**Denmark’s Electronic Research Library - supporting research and education in Denmark**

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**Paper**

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**Introduction**

The Danish Electronic Research Library (DEF in Danish) is the realisation of a vision of a single virtual research library focused on the need for easy access to scientific information for researchers and students in Denmark. DEF is a large government funded project, which over a 5 year period spends 200 million Danish Kroner (27 million Euro) in order to build a national virtual research library in Denmark. The project aims to help the transition from purely paper-based services to electronic services in the library sector and focuses on organisational changes as well.

This paper will describe the background and the present status of the project. The project is heavily based on co-operation on national and international level, and the strategy behind this is put forward.

DEF supports research and education in Denmark by being an important part of the Danish research infrastructure. This part of the Danish research infrastructure depends on the execution of three main activities in the DEF project, and these three activities complement each other in order to give the best access to the largest amount of research information for the users. One concrete result is the establishment of an efficient and cost saving organisation to handle acquisition of electronic journals and databases. Another concrete result is the DEF-portal [www.deff.dk](http://www.deff.dk), which serves as a single point of access to the resources in DEF. It contains a national authentication and authorisation system giving remote access to the electronic journals and databases. In addition the portal allows cross-searching in library catalogues, access to Subject portals and integration of a distributed database system for Danish research results, projects and participants.
The future for DEF after the project phase starts to materialise, since DEF is part of the proposal for the State Budget 2003 and on with a reduced budget. If DEF becomes permanent, the main challenge is to maintain and enlarge the success areas from the project period and find new valuable activity areas.

Finally experiences from a position of controlling a national ICT project are summarised.

**Background**

Denmark’s Electronic Research Library aims to move the Danish libraries from the state of automated, conventional, co-operating individual libraries to the state of one large, coherent, electronic library structure providing integrated information services.

The project was defined in a project description of September 1996 by the three ministries involved:

* Ministry of Culture
* Ministry of Research
* Ministry of Education.

A governmental agency, UNI-C, and the management consulting firm Ernst and Young then conducted a study, which resulted in the publishing of a report in the early spring 1997. The report described a vision for the development of the research libraries in Denmark.

On the basis of this work the three ministries decided to develop the Danish research libraries over a five year period of time (1998-2002) in order to get them to function as one integrated research library: Denmark’s Electronic Research Library. The ministries made a 200 million Danish Kroner (i.e. 27 million Euro) funding available for the project. The project was part of the government's initiative for research and IT in those years, and it is still part of the present political planning for the IT and knowledge society in Denmark.

A project organisation was devised for the implementation of DEF:

* Liaison group consisting of members from the three ministries involved
* Steering Committee with eleven members appointed by the ministries and organisations
* Secretariat integrated in The Danish National Library Authority.

Three director-level members from the three ministries head the liaison group, and the chairman of the Steering Committee represents the project.

The Steering Committee represents various skills, for example library management, research, IT and commercial work.

The role of the Secretariat in the Danish National Library Authority is to execute the decisions of the Steering Committee in general.

After approximately one year's work the roles between the Steering Committee and the Secretariat were changed from traditional Steering Committee and Secretariat relations to relations similar to a board of directors and the managing director in a private company. This was the result of the
chairman of the Steering Committee's demand for speed and low interference in the Secretariat work between the committee meetings.

The goal for Secretariat and Steering Committee is to realise the vision from the report, taking into account that the world is changing and therefore also the conditions and opportunities for the project.

**From vision to action**

Some key sentences from the report are:

* Network of electronic libraries. 
This shows that the goal is not to build one huge central library, but instead the Internet-based networking structure must be used. The physical libraries and information centres must connect to each other and establish several virtual libraries.
* Virtual access to all information resources in Denmark. 
This points out that access to the electronic library should be possible from any location either work, home or mobile. It also says that the goal is access to all Danish resources – but is not limiting the resources to pure Danish ones.
* New standards and working relations. 
This means that new standards must be used in order to build an open structure with possible use of existing subsystems and easy interoperability to other systems. The new working relations is a very interesting and important area, since old borders have to be removed and new relations established mostly due to the new media and its possibilities.

**DEF is operating in four activity areas**

The project is divided into four activity areas:

* National infrastructure
* Library infrastructure
* Digital resources
* User facilities.

**National infrastructure**
The national infrastructure is the IT network and facilities enabling the libraries and the users to communicate efficiently.

The Danish Research Network has been chosen as the IT-network, and this high-speed network has the advantage, that a substantial part of the libraries and the users are already attached to it.

This national infrastructure is, however, more than technology. The overall infrastructure includes creating common guidelines for, in particular, exchange of information, use of international standards, unified user access etc. The regulations for user administration must also be uniform and according to consensus among all the libraries.

**Library infrastructure**
To enable each library to become an active player in the virtual library, it is modernised in a number of ways. Earlier it has been acceptable for each library to use its own individual IT systems and organisational procedures. In the virtual research library the technology and a number of organisational issues must be standardised.

Increased co-operation between the research libraries requires overall common management and co-ordination. Co-operation across ministerial borders has been established, but the local participants must retain their independence in order to preserve the dynamics of the system.

**Digital resources**

National license agreements are negotiated and signed by the Danish National Library Authority on behalf of DEF. A better name for these licenses is common licenses or DEF-licenses, since most of them are not covering the whole nation but only the users of the essential institutions. As usual any library can co-operate with another library or institution, form a consortium and negotiate licenses. The consortium can apply for financial backing from DEF or just hand over the license to DEF, thereby ensuring that more, relevant institutions are invited to share the license. In this case the license will be transferred to the Danish National Library Authority as holder of the license.

Digitisation of some parts of various collections is in progress. For the digitised materials some of the challenges are:

* Efficient management
* Wide access
* Protection against damage and misuse
* Migration to future technological platforms.

National principles and a strategy for digitisation have been developed by the Steering Committee. It concerns a framework for standards, methods, and competence centres - and a plan for selection of collections to be digitised.

Other digital resources are the Danish Research Database, which has been transformed to a new web-based architecture, and a large amount of retroconverted card catalogues, where the conversion has been financed by DEF.

**User facilities**

For the digital library user facilities air a major issue, especially an economic issue. It is crucial to provide the user with sufficient facilities and electronic services.

This activity area focuses on projects, for example user services in subject searching (Subject portals), tools to web-based education and tools for annotation of web-based research and studying.

**DEF in figures in September 2002**

A very precise way to express the current status of the project is to show figures for several key activities:
* 31 libraries co-operate about the DEF portal. It is 12 big and 19 mid-sized libraries, and they have all submitted information about their subject areas, they participate in harvesting of their websites, and they provide guidelines for the DEF portal.
* The DEF catalogue of catalogues gives access to app. 500 electronic net resources:
  - Collections of journals, articles and reports
  - Bibliographies
  - DEF libraries
  - DEF library catalogues
  - Subject portals
  - Collections of links and virtual libraries chosen by reference librarians
* 6 Subject portals operate, and 5 more are under development
* 122 libraries have installed or will implement new library systems through DEF according to DEF technical standards
* DEF gives access to 53 DEF licences including app. 8,900 journals in full text. DEF licenses are defined as licenses negotiated and held by the Danish National Library Authority on behalf of the libraries.
* Each library can access from 1 to 62 licensed products
* 110 libraries (‘sites’) participate in DEF licenses, and these are covering an additional 194 institute libraries/institutes/hospitals
* Retroconversion of app. 2.5 million catalogue cards from card catalogues from 14 research libraries is in progress for a total amount of 19 million Dkr (2.6 million Euro)
* 35 libraries participate in 20 DEF-development projects concerning systems test, Subject portals, user education, user statistics / user satisfaction, digitising, e-learning etc.
* 11 user-driven projects have been started
* 3 libraries and 10 publishers participate in 5 digitisation projects apart from digitising of selected core journals f. ex.:
  * Weilbach Kunstner Leksikon gives information about 37,500 works of art and 6,000 Danish and foreign artists in 55 museums
  * Illustreret Tidende consists of 65 volumes, 58,000 pages and 4,000 pictures
  * Archive for Danish Literature contains 70 of the most important Danish classical authors’ works consisting of app. 150,000 pages digitised in full text, selected portraits of authors and extended with critical materials.

**Co-operation is crucial**

The philosophy in the project development reflects the importance of national co-operation and consensus. No lasting solutions can be implemented without the participation and acceptance from the libraries. Therefore the key words for all activities are co-operation, co-operation and co-operation. After some time everybody realised, that pooling resources gave a better result for everybody than trying on an individual basis. This opinion is obviously more easily obtained with some central money, which facilitates the process.

Another way to support co-operation in projects like DEF is to show good results. Therefore it is advantageous to choose activities, which quickly lead to improved conditions for the libraries and their users. Planning according to “least resistance” gives quicker results, but it is not the same as avoiding conflicts. A lot of confrontation is part of the process and normally every confrontation results in a peaceful and lasting consensus.
In order to achieve the results, co-operation and effort from the biggest libraries are of great importance. These libraries control most of the financial resources and material, they already have an organisation, which can deal with common issues, and they are ready for changes. The DEF project started co-operation with these libraries early, and their efforts have also been of great value to the smaller libraries.

**DEF being an important part of the Danish research infrastructure**

DEF supports research and education in Denmark by being an important part of the Danish research infrastructure. This part of the Danish research infrastructure depends on the execution of three main activities in the DEF project, where DEF:
* catalyses library co-operation
* develops electronic services for the users
* extends resource-sharing between the libraries

These three activities complement each other in order to give the best access to the largest amount of research information for the users. The end users consist of researchers and students, where the total number of academic researchers is approximately 25,000, while the number of students exceeds 140,000.

**Consortia licences for electronic journals and databases**

Acquisition and access to electronic journals and databases is an area, where the three main activities have been particularly valuable. For several years a co-operation organisation consisting of the responsible for acquisition from the libraries and the DEF Secretariat has co-ordinated acquisition of electronic information resources at a value of more than 60 million DKr. (8,0 million Euro). This is by far the majority of the library sector’s acquisitions in this area.

The information specialist expertise is delivered from the libraries, while the commercial, legal and negotiating effort is delivered from the DEF Secretariat. Often the financing model of the individual acquisition is a major payment from the involved libraries’ budgets combined with a smaller payment from the central funding controlled by the DEF Secretariat.

As in many other areas the existence of central ‘seed money’ has been very helpful for the implementation of the three main activities mentioned above. The result of this successful co-operation has been a better exploitation of the existing acquisition budgets for the libraries and an extended access to information resources for all researchers and students. In this way DEF plays an important role in the continued construction of an ICT infrastructure for research and education.

A concrete example of gains from common acquisition is the procurement of a license for the full text journals from the publisher Elsevier.
Before the DEF co-operation the libraries had subscriptions to between 1 and 100 journals in printed version from Elsevier. By signing a common consortia license all the libraries have electronic access to all 1,250 Elsevier journals at an extra fee of 11% of the yearly subscription.

If the individual library stops subscribing to the printed version and only offers access to the electronic version, the library can save 10% on its yearly subscription and at the same time give access to all 1,250 journals. In this way the amount of information to the users is increased dramatically in a very economical way.

The use of the journals from Elsevier is very extensive, and it is increased concurrently with the access to more journal titles. Figure 1 shows the number of complete articles, which on a yearly basis is downloaded for reading and printing on a PC by Danish users.

The heavily increasing usage of the journals continuously lowers the price per article. In this event the price per article decreases from approximately 148 DKr. (19,7 Euro) in 2000 to approximately 62 DKr. (8,3 Euro) in 2001, and the journals from Elsevier are always considered very expensive. For the publisher Springer the price per article decreases from approximately 50 DKr. (6,7 Euro) in 2000 to approximately 25 DKr. (3,3 Euro) in 2001. In comparison it will cost approximately 175 DKr. (23,3 Euro) plus handling expenses at the library to order a paper copy of an article from abroad for a Danish user.

**Gains from other activity areas in DEF**

In a similar way gains are realised in other activity areas in the DEF-project on the basis of the three main activities mentioned above. Examples are:

* Projects are conducted by the libraries in co-operation with a supplement of central funding, and the project results are freely available to all users. In this way knowledge sharing is encouraged and double work is avoided.
* A common EU-tender for converting of card catalogues from paper to electronic version has in total given a bigger saving than carrying out a number of individual businesses.
* Creation of common Subject portals with quality controlled information is done in co-operation between the libraries in the subject area. This gives a complete national access point to the subject area, a bigger and easier accessible amount of information to the users and a rational use of manpower in the libraries.
* DEF has developed tools for common exploitation in the library sector and its users aiming at removing double work and increasing the information content for the users.
Special user-driven projects give extensions to established projects, which are solely started in response to user requests. The results can be re-used by libraries, researchers and students.

**National infrastructure / DEF system architecture**

A system architecture project was launched in order to make a solid basis for 24-hour access to the content and services in the digital library. The project is following three main principles:

* The architecture shall be the concrete practical implementation and realisation of the DEF-vision.
* The vision is a system of systems, meaning that no single central stand-alone system shall be built. A decentralised and networked approach shall govern the project.
* The system architecture project shall be the main project for 5 sub-projects:
  * DEF portal
  * DEF key
  * DEF catalogue
  * DEF Subject portals
  * Danish National Research Database.

**deff.dk: DEF Portal and services 2002**

The DEF portal (deff.dk), the services and the system architecture in version September 2002 are illustrated in fig. 1. Predominantly it is a 2-layer architecture, where the connection between the software modules is realised by the Z39.50 protocol and tools from the Open Archives Initiative (OAI). The services in the upper level are based on software modules, which are nearly 100% self-contained, meaning that nearly no data are exchanged between the services. A common user interface design gives the user the impression that everything is tightly integrated. The background for this design is, that it reduces complexity and time to develop in order to achieve a reasonably simple and efficient system in the project period. Also it allows the individual libraries to exploit the data in the low level for their own local solutions.
The following is a brief description of the functionality of the individual software modules in the upper level:

**DEF Portal:** Welcome pages with introduction, help, sitemap etc.

**DEF Link collection:** Searching or browsing in quality controlled links sorted into DEF’s 26 subject categories giving access to Danish and international free resources, i.e. collections and Subject portals

**DEF Subject portals:** Searching and interaction with all Subject portals partly financed by DEF and based on tools developed by DEF

**DEF Portal Search:** Searching or browsing in metadata from all DEF’s Subject portals and full text search in harvested pages from the libraries websites

**DEF Catalogues:** Searching in all bigger Danish libraries catalogues and selected international catalogues, ordering of material from the Danish libraries with delivery to home or own library

**Danish National Research Database:** Searching in Danish research results, projects and profiles of institutions based on data deliveries from the administrations in the local institutions
DEF Electronic Journals: Searching in journal titles and access to full text articles and databases for authorised users from any Internet connection at any time

In the low level there is one crucial network of modules:

LDAP network: Authentication of authorised user for the DEF Electronic Journals

From project to permanent activity

On December 31st, 2002, the DEF project period comes to an end. This means that all funding has been used or allocated for minor projects, which will end in a reasonably short timeframe after 2002.

The original thinking at the DEF project launch in 1998 was, that the funding would lift the research libraries to a higher level, and maintenance of this new level would be secured by new working routines and the normal, local budgets for the libraries. During the project years it became fairly clear, that this assumption was wrong, and Steering Committee and the Secretariat started to work for permanent funding. In May and June 2002 DEF has been analysed by three ministries:

* Ministry of Finance
* Ministry of Culture
* Ministry of Science.

The result of the analysis has been decisive for the ministries' input to the proposal for the Danish State Budget from 2003 and onwards. DEF is proposed to become permanent with a reduced budget, and if this is accepted, the main challenge is to maintain and enlarge the success areas from the project period and find new valuable activity areas.

DEF 2003 activities

The establishment of a firm co-operation in the research library sector is a crucial result of the DEF-project. This co-operation shall consolidate and extend in the coming period of time. Already today several activities contain an additional international co-operation, which shall be maintained and extended. In the following the possible activities in the future, permanent DEF will be presented.

These activities and initiatives include:

* Development and operation of technical national infrastructure with possibility of usage statistics
* Common acquisition of licenses for electronic journals and databases
* Development and operation of the Danish Research Database
* Implementation and support for Subject portals including development of tools
* Co-operation by subject
* Functional sharing of work
* Common systems operation
* Co-operation with other institutions/sectors
* Digitising
* E-learning
* E-publishing
Development and operation of technical national infrastructure with possibility of usage statistics
The existing common technical infrastructure in the portal deff.dk and its surrounding components shall operate, be supported and in some degree be developed. deff.dk shall consolidate in order to secure simple operation. Furthermore additional components shall be developed for use in the libraries. In this way the users get most value from the investment and double development is avoided.

The systematic usage statistics shall extend. The existing measurements of number of visits and downloads of full text documents shall extend with analysis of user distribution in regard to institutions and time of day.

Common acquisition of licenses for electronic journals and databases
The existing license activity shall continue. This means that the DEF Secretariat shall perform the time-consuming common administration of vendors, contracts and technique as well as the common acquisition procedures with the libraries as information specialists and financial foundation. The major part of the funding will still be found in the libraries’ budgets.

Development and operation of the Danish Research Database
The Danish Research Database shall operate, be supported and developed to ensure that the database is sufficiently complete, and that the content is updated in order to maintain the database as a useful tool in the mediation of Danish research.

Implementation and support for Subject portals including development of tools
The existing work with Subject portals shall continue in areas, where no relevant international alternatives are found. In this way establishment and support of Subject portals can still be performed in a cost-effective way, and the development of tools can be co-ordinated for the common good.

Co-operation by subject
Establishment of subject co-operation aims to give users from the same subject environment a better and more homogeneous library service and to free resources for other tasks. The co-operation is established as bi- or multilateral co-operation.

The co-operation includes a closer license co-operation with subject licenses instead of specific institution accesses, co-operation about selection of material, development of Subject portals for virtual communities with catalogue searching, digitised material, alert services etc. as well as closer co-operation between subject librarians in other fields. The co-operation between the Royal Library, the State and University Library, Odense University Library and the Danish Music Information Centre (MIC) concerning the Online Music Research Library is a good example.

Functional sharing of work
Electronic services become more advanced and more costly to acquire or develop. At the same time they are characterised by being able to service many simultaneous users without significant extra cost. This suggests that in the development of the services the emphasis must be on a division of labour, and the resulting possibility of specialising is used. The aim at this initiative will be to free resources in the libraries by one or a few libraries developing and operating services for the others.
Relevant areas are digitising, access control, e-learning, streaming media, electronic publishing and user facilities. The libraries’ common access system is a good example of this mode of operation.

Common systems operation
The construction of a framework for common systems operation can give a more stable infrastructure and free resources from the individual library. This initiative is similar to the initiative with functional sharing of work, but the main emphasis is placed on systems operation. Naturally this will not exclude that some libraries take care of the systems operations for other libraries. A good example is a number of bigger libraries acting as hosts for smaller libraries. Among the possible activities are:

* General common further development of national architecture/infrastructure
* Further standardising, including usage of XML
* Increased usage of Open Source
* Same type of library or library systems consolidated on 1 or 2 locations. The number of types of library systems should be limited over time in re-acquisition situations
* Subject portals - these can hosted at a web-hotel
* Portal search machine - today it consolidates metadata and it shall continue doing this
* Catalogue search via the Z39.50 protocol - this component is common today, and it gives a simultaneously, completely updated access to by far the majority of the libraries’ holdings. This service shall continue and be extended in one location. Also other virtual systems shall be extended in one location to be perceived as one system.
* Periodical directory to connected journal databases - this component is common today, and it shall continue and be extended in one location.
* Search system - one common search system established in one location as a solution for most libraries
* The Danish Research Database - common base at one location but with possibility for cross searching of the research institutions local databases, if this is rational
* Key/access system - only the biggest institutions are equipped with their own base physically separated from the common base.
* Digitisation equipment - capacity exploited in maximum way, and equipment is only placed in few locations (in this way expenses for technological updating are minimised)

Co-operation with other institutions/sectors
Universities and research institutions are very obvious co-operation partners in several of the above-mentioned initiatives, since they make up the big user group and are owners of most of the university libraries.

The public libraries are also obvious co-operation partners in several of the mentioned initiatives just as the education libraries, archives, museums and IT research environments will be relevant co-operation partners in selected areas. Furthermore co-operation and work division with commercial systems operations partners in Denmark and abroad like Danish Bibliographic Centre (DBC) and OCLC is a likely option. Finally co-operation with libraries and institutions under other ministries will be valuable.

However, it will be difficult to draw a model of organisation, which also consists of public libraries and others, and they can probably be involved gradually in the co-operation or on an ad hoc basis.
Naturally, it is not certain that the co-operation with these institutions will be organised in the DEF co-operation, because it can be more efficient to develop bi- or multilateral co-operation.

**Digitising**
The aim of this initiative is to secure simple end efficient access to relevant information, literature, study and research material in digital version accessible on the net via a systematic digitising effort.

This can happen by completion of digitising programmes, which gradually can supplement the existing amount of electronically accessible journals with other material (textbooks, compendia, central works and works in great demand).

Furthermore a program for a co-ordinated digitising on demand service can be established, which can offer the users of DEF digital versions of journal articles and other short documents, which can be found as a result of searches, but are only available in a paper version in the libraries. The Dutch DocuTrans system is an example of an efficient pdf on demand system, which could be considered integrated in the infrastructure of DEF and the libraries’ collections and service capacity. The programmes are carried out under a documented DEF framework for controlling digitising and in close connection with parallel EU and other international initiatives.

**E-learning**

With this initiative DEF can encourage a further development of the information and study foundation for e-learning through central projects in co-operation with universities and institutions of higher education. A number of common systems are implemented: Common log-in, common handling of networks, common handling of material (clearing, storing and digitising).

DEF can contribute with development of XML-based standards and architectures for open integration of virtual libraries and virtual universities and e-learning environments, including loading of educational material in DEF and integration of DEF's systems and material in an e-learning context.

One example of co-operation between universities and other interested parties is FlexDEF, which is a co-operation project between the Business School in Århus, Odense University, Aalborg University and Århus University, other research institutions and a number of companies, where DEF's resources are integrated in the project.

**E-publishing**

As an important part of the national information infrastructure DEF can work for further e-publishing of research literature and the accessibility of this under attractive economic conditions.

DEF can contribute by launching initiatives in research publishing, including an increased effort for pre-print servers and other ways of publishing, participation in the Budapest Open Access Initiative and SPARC co-operation. DEF can work for changes in practice for handing over the copyright to a publisher in connection with publicly employed researchers. DEF can participate in the development and implementation of institutional ‘super archives’, which assemble research data and information as well as normal publishing. Also this initiative shall be connected with the Danish Research Database.
Experiences in managing a national project

During the first 4½ years a lot of experience has been assembled in managing a national digital library project. The most fundamental issue is that national and international co-operation is the gateway to success. It is impossible to achieve success unless the national players are co-operating, and the only way to avoid duplication work is to co-operate internationally.

Another important area is to control increasing project complexity with many focus areas in the decentralised structure in Denmark. Both the many focus areas and the Danish structure tend to slow down progress, if decisions are not made at a reasonably quick pace.

The Steering Committee members' different background is both a strength and a weakness. It is valuable to have many experts participating in the group, but it can certainly be a challenge for a chairman to control. Furthermore it is of great importance to divide the responsibilities and work between Steering Committee, Secretariat and libraries. Specifically it is necessary to give financial room and mandate in negotiations and project management to the Secretariat, and this has been one way to keep up the speed in the DEF project.

Development work has been done both with academic and commercial partners. Their way of working is very different and both have their pros and cons. Very simply put, academic work seems to be prosperous in the experimental phases, while commercial work fits better into a production system. One big difficulty is the necessary use of EU-tenders, which is time-consuming and does not seem to result in optimal solutions.

Finally a project management coming from outside of the library sector has gathered a lot of experience with libraries. These few sentences illustrate the meeting between the librarian's world and the world of a manager and computer engineer seen from the perspective of the latter:

* Decisions are necessary - everlasting discussions hinder progress.
* Nothing is secret in the library world or in its surroundings - not even commercial secrets.

These sentences are written with the best of intentions - the encounter with the library world has in all aspects been stimulating and enriching.

Summary

The decision of launching DEF and the fulfilment of DEF have both proved to be a success. The funding and lots of hard work have upgraded the Danish research libraries to modern technological level and have secured new national co-operation for the years to come. The overall effort could be summarised in the following three statements:

* DEF has provided a remarkable improvement of service level for the users of the Danish research libraries
* DEF has provided a series of good results in the 5 years project period
* DEF will continue to deliver new services and improve cost-effectiveness as co-ordinator of the co-operation between the Danish research libraries

Summary