

# Experiences from Technology Transfer Initiatives at SISU

## Introduction

Sweden's first university department in information systems was established in 1966. Research on methods and tools for information systems development started almost immediately, primarily by the research groups CADIS and ISAC. Research as well as publication activities of these and other groups during the seventies has been extensively described in the 40:th anniversary book, published by the department (Bubenko jr., Jansson et al. 2006). University research in Sweden started to grow during the seventies. Several persons in organisations in business, industry as well as in the public sector showed a considerable interest in this research. In the early eighties the situation had matured so much that a question could be formulated: can knowledge and technology transfer from university research to practical application be somehow facilitated and enhanced?

In this paper we reflect on our experiences from an initiative to technology transfer in the field of information systems in Sweden. We are concerned with transfer of knowledge as well as of technical prototypes from academic research to product development, exploitation, and practical use in organisations. Our experiences emanate from our work in SISU – the Swedish Institute for Systems Development. SISU was formed in 1984 and existed until the end of 2000. In this paper we wish to describe, firstly, which are the main “products” of technology transfer, and, secondly, which are the main factors that influence (or hinder) the success of a technology transfer initiative.

## Background

SISU was formed in 1984 as a result of an initiative by SYSLAB (the SYStems development LABoratory at the department of computer and systems science, KTH and Stockholm University). Instrumental in this process was SYSLAB's industrial advisory group<sup>1</sup>. Leading researchers from SYSLAB together with the advisory group contacted a large number of Swedish organisations in order to obtain financial support for forming a research foundation. A considerable support was obtained. A “supporting user and partner organisation” called ISVI<sup>2</sup> (Intressentföreningen för SVensk Informationssystemutveckling) was established with 21 organisations and companies as members. SISU's research plans for the first three years, 1985 – 87, were worked out and documented in a “Framework Program” (ramprogram). All members of ISVI guaranteed to support SISU's research according to the Framework Program.

The Swedish government decided in the autumn of 1984 to establish the operation of the industry research institute SISU starting January 1<sup>st</sup>, 1985. SISU was initially financed by STU<sup>3</sup> and by ISVI. The 1985 budget of SISU was about 8 MSEK. Thirteen researchers<sup>4</sup> were transferred from SYSLAB

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<sup>1</sup> Members of the group were Rune Brandinger (chair), Valand Insurance Co., Krister Gustavsson, Statskontoret, Gunnar Holmdahl, ASEA Information Systems, Göran Kling, Volvo-Data, Sten Martin, Swedish Defence, Per-Olov Persson, Riksdataböndet, Sven-Erik Wallin, Esselte Datacenter, and Kurt Wedin, Vattenfall.

<sup>2</sup> ISVI members in 1984 were: ASEA, DATALOGIC, DBK, ENEA, ERICSSON, FÖRSVARSSTABEN, GÖTABANKEN, IBM, INFOLOGICS, KOMMUNDATA, PROGRAMMATOR, SAAB-SCANIA, SEBANKEN, SKANDIA, STATSKONSULT, STATSKONTORET, TELEVERKET, VALAND, VATTENFALL, VOLVO-DATA, AND VOLVO-PV.

<sup>3</sup> STU – Styrelsen för Teknisk Utveckling (The Swedish Board for Technical Development).

<sup>4</sup> These researchers were Matts Ahlsén, Peder Brandt, Stefan Britts, Janis Bubenko, Roland Dahl, Tord Dahl, Mats-Roger Gustavsson, Christer Hultén, Lars-Åke Johansson, Eva Lindencrona, Stefan Paulsson, Lars Söderlund, and Håkan Torbjär. SISU's first secretary was Marianne Sindler.

to SISU in January 1985. In its “peak era” (1990 – 1993) SISU had about 35 supporting organisations, an annual turnover of about 35 million Swedish crowns, and a staff of about 40 employees. SISU continued its operations until 2000, during the last two years as part of a research company Framkom. The foundation had a concluding passive period 2000 – 2004. SISU’s managing directors were Janis Bubenko (1985 – 1992), Thomas Falk (1992 – 1994), Eva Lindencrona (1995 -1998) and Mikael von Otter (1998 – 2000).

## **SISU’s mission and initial work areas**

The main goal of the SISU institute was to act as a technology transfer engine between academic research and practical application. By this we mean that SISU should take in ideas, knowledge and software prototypes developed in academia and further develop and package them so that their usefulness could be demonstrated in practical situations. It was our hope that this demonstration would stimulate commercial organisations to “take over”, or “productify” the knowledge, method or prototype for further development and exploitation. SISU’s areas of activity were determined in a “framework program” which was approved by the supporting organisation ISVI. It is natural that this first set of directions of SISU coincided very much with the research areas pursued by SYSLAB.

SISU’s main areas of activity during the first years were:

1. The Information Centre (information dissemination, education),
2. Management of Information and Data Resources,
3. Methods and Tools for Problem-oriented Systems Development,
4. Interactive Systems – Office Information Systems.

The task of the first area was to disseminate information about SISU’s research as well as information about other international research activities and results. This was essentially a “knowledge transfer” activity. It included seminars and courses. Courses could be open to all or they could be given to particular organisations.

The second area had the goal to exploit one of SYSLAB’s strong and internationally well known assets: conceptual modelling as an activity in the information systems development process.

The third area dealt with CASE tool development. SYSLAB had developed an idea to build a “meta-tool”, i.e. a tool by which CASE-tools for particular methods could be built. This meta-tool was called RAMATIC. As the members of ISVI were using different methods, this activity was expected to be beneficial to all supporting organisations.

The fourth area dealt with development of a prototype for developing distributed object management systems. The prototype was called OPAL. OPAL should be used for quick implementation of interactive systems, at this time called “office information systems”.

## **Initial technology transfer – the first three years**

The information Centre was perhaps the easiest to instigate. SISU’s personnel were active in a comparatively large network of international researchers and centres. They appreciated visiting SISU and share their knowledge in a number of topic areas, such as office information systems, databases, conceptual modelling, CASE technology, Artificial Intelligence, and Software Engineering. Seminars and courses organised by SISU were well attended. SISU did also organise company-specific education on a number of topics. For instance, SISU was responsible for a 10 week course in modern IT, involving several of the topics mentioned above, for the company ABB in Västerås. This particular course was carried out in close cooperation with DSV, the department of Computer and Systems

Science. Additional “products” of the centre was the monthly magazine “SISU Informa” and the report series “SISU Analys<sup>5</sup>”. These publications were distributed to all supporting organisations.

The conceptual modelling area generated a number of consulting activities as well as modelling courses. In the consulting activities SISU personnel and persons from organisations collaborated in practical design and development of systems. This resulted in knowledge transfer in several practical applications. Also a modelling language SIMOL was developed. A considerable number of modelling projects were initiated where SISU personnel took a leading and tutoring role. Modelling was primarily done in the health management sector with the purpose to improve information exchange. These projects pointed out the difficulty in transferring modelling knowledge to laymen. On the other hand, this work improved SISU’s competence in participatory modelling, to be a few years later used in collaborative national as well as in EU-supported projects. It also acted as a door-opener to join a number of EU-projects. Furthermore, SISU’s modelling approach was later picked up by a number of private consultancy companies who adjusted and packaged the research results into commercial method-products.

The idea of creating a CASE “meta-tool” was born in the early eighties. This project was called RAMATIC. It exploited both our modelling knowledge and an earlier academic product – the associative database management system of CS4. The problem was that we underestimated the complexity of the venture to build such a meta-tool. Furthermore, the computer and software technology in the mid eighties was not ready for such an effort. For instance, no windowing techniques existed on the computers. Another problem was that we started building the meta-tool not using object-oriented technology. An additional difficulty was that we were too optimistic to find potential producers and exploiters of this tool. To make it a robust and user friendly product would require both more advanced computer and software technology and personnel resources in the range of several hundred person-years. Consequently, we did not manage to find an organisation that was willing to take such a risk. On the positive side we can mention that, at the end of the three year period, we could perform practical experiments with the tool in some companies, e.g. Volvo Car and Televerket (now Telia). We can also report that RAMATIC later became used in a number of collaborative EU-projects for building experimental CASE-tools for particular methods developed in the projects. In a sense one can say that the CASE tools and SISU knowledge of building such tools was one of the roots for SISU’s early and successful participation in several EU projects.

The fourth activity also involved building an extremely complex software system. Significant resources were assigned to developing a prototype for software development in the area of distributed, interactive office information systems. The prototype was designed to make use of recent advances in hardware, software and communications technologies. Ideas implemented in this prototype were novel. It was an object-oriented system architecture that could define, create, and manage active objects in a distributed environment. It demonstrated system properties that can be seen in full operation today, e.g. workflow systems, CSCW-systems, and objects with properties similar to cookies, viruses, and “spyware”. This kind of objects were discussed by the originators of the object-oriented OPAL system before we even had heard of Personal Computers, Windows, workstations, the World Wide Web and all its peculiarities. At the late eighties, on the other hand, no Swedish organisation could be found, willing to take the economic risk to make a product out of these prototypical ideas.

During this period planning for collaborative projects was initiated. Six working groups, staffed by employees of SISU and of ISVI, used a large part of 1985 to analyse the need for research in systems development among the companies and organisations of ISVI. A number of project proposals were presented to the members of ISVI. It was decided that six of the proposals should eventually be

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<sup>5</sup> These reports had the ambition to give a popular introduction to complex, technological topics such as “Conceptual Modelling”, “Graphical Tools for Systems Development”, “ADA Technology”, “Office Information Systems”, etc.

initiated. Later a permanent technical advisory committee of ISVI was formed. The committee, staffed by ISVI experts, would give advice to leading researchers of SISU regarding its research programme.

Another interesting activity that we proposed in 1985 was to use the electronic conferencing system KOM (on DSV's Digital Equipment DEC 20/20 computer) for communication between SISU and its supporting organisations, and among themselves too. This was more than five years ahead of the start of internet. Unfortunately our initiative failed, mainly due to problems with equipment compatibility.

At this stage it is probably reasonable to ask – was SISU's first framework program too optimistic? Should the transfer problems not have been anticipated? The initial framework program, where the above research areas and tasks were described, was accepted by the supporting organisation ISVI without any serious critique. How could this happen? There are at least two reasons. Firstly, we did not bother ourselves to sufficiently well examine the critical question: can this be done with available time and resources? In our enthusiasm, we did not want to hear anything that might reduce our ambitions. The second is that ISVI-people perhaps did not always understand the complexity of the tasks we were proposing, but they trusted us and they wanted to believe us. We conclude this section, nevertheless, that, even if the prototypes themselves were not turned into products, they served as concrete ideas and tools for knowledge transfer and introduced new ways of thinking and new methods in the ISVI group of companies and organizations.

## Succeeding projects and transfer initiatives

After 1988 SISU continued to generate and carry out a large number of national as well as international, collaborative projects where the supporting organisations from ISVI and European enterprises took an active part. Collaborative projects can be seen as one of the most efficient ways of knowledge transfer. It is important to note that the transferring of knowledge is bidirectional. Knowledge created in research projects was introduced in the collaborative projects. Knowledge of practical problems and requirements was observed in the same projects and at the same time new, shared knowledge was created. In the sequel we describe some national as well as some international (within the EU framework) projects.

### National projects

One national project is **TRIAD** that generated a vast amount of knowledge in business modelling in organisations. This was essentially a follow-up project of area 2 above. The technology to be transferred was not a software product, but rather a particular business modelling method – *participatory modelling*. More than 100 persons from ISVI organisations took part in different knowledge generating activities of TRIAD thus supporting and carrying out the transfer of modelling knowledge. TRIAD also produced a by-product: a very easy to use, simple Macintosh based graphical modelling tool called Business Modeller. Regrettably, Business Modeller was not exploited outside the TRIAD project.

The **HYBRIS project** generated a hypertext-based tool that allows inexperienced computer users to navigate in and retrieve information from large corporate databases at a conceptual level. The information in the databases is represented in a conceptual model, called an information map. By pointing and clicking directly in the information map, users can retrieve information from the databases. Constraints that restrict the information search can be formulated. The graphical query is then translated to SQL (Structured Query Language) and sent to the database. The result of the SQL-query is brought back to the HYBRIS tool where the users have different alternatives for manipulating the result. HYBRIS became practically applied, in particular at Televerket (Swedish Telecom).

**Effective IT** is the name of a fairly large, two-year, umbrella-project run 1993 – 95. It was initiated by a preliminary study project ordered by Sweden's ministry of industry and business and by NUTEK. The aim of Effective IT was to investigate the possibility to define a national research program for improved and more effective use of IT in Swedish business and industry. Five subprojects were

carried out: 1) Improving the quality of systems development, 2) Management of legacy systems, 3) Economy and Management of IT, 4) Tools for business development and modelling, and 5) Business communication and EDI. Effective IT involved a large number of supporting organisations.

A two-year joint project, **The Electronic Newspaper**, with partners Dagens Nyheter, Telia, Institutet för Medieteknik, and SISU analysed new possibilities for producing and interacting with a newspaper enabled by advances in computing, communication, and media technology. The project resulted in a prototype newspaper with advanced possibilities for searching of information and for communication between readers.

The project **E-society** (2004 – 2006) concerned various topics deemed relevant for the society in the future, such as internet services, information noise, privacy, and security. The project was partly financed by SISU and carried out at the Santa Anna IT Research Institute AB.

## International projects

One of the distinguishing initiatives of SISU was its participation in the European strategic programme for research and development in information technologies (ESPRIT). Also non-EU countries, but belonging to the European Economic Area<sup>6</sup> were invited to participate in the ESPRIT 2 programme at their own cost<sup>7</sup>. SISU understood very early the scientific, technological, and the economic importance of joining the ESPRIT programme. Work on forming of consortia and on preparing project proposals started 1987.

In 1988 the KIWIS proposal, with SISU as partners, was awarded EU-support for 3,5 years starting Jan. 1<sup>st</sup>, 1989. The goal of KIWIS was to develop a knowledge-base system to support sophisticated applications requiring complex operations on data and knowledge, possibly located in other systems, i.e. a federated database architecture. KIWIS started an era of SISU where several more EU-projects were awarded. A greater part of SISU personnel became part time engaged in European collaborative project work. During the period from late eighties until the year 2000 SISU participated in more than ten EU-supported projects. These projects pursued a number of advanced topics, such as, temporal-deductive information modelling, multimedia object management, accessing information in heterogeneous corporate databases, advanced techniques in requirements engineering, and several more topic areas.

These EU-projects considerably extended SISU's contacts with European companies as well as with research institutes and university departments. They significantly enlarged SISU's knowledge and experience about systems development principles, approaches, and methods, including supporting tools. Our participation in European activities thus directly helped many of SISU's supporting organisations to prepare themselves for future collaboration in the European union. Last, but not least, these projects gave SISU improved financial means to engage young persons in advanced research activities leading to a higher academic degree as well as to prototypes and ideas about starting up own companies (see below).

## Other international activities

During a couple of years one of SISU's researchers (Stig Berild) was stationed in Silicon Valley as a member of the Swedish Technical Attaches in the US. Stig reported back to SISU's supporting companies valuable observations of the information technological development in the USA. Later Eva Lindencrona was during one year temporarily employed by the European Commission in Brussels. Eva's work in Brussels gave SISU and its supporters valuable information about how the commission was performing strategic planning of research and development in the IT area as well as information about criteria for evaluation of project proposals.

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<sup>6</sup> Other countries of EEA at that time were Norway, Finland, Austria, Iceland, and Lichtenstein.

<sup>7</sup> For Swedish participants of ESPRIT 2 the costs were absorbed by NUTEK, the follow-up organisation of STU.

## Conferences

SISU personnel has been active in the Very Large Data Base conference series since its start in 1975. In 1985 SISU (together with DSV) were hosts of the VLDB-85 held in Stockholm. A record number of more than 800 delegates attended the conference. Many of them were from industry, business, and the public sector. In 1989 SISU took the initiative to arrange the first International Conference on Advanced Information Systems Engineering (CAiSE). CAiSE'89 was attended by a large number of international delegates making it a considerable achievement for SISU as well as for the Nordic countries. CAiSE has now developed into a very successful annual, international conference event, including large number of workshops, such as EMMSAD and REFSQ. Both VLDB and CAiSE should be seen as effective knowledge dissemination activities. Conferences also served as a means to introduce new technologies to business and public services. An example of this is a seminar organised by SISU in spring 1995 on internet services where Tim Berners-Lee presented the new WWW service. Another example is a serie of seminars on "business intelligence" organised by SISU during 1996-97. New technology was demonstrated in the SISU laboratory. An example of that was the "liveboard" computer initially developed by Xerox.

## Academic degrees

Already from the start of SISU an agreement was established with the department of Computer and Systems Science (DSV) to cooperate in the area of graduate education. Many SISU employees registered at DSV as PhD candidates. They did not receive any scholarships for their studies, but SISU was in general very concerned to allocate PhD candidates tasks which harmonised with their thesis works. Also their work load was, in critical thesis writing stages, adjusted to make it possible to complete the thesis. Senior staff at SISU gave considerable supervision and help to the PhD candidates regarding technical matters of their theses. PhD degrees have been awarded to more than 10 former employees of SISU.

## Spin-off companies – knowledge transferred into commercial products and consulting work

A number of spin-off companies have been created by people from SISU. Most of them are based on and exploitation of results from SISU's participation in EU projects. "Research is the transformation of money into knowledge and transformation of knowledge into money is innovation". Here are some samples of "Innovations" indirectly created by SISU.

### NeoTech AB

In the late eighties – almost two decades after the relational model's breakthrough in the database research field – commercial relational database systems were rapidly increasing their market shares. It was decided that the time had come to take relational database design methodology to the business scene in Sweden. In 1987, Christer Hultén and Lars Söderlund founded NeoTech and Stefan Britts joined a year later. NeoTech's expertise covers: 1) Tactical issues concerning business information requirements and the use and refinement of this information, 2) Methodology issues of classification, structuring and description of business information, and 3) Technical issues in database organization and in retrieval and communication of data in networks. NeoTech's clients include several large companies in Sweden.

### CNet

CNet was established in 1995 by a research group within SISU (including Matts Ahlsén, Peter Rosengren, Stefan Paulsson, and Ulf Wingstedt) and became a separate company in 1998 to commercialise results from the EU-projects Intuitive and Multimedia Broker. These projects had developed graphic search interfaces for multimedia databases and multimedia services intended for electronic publishing. The separation resulted in a software product, which in 2006 is still an important part of the company's business. It was also an early application of XML technology. The company's

core business is their own portfolio of products, together with a solid knowledge in information systems development with Internet technology. During the years, the company has developed a number of products focused on semantic knowledge-techniques.

### **Projectplace International AB**

Projectplace International AB was founded in January, 1998 by Mattias Hällström, Magnus Ingvarsson and Peter Engstedt (prev. Johansson). The company is based on ideas developed within the European research project Coop-www in which the tool BSCW (Basic Support for Cooperative Work) was developed. Projectplace International develops and provides web services for those working in projects together with colleagues, customers and partners. The business concept is to improve efficiency and quality in project-oriented organizations by providing a web service that simplifies planning, implementation and follow-up of projects. The clients are project managers, IT departments and project-intensive organizations in private and public sector. The company has subsidiaries in Norway, Holland, Great Britain and Germany. Language-specific versions of the web service and locally adapted services are offered.

### **ALKIT Communications AB**

ALKIT Communications AB is a small research oriented company bridging the gap between university research and practical applications. Results from the EU-supported project Intercare has been a starting point for this activity. The company was initiated by Lars-Åke Johansson, a former SISU employee, and a number of colleagues. ALKIT co-operates with many universities, e.g. Luleå Tekniska Högskola, KTH, CTH, and Karolinska Institutet, as well as with organisations in the private and in the civic sector, e.g. Volvo Cars, Volvo Aero, SAAB, Sandvik, Stockholms Läns Landsting, Socialstyrelsen, and several more. Areas of expertise are modelling and development of IT strategies, component based design, and synchronous video communication.

## **Concluding comments**

The knowledge transfer initiated by and carried out by SISU is, in retrospect, indeed substantial. Initially, making up our first framework program, we anticipated knowledge transfer to be of two kinds:

1. Transfer of methods and method knowledge to practical use in organisations by education and training
2. Transfer of prototypes to existing organisations which then would turn them into practical products on the market.

The first kind of transfer can be considered as successful while the second kind of transfer largely was less immediately successful..

Transfer of knowledge about conceptual modelling and enterprise modelling took place in most SISU projects (TRIAD, EU-projects). Many organisations in Sweden as well as abroad do now perform participatory modelling as part of developing and IT-aligning their organisations. Modelling is also one of the main services and products of most of the spin-off companies of SISU (see above). It should, however, also be mentioned that transfer of modelling knowledge has taken a considerable time. Modelling is something that requires skills of abstraction as well as skills in facilitating group-work. It is not the case that many people in business and industry are, initially, skilled in these abilities. Nevertheless, we can now conclude that SISU's training activities, conferencing activities, and running of collaborative projects nationally as well as internationally, has significantly contributed to awareness of and use of conceptual and enterprise modelling in many organisations in Europe.

On the other hand, our intention to transfer of prototypes to existing organisations which then would turn them into practical products on the market was not immediately successful.. Why was it so? We believe in the following reasons:

- Very few IT people in industry and public service, by that time, had an academic degree in IT, and most often did not know what kind of results that could be expected from R&D.
- The cost of developing a marketable product is normally extremely high (perhaps in the range of several hundred person-years). Large Swedish IT-companies were not willing to make such a commitment.
- Making an advanced product also required extremely skilled and knowledgeable workers. These were not often at hand.
- Very few people in Sweden really understood and anticipated the value of prototypes developed by SISU. They were also unsure about the “practical need” of such a product. The “business value” of potential tools to be developed based on SISU prototypes were not very clear by that time.
- Productising a complex prototype for a market was a considerable risk. People in business also understood that Sweden was a too small market in order to productise the prototype. Their knowledge of how to approach foreign markets was not well developed at that time.
- One particular problem, that did not make contacts with business and industry simpler, was the case of “rotating people”: people in organisations that SISU had established close relations with were, in several cases, moved to other positions in their organisation. This led to disrupted contacts with that organisation which took time and resources to restore.

What happened instead of the anticipated knowledge transfer as above, was that groups of SISU’s own employees decided to take the risk of developing and making products of ideas and prototypes developed within SISU. Looking at the set of spin-off companies above, this kind of technology transfer was obviously successful. SISU played some role in supporting the formation of these companies. In some cases the company initiators could use large networks of contacts in Sweden developed during their time at SISU. In other cases SISU supported the employees with continued part time work during the formation stage of the companies.

In conclusion, our experience shows that in most cases the best “receiving organisations” in technology transfer situations are companies formed by the same people who developed the technology in the first hand.

## Dedication

This paper is dedicated to our friend Professor Benkt Wangler in connection with his retirement. As a SISU employee for 10 years, Benkt has primarily been responsible for information system development tool and method development at SISU. Benkt has been instrumental in several EU-projects of SISU, such as TEMPORA, Nature, MILORD, LYNX, HOD, and ESPITI, and also in EU-projects of DSV, ORES and HYPERBANK. These projects have resulted in a vast amount of publications by Benkt and colleagues as well as of a large number of Ph.D. works.

## References

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