manage and reward two contrasting sets of expectations and demands during the research process.

In our work as industrial researchers we experienced two areas of idiosyncracy, where the dialectics between the two rationales particularly exerted influential on the research project: first, the question of purpose & results, and second, the question of process.

THE QUESTION OF PURPOSE AND RESULTS:
IMPROVING BUSINESS OR ADVANCING SCIENCE

Research projects as learning partnerships have a dual purpose. What looks like a joint venture

between two actively involved partners may very well contain a number of divergent intentions and expectations. The researcher's ambitions seldom coincide harmoniously with the interests of the company being studied. A clear definition of the project's purpose and result is significant for bridging these sets of expectations.

The enterprise's main reason for participating in a learning partnership is to improve business. By engaging in an - oftentimes resource-demanding - research process, managers expect to receive practical advice on how to enhance for instance organizational or marketing principles. The manager is interested in applicable results in her organization.

In contrast, the main object for the researcher is to advance knowledge within her field, and thus, her primary objective is to understand organizational systems and processes. A research project is conducted according to scientific standards to validity and reliability. The researcher's primary focus is the academic significance of the research results - and not necessarily its practical implications.

An example of the duality in purpose can be found in *the lack of clarification of the research project's direction and ownership*. One of the authors experienced that, on the one hand, the business manager managed to proliferate the research project as he often encouraged application of new theoretical and empirical angles, while the academic mentors, on the other hand, suggested reducing the scope of the research project. The lack of initial and concise agreement between the industrial researcher and the company concerning the purpose of the research project caused frustration for the business manager and lack of focus and concentration for the industrial researcher. In addition, it turned out to be rather time-consuming to avoid the business manager's attempts to redefine the research project.

The divergent expectations from academia and from the company raise the question about who

owns the project? Who decides which theoretical orientation and empirical angle should be analyzed? The company who funds the project or the industrial researcher who runs it? On the one hand, the funding company feels a natural ownership, as it pays for the project and, as such, wants to exert influence on its direction. On the other hand, the industrial researcher feels a strong attachment to the project, as she acts as project manager. The research project is often the initial step in her academic career, and therefore, it indicates her future potential and research interests. The focus of the research project is, thus, closely linked to the industrial researcher. To further complicate the situation the academic mentors from the business school may also express a psychological commitment and responsibility to the project's academic level discourse.

We experienced this duality of ownership between the academic rationale and the business rationale to be implicit in our research projects, and we experienced that it amplified the divergent expectations instead of bridging them, as the ownership relations were never clearly confronted in a discussion between the company and the industrial researcher.

One of the authors experienced the duality of expectations to results strongly in her analysis of an organizational change project. The business manager's interest was quantitative evidence for the causal effect between the organizational change project and organizational performance. The researcher argued that causality between the organizational change project and organizational performance was close to impossible to prove in a single case study. Instead, she argued that the company represented a unique example of how social processes between organizational actors may act as a bottom-up driving force for organizational transformation. This duality of quantitative or qualitative results was never completely clarified and was an on-going battle during the research period.

The duality of purpose and results: improving business versus advancing knowledge, introduces dialectical tensions in a learning partnership. However, we find the duality enriching for research projects in organizational analysis, if the duality is surfaced initially and discussed openly between the partners initially. However, this is seldom the case. Oftentimes, the duality of the research project does not reveal itself until the project is completed and the results are presented. The business partner's practical "and so what?" question may leave the researcher disappointed, as she withdraws from the "field" for months in order to analyze the data and finally presents some academic results of little interest to the practitioner.

An important implication of the divergent expectations to purpose and results is that the social scientist is often criticized by the manager for being decoupled from practice, and the scientific outcomes are characterized as irrelevant (Dubin, 1976; Beyer, 1978; Oviatt & Miller, 1989; MacRae, 1976). From the organization's point of view, the focus of interest is not scientific validity but practical applicability: "Does it work or not? Does this help increase our performance?" By the time, the researcher presents his results, the organizational context may have changed and the findings may seem irrelevant. And as the next step for the researcher may be to engage in a comparative study of the results, the business partner may find the entire research process irrelevant and a waste of resources.

We find that it is only when the partners acknowledge and surface the dual purpose that the research project fulfill expectations and enrich understandings on both sides of the learning partnership.

THE QUESTION OF PROCESS: DISTANCE VERSUS PROXIMITY

It is vital in a learning partnership concerning organizational analysis that the researcher has simultaneous proximity and distance to the field, i.e., the organization being studied. A too close or too distant relationship between the partners impedes the quality of the research project. This aspect introduces a duality concerning the methodological approach.

In a case study the primary issue confronting the industrial researcher within the social sciences is *how to handle the unlimited access to data*. In order to understand the organization in its context proximity to the field is necessary. For a period of her life the researcher lives with the organization. She collects data, participates in meetings and social events, and observes organizational everyday life close-up. She becomes a member of the organization. The danger deriving from a close connection to the organization is the unlimited access to data, which does not force the industrial researcher to economize on collecting data. On the one hand, the learning partnership is a unique opportunity for doing intensive case studies, and on the other, it is a strategy filled with potential dangers. The traditional warnings about not going too native (Andersen, 1990; Launsr & Rieper, 1993) and to avoid data asphyxiation (Pettigrew, 1990) cannot be emphasized too strongly to the industrial researcher in her analysis of organizational phenomena.

Another issue concerning proximity to the field the danger that it may veil the researcher's scientific "objective" mind. As the researcher gradually becomes involved in organizational everyday life strong loyalties may evolve towards the organization and its members, which can overshadow the scientific aim of the research project. Furthermore, organizational culture, norms and rules may gradually be taken for granted by the researcher and as a result avoid scientific scrutiny. Personal

detachment from the organization is a condition for analyzing data with a (presumably) value-free mind.

We find that in addition to theorizing as a tool to keep a distance to the field, a physical and temporal distance to the field may help develop a mental distance and hereby improve (regain) objectivity of the research project.

Another example of the duality in the process is *the lack of clarification of the industrial researcher's role*. The industrial researcher is visible in the company as she observes, interviews, reads or writes. She works on a project somewhat isolated from other organizational tasks, and it is not always completely clear to business managers exactly how the industrial researcher spends her time. For example, in the intensive writing periods she may find it necessary to isolate herself for months from the company in an office at the business school. One of the authors had personal telephone calls in the morning from the company in one of the intensive writing periods, where she worked in her office at the business school: a check-up call from the company just to know what she was doing, and whether she was at her business school office at all. Do not forget the company pays half of the industrial researcher's salary.

This set-up in the learning partnership makes it tempting for business managers to ask the industrial researcher for assistance on a variety of smaller projects. We both experienced this on a number of occasions. One of the authors was asked by the business manager to search for literature and write notes on various subjects, e.g., critical success factors, managerial roles, and visions. The other author was asked to develop and conduct surveys throughout the organization. Both authors found these tasks beyond the scope of their research projects, but at the same time difficult to avoid. The financial ties to the company created a subtle kind of social obligation and legitimized the managers'

asking for assistance. In both cases a precise definition of the industrial researcher's obligations to the company had not been obtained. The lack of open discussions about how the industrial researcher's time, capacity and competence should be spent between the two rationales raised tensions and questions during the process concerning the nature of the industrial researcher's role.

Another aspect of the industrial researcher's role is her acting as a consultant. She has presumably a broad insight into managerial and organizational literature, and sometimes even consultancy experience. This knowledge may qualify her for consultancy work within the company whilst becoming acquainted with the organization. The consultant-approach is a tempting approach for the industrial researcher as well as for the company. On the one hand, the researcher's presence in the company is more smoothly legitimized among managers and employees if she acts as a consultant providing practical advice on how to improve business ("she is doing a visible job for us"). On the other hand, there is a high risk for the industrial researcher to be considered an almost costless consultant. Consultancy in a traditional sense implies a normative outlook upon what is good and what is bad for the organization, in which the consultant "knows the better way" (French & Bell, 1984). This idea sharply contrasts with our idea of the industrial researcher's role in learning partnerships. In the following section we elaborate this aspect.

PRODUCTION OF KNOWLEDGE IN LEARNING PARTNERSHIPS

The present section discusses how social scientists can produce and transfer knowledge to companies in learning partnerships, and it presents some strategies for administration of dualities in learning partnerships.

Three Modes of Knowledge Utilization

Having described and discussed the major implications of the dualities associated with learning partnerships, we now face the question of how to produce knowledge in learning partnerships for the benefit of both social science and managerial practice. Our point of departure for providing an answer to this question is Pelz's (1978) three categories of knowledge utilization. Focusing on the problem of how knowledge is utilized three different modes are suggested: instrumental, conceptual, and symbolic. *Instrumental* utilization happens when findings from research directly influence managerial action. *Conceptual* utilization takes place when ideas, concepts, or outcome from scientific research influence how a practitioner conceptualizes a problem, as, for example, when a theory influences how managers frame a problem. *Symbolic* utilization refers to the use of information from social science to legitimate managerial decisions, actions, or ideas, e.g., managers may point to theoretical models or research findings to justify a chosen course of action (Astley & Zammuto, 1992). It can be difficult to distinguish between the three types of knowledge utilization in practice, but we find the categorization helpful in defining and arguing for the industrial researcher's role in a learning partnership. In the following discussion we emphasize the instrumental and the conceptual utilization of knowledge.

Consequences of Traditional Production and Transfer of Knowledge: Single-Loop Learning

It appears from the description of the intentions of the programme that the Industrial Research Education Committee[2] focus on projects that deals with technical issues. Although the committee has approved start-up of projects focusing on management and business administration for several years, there is still no written material from the Danish Academy of Technical Sciences that deals with the purpose of this kind of projects. Therefore, if an industrial research project focus on organizational issues then managers' expectations for outcome from the project are likely to focus on instrumental knowledge utilization, i.e., they will focus on the impact of social science on managerial practice through supply of tools, techniques and prescriptions for managerial practice.

Yet, as it appears from our discussion of dualities in learning partnerships, we believe that production of knowledge for instrumental utilization can solely take place at the expense of the advancement of social science. If the social scientist believes the aim of her research is to act as a consultant and to produce outcome for instrumental use in the company, then she must accept that the "business pull" is likely to "out-balance" the "academic pull" and give her research status of a consultant report rather than an academic work. A strong orientation towards the business rationale will tempt the researcher to become a-theoretical and a normative pragmatic, eager to please management by presenting what they consider acceptable results. The researcher will get caught in a pragmatic circle with its own legitimation principles, language and ways of discussing and presenting arguments, which differs considerably from the academic circle. Such an instrumental

[2] See appendix.

orientation does not further social science. However, we also believe that it will not contribute to any significant renewal of organizational norms and routines. We believe that knowledge produced for instrumental utilization will at best contribute to sophistication of existing organizational practices within the company, and as such it will only stimulate managers to perform single-loop learning (Argyris & Sch`n, 1978), i.e., problem-solving within the existing frame of reference.

This argument finds support in organizational practice, as the consultants' frame of reference must reflect the managers' frame of reference (Burke, 1987) for the simple reason that if the consultant initially contrasts with or opposes management, she will not be recruited at all. Opposite, if the industrial researcher wants to contribute to the advancement of social science, the production of knowledge for instrumental utilization seems fruitless. In the next section we will discuss another way of producing and transferring knowledge in a learning partnership, which may bridge the gap between the two rationales.

An Alternative to Production and Transfer of Knowledge: Conceptual Utilization

The point of departure for this discussion is the belief that both researchers and companies participating in learning partnerships will benefit significantly by aiming at *production and transfer of knowledge for conceptual use* in managerial practice.

Production and transfer of knowledge for conceptual use in managerial practice already take place[3] as knowledge flows from social science to managerial practice through consultants, books, business

[3] In the early 1980s Beyer & Trice (1982) showed that conceptual and symbolic use were more prevalent than direct application of findings.

periodicals, executive education, etc. Books, for example, provide information of conceptual value when they suggest different world views of managerial life and new concepts for managerial behavior. A good example is; 'In Search of Excellence' by Peters & Waterman (1982).

Managers, in turn, apply such concepts with great flexibility as the concepts induce them to use their inside knowledge of an organizational setting to interpret the well known problems in new frameworks. Consequently, concepts from social science do not in fact furnish new knowledge, however, they furnish new perspectives on what is already known. Social science provides a conceptual language that shapes managers' perceptions and thoughts, and enhances their problem-solving capabilities, as it helps managers to develop what Bartunek et al. (1983) refer to as 'complicated understanding' - the ability to see and understand organizational events from several, rather than a single perspective.

Complicated understandings are necessary as many of the problems faced by managers are very complex. They are problems that can be framed in many different ways, have many possible answers, and are rarely definitely resolved, as they tend to resurface in different ways through time. In part, because past 'solutions' reconstitute the nature of the problems. Hence, complicated understandings facilitated by alternative views are valuable when dealing with complex problems, as they enable managers and employees to view complex problems from different angels and to reconceptualize and creatively resolve them over time (Astley & Zammuto, 1992; Weick, 1993). Moreover, only alternative conceptual frameworks will provoke managers to engage in double loop learning (Argyris & Sch`n, 1978), i.e., problem-solving by questioning the existing frame of reference.

It is vital to identify yourself as a *researcher*, independent of managerial views, in order to allow

yourself to develop concepts and frameworks for explaining organizational phenomena that may challenge managers' self-perception and perception of the company and its context. If researchers are to do other and more than reproducing managerial interpretations of "reality," a psychological detachment between researcher and management is necessary - in spite of the financial attachment between the two actors. By freeing researchers from a pragmatic here-and-now outlook, we believe on the one hand that researchers will be able to scrutinize organizational problems and taboos and hereby provide new insight to social science. On the other hand, this conceptual utilization of knowledge may contribute the surfacing of implicit assumptions and provide managers with alternative views upon the organization and its context. This, in turn, may lead to questioning the existing norms and routines: Is our current high-technology orientation suitable for future competition? Are we an attractive workplace for highly qualified personnel? Will the demotivated workforce be motivated by higher salary, or is it my management style that needs to be changed?

Asking these questions will impose a broader perspective on organizational tasks and norms, which, in turn, may foster significant improvements of the business.

However, asking such questions hurts. Either the organization or individual managers. Therefore, they are rarely asked. It is more comfortable to keep on producing high-technology products to the known markets, and it is certainly more comfortable to pursue one's usual management style than to question it and change it. Double-loop learning is painful, as it questions the identity of the organization and the individual. By letting the researcher present organizational taboos and an alternative picture of reality, the difficult double-loop learning process is provoked. In the short run it may impose conflicts and disharmony in the organization, but in the long run it may turn out useful, as managers themselves have been forced to face some of the organizational phenomena, which

often tend to get overlooked, either because they are unpleasant or because they are outside managers' current world view.

In summary, if social scientists want to assist managers in developing complicated understandings, they must urge managers to reconsider, discuss, and question contemporary organizational practice. This exercise will enable them to renew and prepare the company for the future. We believe that in order to facilitate generation of discussions and reviews of current organizational practice within a company social scientists must supply managers with alternative conceptual frameworks and solid critique that questions managerial behavior and 'the way we do things here.'

RECOMMENDATIONS FOR HANDLING OF LEARNING PARTNERSHIPS

Based on the discussion above and in spite of forceful warnings from other researchers[4] we claim that learning partnerships will only contribute to the advancement of social science as well as to the improvement of business, if they are organized as *partnerships*, inducing the partners to aim at production and transfer of alternative concepts, critique and ideas, and not as *consultancy-ships* focusing on development of tools, techniques, and prescriptions. Furthermore, we hold that in learning partnerships the social scientist must act both as a critic of contemporary organizational practice and as a supplier of alternative conceptual framework that facilitate development of

[4] For example, Donaldson (1992) who suggests application of a positivistic research approach, which focus on the construction and validation of theoretical models that has operational implications for managerial practice and offer detailed practical guidance for managers.

multidimensional understandings in the company. In contrast to Beyer (1992), we believe it is realistic for social scientists to cross the gap between science and practice without structures and roles dedicated to the transfer of knowledge for conceptual utilization.

Two reflections explain our position. First, and as previously argued, *consultancy-ships* will not contribute to the advancement of science. Second, based on our considerations about single- and double-loop learning we believe that knowledge for instrumental utilization is of less importance to the company than knowledge for conceptual utilization, as *partnerships* facilitate double-loop learning, whereas *consultancy-ships* mainly facilitate single-loop learning. Cultivating good single-loop expertise proves to be easier for organizations than to develop double-loop expertise. In order to provoke double-loop learning in organizations and to make it possible for both partners in a learning partnership to benefit significantly, we suggest that the industrial researcher cultivates and maintains her conceptual framing skills.

To facilitate establishment of *partnerships* industrial researchers and companies must agree that the purpose of the learning partnership does not involve production of knowledge for instrumental utilization. Therefore, we suggest that the industrial researcher in the project's early phase arranges discussions between the stakeholders in the learning partnership, i.e., between representatives from the company and the academic institution in order to clarify expectations concerning outcome, theoretical approach, methodological angle and capacity, including the industrial researcher's role and type of involvement in everyday life in the company. Oftentimes, learning partnerships begin without such a clarification, as neither researchers nor business representatives are aware of its

significance for the research project's process and results[5].

SUGGESTIONS FOR FURTHER RESEARCH

We do not believe that the problems and solutions discussed in this paper are restricted to learning partnerships between social scientists and commercial companies. But we believe that the struggle between practice and research, in particular, is an everlasting issue related to the social sciences. First and foremost, we build our belief on statements put forward by researchers over time. For example, in 1947, dr. Mogens Fog, former president of the University of Copenhagen, in a speech at the Danish Communist party's national congress warned the delegates against mainly viewing like-minded researchers' and intellectuals' work as instrumental to the achievement of the party's political objectives (Thing, 1991). Nevertheless, no systematic research validates our belief, and therefore, we suggest that there is every reason to undertake research in the phenomenon within other scientific disciplines.

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[5] An exception is the Minnesota Innovation Research Programme (Van de Ven & Angle, 1989) where researchers conducted many discussions and meetings with commercial partners before initiating the research.

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APPENDIX

Context and Set-Up of Learning Partnerships

The learning partnerships referred to in this paper are Ph.D. projects organized within the framework of a Danish research programme named: the Industrial Research Education Programme. In this programme each project requires cooperation between a Ph.D.-candidate, a company, and an institute of one of Denmark's institutions for higher education. The programme was initiated in 1970 by the Danish Academy of Technical Sciences for the purpose of educating Ph.D.'s for the private sector. Until today about 130 companies have participated in the programme, more than 500 researchers have entered the programme, and so far about 300 have gained their Ph.D degrees.

Intentions and Focus of the Programme

The intentions of the industrial research education programme appear to be clear as its curriculum states that the programme aims at ensuring fulfillment of the need for developing of solutions to concrete problems, for the benefit of the participating company. More clearly, it states (Industrial Research Education Committee, 1991):

"The industrial research education programme implies that the participating companies receive:

-completion of a concrete R&D-project which may lead to new, patentable prototypes or

-new knowledge, techniques and methods,

-a well-qualified employee who can work independently on new development projects,

-the opportunity to establish closer contact with universities and institutions of higher

-financial aid to cover expenses."

Financial Issues

The projects are sponsored by the Danish Academy of Technical Sciences and the participating company, each paying half of the expenses of a project. The industrial researcher holds status as an employee in the company, but the academy pays half her salary and all her expenses for travelling,

participation in conferences, etc. The programme is funded by the Danish National Agency of Industry and Trade.

Formal Requirements

To enter the programme the applicant must hold a master's degree, and she must bring together a company and a department at a university. These three parties must agree upon the purpose of the research project, and they must formulate and forward an application to the Danish Academy of Technical Sciences, where the Industrial Research Education Committee[6] meets four times a year to select projects for the programme.

Various kinds of people enter the programme. In general, applicants fall into two categories. Some applicants have worked in the participating company for many years, whereas others graduated from university recently.

[6] The committee includes 15 people from academia and industry. At present 14 hold degrees in technical science and 1 holds a degree in social science.