An introduction to the concept of Science Shops and to the Science Shop at The Technical University of Denmark

September 2005

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This paper presents the overall concept of Science Shops as practised in most of the European Science Shops and presents the concept practised and some experience obtained at The Technical University of Denmark. At the end, an outline for the planning of new Science Shops is presented.

1. The concept of Science Shops

Science Shops are organisations that offer citizens groups free or very low-cost access to scientific and technological knowledge and research in order to help them achieve social and environmental improvement. Originally developed at Dutch universities during the 1970's, Science Shops now also exist in Denmark, the U.K., Germany, Austria, Belgium, France, Spain and Romania, as well as in a number of non-European countries (including Canada and the USA). Since the mid 1990'ies the international networking among Science Shops have been growing, due to funding of networking activities and research activities by the European Community. An international network, Living Knowledge is open to all interested persons, departments, Science Shops etc. One can sign up for the network and its discussion list and newsletter at www.scienceshops.org

Most Science Shops are a department of a university, run by scientific co-ordinators who act as the intermediary between a citizens group that poses a question and university researchers, teachers, or students, who conduct research in response. The co-ordinators also acts as project (co-)supervisor for the research. However, some Science Shops are not part of a university, but are non-profit private organisations through which researchers and students give advice to citizens groups. **The knowledge need** expressed by the citizens groups can in most cases be characterised as being one or more of the following three types:

- Problem documentation: the citizens group experiences a problem, which they want documented in order to make governmental authorities, companies etc. aware of the problem. This can also include counter-expertise.
- Knowledge enhancement: the citizens group wants knowledge about possible future changes in technology, public policy etc. within a field of industry or a region, in order to be able to participate in the shaping of the future.
- Perspective change: the citizens group wants assistance in developing preventive solutions to a problem, in order to support their efforts for social and environmental improvement.

The main benefits of the Science Shop model are:

- Science Shops help empower citizens groups by giving them access to scientific research in a wide range of disciplines. This enables them to participate more effectively in democratic debate and helps build a strong civil society.
- Because Science Shops are demand driven, Science Shops perform research that is actually used in society. That is, Science Shops facilitate knowledge production and use, and not 'just' transfer of knowledge. When citizens groups lack the capability to use the Science Shop research practically, they are supported in doing this.
- Science Shops develop education and research at universities. Students learn valuable skills in socially relevant practice. University curricula and scientific research take up new socially relevant themes in a multidisciplinary way (demands are problem-driven, not discipline-driven). The capacity of universities is thus opened to benefit society directly.
- Science Shops advance public understanding of science by confronting citizens groups directly and practically with the possibilities and limitations of science.
- Science Shops are very cost-effective. Because students as part of their curriculum do much of the research, additional costs to universities and society are relatively low.

Some of these benefits are unique to university-based Science Shops; other benefits are general to all Science Shops.

2. The Science Shop at The Technical University of Denmark

The Science Shop was started in 1985 and was the first Science Shop in Denmark. The Science Shop has three main objectives:

- To give citizen groups who need for advice on topics related to technology and society access to the resources of the university.
- To contribute to the on-going renewal of the University based on the knowledge needs of the citizen groups approaching the science shop.
- To give the students the opportunity to gain experience with project work and co-operation with citizens and citizens groups.

The Science Shop is affiliated to The Department of Manufacturing Engineering and Management. The personnel resource for the Science Shop is 1/3 associate professor, 1/3 a research assistant, and 1/3 student assitance. The Associate Professor working part-time in the Science Shop has expertise within participatory action research, technology assessment, technology transfer, user participation in technological changes and capacity building. The Science Shop has an Advisory Board with representatives from faculty, administrative personnel and students at the University and representatives from some of the citizen groups that have approached the Science Shop during recent years.

Most of the Science Shop projects are carried out by graduate students as part of their engineering education within the frame of an optional or obligatory course and project module and supervised by a Professor from the relevant department. The Science Shop supervises the co-operation between the citizen group, the students and the teacher. A

few projects are carried out as short-term advice to the citizen group by the Science Shop, sometimes assisted by a Professor, or as research projects.

Based on the knowledge needs put forward to the Science Shop a number of changes have been made in research and curricula at the university (described in details in the next chapter):

- Research programme and new course modules within urban ecology, cleaner production and environmental management.
- Research programmes and integration of new aspects into existing courses on waste water treatment and food technology.
- Research and new course modules concerning technological change and co-operation between experts and citizen groups.

The Science Shop is part of a network of three Science Shops in Zealand, which publishes its own newsletter 'Applied Knowledge' two times a year. The Science Shops within the network also exchange the requests for advice from the citizen groups in order to make them known to as many students as possible. In 1996 the network organised a Nordic conference on 'Democracy and Knowledge'. The Science Shop and The Department of Manufacturing Engineering and Management have been involved in a project on transfer of the Science Shop concept to Malaysia by supporting a group of Malaysian universities in the establishment of a Malaysian Science Shop

The Science Shop receives around 25 requests a year from different kinds of citizen groups. Around 20 projects are carried out per year. Some of the citizen groups approaching the Science Shop are NGOs concerned with energy related and environmental issues, NGOs working on traffic issues, local citizen groups, trade unions, organic agriculture organisations, organisations for disabled and Third World organisations. Some of the most popular topics during the last five years are working conditions, urban ecology, organic food, fair trade, energy, cleaner technology, technology for handicapped, design, and traffic.

The Science Shop has written an unpublished handbook on establishing and managing Science Shops, which will be used as base for developing a handbook in English about Science Shops.

Through its affiliation to The Department of Manufacturing Engineering and Manaement, the Science Shop has access to expertise within sociology of technology and environmental psychology and organisational learning.

3. The Science Shop as a source for renewal at universities: Experiences with development of research and education based on the user groups' need for knowledge

The Science Shop at The Technical University of Denmark has three main goals, to help groups outside the university, to give the students possibilities for qualifying through co-operation with user groups on real-life topics, and to contribute to the renewal of the education and research at the university.

The aim of the renewing activities is to give the knowledge needs of the user groups of the Science Shops more permanent impact on research and education. The renewal has taken place through a number of different initiatives:

- Research based directly on proposal from a user group
- New research programmes and new course modules developed within areas, where the science shop has had a number of proposals and a number of science shop projects have been carried through
- Research and course modules developed within methods and theories on co-operation between experts and user groups.

This renewal is based on knowledge needs from societal groups, with whom the university normally do not co-operate. During the first years of experience in the Science Shop, this type of renewing activities became part of the plan for a permanent Science Shop at the university. Visits to a number of Dutch Science Shops had shown that research and teaching programmes based on the projects in the Science Shop are necessary in order to obtain a more long-term and permanent impact of a Science Shop on the research and the education at a university.

Furthermore the Science Shop found it necessary to have resources for research and teaching within concepts for holistic technological development and within co-operation between experts and user groups.

These needs show the need for academic resources for a Science Shop. It is also important to consider how these academic positions can be made attractive for academia in order to secure continuity in the work of the Science Shop. Two possibilities seem adequate, either to develop a research group in the Science Shop or to affiliate the Science Shop to a department with research.

When the Board of Science Shop in 1987, based on two years of experience, applied the Council of the University for a permanent Science Shop, the university was applied for two permanent positions as associate professors in order to obtain academic resources for the renewing activities, research and teaching. Furthermore the Council approved that the Science Shop should be an open door to the university and be part of a new interdisciplinary centre, where the renewing activities could be organised and research and teaching within concepts for holistic technological development and co-operation between experts and user groups take place. The tasks for the two associate professors were planned as one third each for the daily work in the Science Shop, research and teaching.

In the application the Board of the Science Shop pointed out some areas, where the Science Shop, based on the requests for advice, considered it relevant and necessary to develop research and teaching in order to support the further development of concepts for a more holistic and sustainable technological development:

- Urban ecology
- Cleaner technology (minimisation of environmental problems through prevention at the source)
- Organic food production
- User-directed development of technologies for disabled people.

When a new department for technology and social sciences was formed at the university in 1995, the Interdisciplinary Centre was part of the planning group and became part of the department together with units for social sciences, working life, technology assessment and didactics. The Science Shop is now affiliated to a new department called Department of Manufacturing Engineering and Management, which among other departments consist of the old Department of Technology and Social Sciences. That is, the organisational strategy has changed from an independent research group in the Science Shop to integration with a department within the field of societal and technological change.

Renewing activities initiated by the Science Shop

The Science Shop DTU has during the years initiated and been involved in a number of renewing activities within urban ecology, cleaner technology and organic food production.

One way of obtaining more permanent impact on the research agenda at the university can be through organising research activities based on the requests for advice from the user groups. Most of the projects based on a request to the Science Shop DTU from a user group are carried out as student projects supervised by a professor from one of the departments. However, a few research projects have been started directly based on requests to the Science Shop (e.g. urban ecology, substitution of chemicals at hospital laboratories and environmental friendly preservation of forest tree seeds). Most of the projects have been based on a combination of permanent staff and external funding. Especially the project on urban ecology has had an impact on the research at the university.

Some Dutch Science Shops also have the possibility to get research funded based on topics raised through the Science Shop. One of the schemes that have existed for quite a long time is at Tilburg University. In May 1984 it was decided that the university would make funds available for the Science Shop of Tilburg University, which would enable the Science Shop to finance long-term research projects. These projects should make scientific research at Tilburg University more committed to the needs of society. In the first years after 1984 the Science Shop allotted most money to projects, which had a duration of one or two years. Since the end of the 1980'ies most of the money has been spent on co-investment with university departments in Ph.D. projects. Also some money goes to 6-month preliminary investigations that should lead to proposals for Ph.D. projects. Nowadays all Ph.D. projects are co-financed on a matched funding basis. Other partners in these Ph.D. projects are mainly the departments of Tilburg University, but other institutes, municipalities and other parties outside of the university also take part. Each Ph.D. project that is co-funded by the Science Shop has its own steering committee, which consists of members from societal organisations, such as environmental groups, civil servants of municipalities or departments, representatives of minority groups, etc. In this way the Ph.D. researchers get their input from society on the one hand and the members of these committees get the latest results from scientific research on the other hand. These interactions turn out to be extremely useful and are highly valued by both parties. There is also some interaction between some of these Ph.D. projects and the research questions from groups and organisations in society that are mediated by the Science Shop and that are researched by Master students of the university. This kind of cross-fertilisation with Masters' projects is beneficial to both the Ph.D. projects and to the research questions

from groups and organisations in society (Personal information from Tim van der Avoird, 28 March 2001).

Another strategy for obtaining more permanent impact is to organise a research programme. Together with the department for urban planning, the Science Shop at The Technical University of Denmark organised and co-ordinated a research programme within urban ecology and cleaner technology at the university 1991-94. Altogether, 16 departments and research units took part in the programme, which was applied for as a so-called high-priority area at the university and got money from the university for half a year of visiting professorship, three Ph.D. grants, two senior researcher grants and seed money for preparation of research projects.

The research started by the Interdisciplinary Centre at The Technical University of Denmark within the research programme was focusing on citizen involvement in urban ecology, employee involvement in corporate environmental activities and integration of care for external environment and working environment, which had been identified as crucial seen from a user group point of view. The activities within the research programme supported the development of citizen involvement in urban ecology and employee involvement in corporate environmental activities into two important research topics at the Interdisciplinary Centre (and today at the new Department of Technology and Social Sciences).

Within urban ecology, the Science Shop invited already in 1987 the department for urban planning to jointly plan and teach a course module in urban ecology. Later on, the course module was taken over by the department for urban planning and it is still one of the course modules offered by the department.

Within cleaner technology, the Science Shop has planned courses within cleaner technology, environmental management and life-cycle assessments together with departments for working environment, ecology and environmental sciences, chemical engineering and manufacturing engineering. Today permanent courses are offered on management of environment and working environment and life cycle assessments of products and systems.

Within organic food production, the Science Shop tried back in 1989 to involve the department for food technology in a research project on organic food production planned together with a number of user groups involved in activities related to the development of the agriculture and the food sector. The department for food technology was not interested at that time (although they had supervised some science shop student projects within organic food products), so the Interdisciplinary Centre decided to apply itself. Since then the Interdisciplinary Centre (and now the Department of Technology and Social Sciences) has had a small research group with three researchers within organic food production. Two researchers have almost been fully financed by external funding for more than 10 years. The group has given good possibilities for finding supervisors for science shop projects within the area. The group has also offered a course module in organic food production for five years. The long-term vision is to develop a permanent course module together with the department for food technology. Today, the research group is giving a single lecture on organic food processing at the department for food technology.

A third strategy used for developing the base for permanent activities based on topics highlighted in requests to the Science Shop has been discussion groups organised in co-operation between the Science Shop and departments at the university. Discussion groups has been organised together with the department for environmental technology and the department for urban planning on the use of rain water, water savings in households and new methods for waste water treatment. A number of lectures given by researchers, NGO's and authorities have been the basis for exchanging experiences and views on these new technologies and a number of student projects have been organised as a low-budget way of exploring aspects of the technologies. The department for environmental engineering has integrated lectures on these technologies in some of there existing and has also been given small research grants by the National Environmental Protection Agency to research within the use of rain water.

A final renewing activity is the development of new course modules within community-oriented research and development. The Science Shop developed already after one year a course module on theories and methods for co-operation between experts and user groups. The Science Shop found it a need for all engineering students to learn how to co-operate with lay people in an interactive way by facing the differences (e.g. scientific based knowledge versus experience based knowledge) and try to use them in a proactive and productive way. Another problem is that lay people sometimes expects an expert to be able to give definite answers. This course is today quite popular among the students at the university.

It is important to be aware that the renewing activities take time from the day-to-day project management in the Science Shop. This is experienced by the Science Shop at The Technical University of Denmark, but also by several of the Dutch Science Shops. It is of course important that not all resources are used for the renewing activities, since this might favour the bigger user groups on behalf of smaller and more local oriented user groups.

4. Planning and starting a Science Shop

Before starting a Science Shop, it is important to consider why you want to start the Science Shop at the university. Which needs do you expect the Science Shop to fulfil? Which benefits do you expect whom to get from the Science Shop? The initiative for Science Shops has sometimes come from students and sometimes from the scientific personnel at the university (or school or faculty). It is a good strategy to develop the proposal for a Science Shop as a joint initiative from students and scientists. It is also a good idea to involve possible users of a Science Shop to discuss the possible needs for knowledge that could be covered by a Science Shop at the university. Students, scientific and maybe administrative personnel from the university and some possible user groups could form a planing group to be responsible for the preparation of an application.

An application for a Science Shop to a university should at least touch the following topics:
- Why a Science Shop at the university: potential benefits for the university and in the society.
- Potential user groups and their need for knowledge.
- Experiences from other Science Shops.
- Activities in the Science Shop.

- Affiliation of the Science Shop to the university: Organisation and management.
- Personnel in the Science Shop.
- How can a Science shop and students' project work fit into the curricula of the university?
- How can the scientific personnel be involved in the Science Shop work: As supervisors? By working themselves with requests?
- Budget and financing: University funds? National funds?

These topics are considered in the following.

It is important to discuss the potential benefits from a Science Shop and stress that a Science Shop not only helps outside the university. It is also giving something to the university. These four types of benefits should be discussed:
- More democratic access to the resources of the university.
- Developing the relations between the university and the society.
- Giving the students experiences with project work and co-operation with user groups outside the university.
- Renewing research and education at the university based on the user groups' knowledge needs and developed through the project work.

It is an important part of the planning to get in dialogue with the possible users of a Science Shop and ask for requests for research and advice. Such proposals illustrate the needs to the planning group and can support the application by showing that there actually is a need for research and advice among lay people, NGO's and others. One or two pilot projects might be carried out as part of the planning work in order to get first hand experience at the university with co-operation with user groups.

The existing Science Shops perform a number of different activities. They all work with the requests from the user groups and some of them also work with renewing activities at the university. The need and the possibilities for these different activities should consider during the planning of a Science Shop:
- Short term advice: Answering by the Science Shop, using the scientific personnel at the university, referring to external sources.
- Student project work.
- Advisory groups for meeting with user groups on ongoing projects.
- Research projects.
- Developing new areas for education and research: Empirical fields, theories and methods for co-operation with user groups.

An important part of the planning is to prepare the budget for the Science Shop. Since the activities of the Science Shop are free, the resources have to come from the university. Some important resources needs for a Science Shop:
- Personnel: Student employees, scientific personnel, secretary. The students are very important because they are close to the other students and the different departments. Salary to the personnel, including allocation of working hours of permanent personnel.
- Volunteers: Networking with scientific personnel and students. There is a need for developing networking at the universities within the topics the user groups are coming up with.

- Equipment, including computers, and resources for copying, postage etc.
- Rooms and other facilities.