# Final report

## Swedish Research Links programme

**Swedish Research Council's reference number: 348-2006-6728**

# Participatory, sustainable, convergent and high quality public e-services

## – developing methods and practices


**Project leaders**

**Professor Sara Eriksén, Blekinge Institute of Technology**

**Professor Ashok Jhunjhunwala, Indian Institute of Technology Madras**


**February 2011**

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**General information about the project**

***Swedish Research Council's reference number:*** 348-2006-6728

***Title of International Collaborative Research Project***
*Participatory, sustainable, convergent and high quality public services – developing methods and practices* [In Swedish: *Delaktighet, hållbarhet, konvergens och kvalitet i offentliga e-tjänster – framväxande metoder och praktiker*]

***Project leaders, in Sweden and in India***
Swedish project leader: Professor Sara Eriksén, BTH
Indian project leader: Professor Ashok Jhunjhunwala, IIT-M

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In India: The Telecommunication and Computer Networking Group (TeNeT), Department of Electrical Engineering, IIT-Madras, 600036 Chennai, India

***Project co-workers***
In Sweden: Dr. Annelie Ekelin, Ph D student Charlotte Eliasson (now Lorentzen), Dr.-Ing. Markus Fiedler and Professor Hans-Jürgen Zepernick, BTH
In India: Professor Timothy A. Gonsalves, Professor Hema A. Murthy, Dr. K. Giridahr and Dr. Aarti Kawlra, IIT-M, along with a number of other members of the TeNeT Group and staff at RTBI (Rural Technology Business Incubator).

***Total amount of grants received for the International Research Collaboration***
From the Swedish Research Council: SEK 600 000
*Note: The grant from the Swedish Research Council is split equally between the partners, in this case providing SEK 100 000 per year for 3 years for the Swedish partner and the Indian partner respectively. The grant is intended to cover travel expenses and other expenses relating directly to the international research collaboration, such as joint workshops. The grant is not intended to cover wages or costs for running actual research projects.*

From other funding providers: Region Blekinge granted SEK 1 287 500 to the India project [Indienprojektet] in May 2008 for 2008-2009, with the aim of supporting multi-stakeholder collaboration in Blekinge around developing long-term relations with key actors in business and academia in south-eastern India (Chennai, Hyderabad and Bangalore). The regional India project, led by international project coordinator Eva-Lisa Ahnström, BTH, focused on three parallel themes: business collaboration, student and teaching staff exchange, and collaboration in research and development (R&D). The India project thus enhanced regional, national and even international dissemination of information and results from the R&D research collaboration with IIT-M funded by the Swedish Research Council and SIDA. See Appendix A. Evaluation of the India Project (in Swedish).

VINNOVA granted SEK 50 000 for co-funding of local hospitality costs in connection with a visiting delegation of researchers from IIT-M in June 2008.

Swedish South Asian Studies Network (SASNET) granted SEK 20 000 for co-funding of networking costs in connection with Dr. Aarti Kawlra's visit to Blekinge in October 2009.

### Objectives of the collaborative project

The main objectives of the collaborative project, as stated in the accepted proposal, were to develop long-term, high quality research cooperation between researchers at BTH and researchers at IIT-M around converging technologies, as these are unfolding in application areas such as public e-services/ e-government. The overall aim is "ICT for Development" (ICT4D) – taking an active and reflective role as researchers in developing methods and practices for participatory, sustainable, convergent and high quality public e-services. The research approach has been multi- and interdisciplinary, involving researchers from telecommunications, computer science and informatics as well as from human work science, social anthropology, techno-science and gender and IT studies.

The Swedish Research Links program does not fund research per se. It contributes to covering costs of international collaboration, such as travel costs, costs for organizing joint workshops, etc. Thus, we did not have the objective to start a new, shared R&D project. Rather, we used local, on-going R&D projects at IIT-M and BTH as our starting point for collaboration.

Thanks to additional co-funding through the regional India project in Blekinge (2008-2009), VINNOVA and SASNET, we were able to expand student and staff exchange beyond our original plan. This enhanced the research collaboration, as we were able to collaborate around supervising 3 master students from IIT-M who came to BTH and did part of their master thesis projects in direct connection with our on-going R&D projects on Quality of Service, Quality of User Experience and mobile services for accessibility. Senior researchers from IIT-M visited BTH in the autumn of 2009 as part of this shared supervision process.

### Scientific progress and output

We followed the original plan of having multi- and interdisciplinary groups of researchers making exchange visits between IIT-M and BTH each year, during which visits we presented and shared experiences from our respective on-going research projects. These exchange visits were inspiring for all involved, and strengthened our shared conviction that ICT should be, and can be, developed in ways that make it accessible and supportive for everyone.

So far, the collaboration has resulted in 3 scientific publications, 10 conference presentations, and one popular-scientific publication (see publication list and list of conference presentations pages 5-6). Three master students at IIT-M have visited BTH and been co-supervised in connection with the on-going R&D collaboration. The students presented their master thesis reports at IIT-M in spring 2010. Two shared publications (a book chapter and proceedings from a joint workshop) are forthcoming.

The research collaboration has high-lighted issues concerning the need for robustness and affordability of ICT solutions. These issues are highly relevant not only for Indian rural populations, but for sustainable growth in a global context. The Swedish researchers have been impressed and inspired by the innovative solutions coming out of the on-going R&D projects at IIT-M. The Indian researchers are interested in the Scandinavian tradition of participatory design (PD) and how PD methods can be further developed and applied in an Indian context. The Scandinavian PD tradition seems to fit well with the philosophy of Mahatma Gandhi in emphasizing the need to support people in gaining self-sufficiency and enhancing opportunities for situated innovation and design-in-use of technology.

User-driven design and development of e-services however also raises issues concerning Intellectual Property Rights and possible alternative business models for services where both content and form are co-constructed in use. These are areas where we have shared concerns, and where there is need for further research.

The research collaboration has been multi- and interdisciplinary, based in three main research areas: telecommunication systems, advanced wireless networks and computer science with a shared focus on quality of experience and participatory design of public e-services.

In the area of Quality of Service Experience, collaboration took part between the research groups of Prof. Timothy A. Gonsalves at IIT-M and Assoc. Prof. Markus Fiedler at BTH. A student from India, Anuraag Bhardwaj, joined BTH for two months and performed a measurement campaign with both Indian and Swedish performance measurement tools on several Swedish mobile broadband networks.

During this work, we obtained a set of interesting and useful insights on the performance of downloads, which are documented in reference [5]. This type of quantitative hands-on research work is expected to continue, with the specific goal to facilitate the successful introduction and provisioning of broadband services in both India and Sweden.

In the area of Advanced Wireless Networks, research has been conducted between the research groups of Prof. Krishnamurthy Giridhar at IIT-M and Prof. Hans-Jürgen Zepernick at BTH. A student from India, Anvesh Reddy, joined BTH for two months. The student performed research in the area of unequal error protection (UEP) for transmission of JPEG2000 images over Rayleigh fading relay networks. Several strategies of UEP in combination with such wireless relay networks have been proposed and analyzed. Among others, performance has been evaluated in terms of quality of experience as it would be perceived by a human observer.

In the area of Participatory Design of public e-services, research has been conducted between the research groups of Prof. Timothy A. Gonsalves and Prof. A. Jhunjhunwala, along with Dr. Aarti Kawlra at RTBI (Rural Technology Business Incubator) at IIT-M, and Dr. Annelie Ekelin and Prof. Sara Eriksén at BTH. A student from IIT-M, Kishore Reddy, joined BTH for two months and participated in the Augment project, in which an interactive mobile service for accessibility with user-generated content is being developed. Kishore Reddy contributed to requirement specification and developed the first working prototype of the service, which thereafter became input for a proof-of-concept project now being run in collaboration with BTH Innovation.

During the entire Swedish Research Links project and thereafter, the ambition has been to broaden and strengthen the collaboration between IIT-M and BTH as well as with and between the IT and telecom industry in our respective regions, as a way of building a sustainable platform for long-term R&D collaboration around participatory and sustainable design of ICT. The following list of events taking place within the framework of the project should be seen in the light of this aim of developing a foundation for long-term collaboration;

In the autumn of 2008, IIT-M and BTH signed a Memorandum of Understanding concerning R&D collaboration and student exchange between the two institutes of technology.

In December 2008, Dr. Kawlra, IIT-M, and prof. Sara Eriksén, BTH, collaborated around participation and research presentations at an international sustainability workshop in Kerala, India, which was co-organized by the INSTEC network (INSTEC stands for Indian-Swedish cooperation on Technical research and Education Center).

In the autumn of 2009, Dr. Aarti Kawlra, IIT-M, spent 3 weeks as guest researcher at BTH, and 3 master students from IIT-M spent several months at BTH doing part of their master thesis projects in connection with on-going R&D projects here. The students were co-supervised by senior researchers at IIT-M and BTH. Several scientific publications, besides the students' master thesis publications, came out of this collaboration.

In February 2010 BTH and IIT-M co-organized a Participatory Design Workshop which was hosted by IIT-M.

In the autumn of 2010 BTH signed an agreement with Ericsson India in Chennai which gives BTH students the opportunity to do their project work at the Ericsson office in Chennai. Senior researchers at IIT-M will share in supervising these student projects, in collaboration with supervisors at BTH. Accommodation will be offered for the Swedish students at the IIT-M Research Park, at the edge of the IIT-M campus in Chennai.

Professor Ashok Jhunjhunwala became honorary doctor at BTH in 2008. He is currently also a member of the international scientific advisory board for the School of Engineering, a group that meets twice a year at BTH.

Professor Timothy A. Gonsalves became director of the new IIT Mandi in northern India in 2010, and a Memorandum of Understanding has since been signed also between BTH and IIT Mandi. Professor Gonsalves remains a core member of the TeNeT Group at IIT-M, and the aim is for BTH to collabo-

rate with both IIT-M and IIT Mandi in ways that can be beneficial for all concerning sharing and dissemination of research results, international networking and staff and student exchange.

### Collaborative experience and output

The collaboration has mainly been driven by shared research interests and overlapping research profiles in applied technology and sustainable development. Both BTH and IIT-M have a tradition of close collaboration with IT and telecom industry and have incubators and research parks with seed companies in their close vicinity. From the start, there has been an interest on both sides of cultivating industry-academia-public sector collaborations. Our shared workshops have included both researchers and industry representatives from both Sweden and India. Among others, the Ericsson office in Karlskrona and the Ericsson India office in Chennai have been supportive in this endeavor.

In order to make the most of the R&D collaboration, we have arranged exchange visits between BTH and IIT-M twice each year, usually involving 3-6 senior researchers in each direction. A Ph D student from BTH was included in our first visit to IIT-M. In spring 2009, BTH:s vice chancellor Ursula Hass and the governor of Blekinge Gunvor Engström were also part of the delegation when we visited IIT-M (their travel expenses were funded by Region Blekinge through the regional India project).

Using local R&D projects as the base for sharing experience and developing long-term collaboration has been an important success factor, as we could collaborate from where we already stood and did not have to start by developing a shared R&D platform. We have aimed from the start to keep the administrative overhead to a minimum and to make the most of our visits and of shared supervision of master students doing thesis work in direct connection with on-going R&D at BTH and IIT-M respectively.

Spin-offs came out of opportunities that opened up along the way. IIT-M became interested in a remote lab developed by a teacher at BTH, and collaboration was initiated around that. An IIT-M student visiting BTH and working with R&D on mobile accessibility services managed to develop, in just a few weeks, a functioning first prototype, which later became input for a proof-of-concept prototype now being developed at BTH Innovation.

Aware of the fact that project funding inevitably comes to an end, we searched for alternative ways of funding long-term R&D collaboration. There is a shared ambition to apply for a large-scale India-European project in the near future. We have also made use of our existing research networks in Scandinavia, mainly with Lund University and the IT University in Copenhagen. By sharing international research links, we can support each other through sharing travelling costs and making the most of each visit from afar, and at the same time strengthen constructive R&D collaboration in Scandinavia. It not only keeps the cost down, but also keeps us on our toes – through competitive collegial cooperation in building sustainable research networks on an international level.

BTH has among the highest percentage of international students of all the universities in Sweden. A large number of our students are Indian engineering students. BTH, and especially the Schools of Computing and Engineering, have developed infrastructures for supporting student and staff exchange with a few selected Indian technical universities and, thanks to the Swedish Research Links program, two Indian Institutes of Technology, IIT-M and IIT Mandi.

The R&D collaboration between IIT-M and BTH has been successful so far. We believe that the best way of developing this collaboration over time in a sustainable way is by sharing it with Scandinavian and European research and industry partners we have good working relationships with, so we can make the very most of it for all involved.

### Popular-scientific description of the research collaboration

The main focus within our R&D cooperation is on user participation in design and development of mobile e-services for citizens, and how user experience of service quality can be measured and enhanced once the services are in use. Thanks to the R&D cooperation between IIT-M and BTH, we have the opportunity to "think globally" about our research and what it might mean to be doing research on applied technology and sustainable development and growth - on the one hand from a local, regional and national perspective, and on the other hand in comparison with research and development in these areas in a country with vastly different conditions than we are accustomed to.

Conditions in rural areas in India are in many ways extremely different from conditions in rural areas in Sweden. In India, more than 70% of the total population live outside large cities, and thus are classified as rural inhabitants. But rural areas in India are densely populated compared to rural areas in Sweden. Many villages and towns still have problems concerning power supply, and lack telecommunication infrastructure. It is a huge challenge for India to improve the infrastructure and accessibility to the Internet, public e-services and other public services throughout the country, and not just in urban areas.

It is obvious that, in general, the Swedish rural population is extremely privileged compared to the Indian rural population when it comes to power supply, transport and communication infrastructure and access to public services. However, upon closer scrutiny, it becomes visible that people living in rural areas in Sweden, too, are living in the wind shadow of urban areas.

In comparing the Swedish situation with the situation in India, we thus become aware, not only of tremendous differences, but also of certain similarities and shared problems, which may force us to question our own habits and practices concerning methods, figures of thought and speech, and goals. What, actually, is good quality of life and sustainable development for people living in rural areas? And how can IT contribute to both quality of life and sustainable development for everyone, whether they live in rural or urban areas? Is that where we are currently heading, in R&D? If not, what do we need to change to get there?

Striving towards globalization of our research thus also involves acquiring new perspectives concerning the seemingly well-known, "close-to-home".

**Publications (in chronological order)**


[1] Eriksén, S. and Ekelin, A. (2008) "Beyond the Buzz": Participatory, sustainable, convergent and high quality public e-services – developing methods and practices in India and Sweden. *Proc. IRIS31*, Åre, Sweden, August 2008.

[2] Ekelin, A. and Eriksén, S. (2010) Blekinge och Indien – kan vi lära av varandra? [In English: Blekinge and India – can we learn from each other?] Popular-scientific article published in the Researcher Pages in the journal for municipal economists, *Kommunal Ekonomi* #3 2010.

[3] Ekelin, Annelie, Anderberg, Peter and Reddy, Kishore (2010) The Augment Project: Co-Constructive Mapping and Support of Accessibility and Participation. Conference paper presented at e-Part 2010. In *Lecture Notes in Computer Science* Vol. 6229/2010, pp.95-103, Springer Verlag. ISSN: 0302-9743, ISI number 000283807300008

[4] Fiedler, M., Arlos, P, Gonsalves, T.A., Bhardwaj, A. and Nottehed, H. (2010) Time is perception is money – web response times in mobile networks with application to Quality of Experience. *Proc. PERFORM*, Vienna, Austria, Oct. 2010.

[5] Eriksén, S., Kawlra, A., Jhunjhunwala, A. and Ekelin, A. (forthcoming) Planning beyond the urban-rural divide: Participatory design of ICT for sustainable development in India and Sweden. In Christer Bengs edited volume *Knowledge as Empowerment*.

[6] Eriksén, S., Gonsalves, T., Jhunjhunwala, A., Kawlra, A. and Murthy, H. (forthcoming) *Participatory Design of ICT: Opportunities and Challenges.* Summary of presentations and discussions from the Indo-Swedish Workshop co-organized by IIT-M and BTH at IIT-M, February 2010. Blekinge Institute of Technology Research Report.


**Conference and workshop presentations (in chronological order)**

Papers presented at the International Workshop on the Sustainable City: Technologies and Systems for Sustainable Development, organized by INSTEC at CUSAT, Cochin, India, December 10th-12th 2008;

Eriksén, S.(2008) Evolving methods and practices concerning participatory design of public e-services for sustainable rural development in India and Sweden.

Kawlra, A. (2008) Inclusive Entrepreneurship for Sustainable Development: IITM's Rural Technology and Business Incubator."

Ahnström, E.-L. and Eriksén, S. (2009) Poster presentation about the India Project at the national conference Internetdagarna, November 3rd-5th 2009, Stockholm, Sweden.

Papers presented at the Indo-Swedish Workshop on Participatory Design of ICT: Opportunities and Challenges co-organized by IIT-M and BTH and hosted by the Dept. of Computer Science & Engineering, IIT Madras, Feb 18-19, 2010, see www.bth.se/exr/india.nsf/pages/pd-workshop ;

Bjørn Rasmussen, P. (2010) Intercultural Collaboration: Investigating cross-cultural collaboration in design teams of engineers [affiliation: IT University Copenhagen, Denmark]

Dittrich, Y. (2010) Bridging the gap between PD and Software Engineering. Cooperative Method Development for Participatory Design [affiliation: IT University Copenhagen, Denmark]

Ekelin, A. and Reddy, K. (2010) Co-Constructive Mapping and Support of Accessibility and Participation

Eriksén, S. (2010) Participatory Design of ICT: Opportunities and Challenges.

Fiedler, M. (2010) Generic quantitative relationships between Quality of Experience and Quality of Service.

Fiedler, M. (2010) A joint Indo-Swedish study on web response times via mobile networks

Gonsalves, T.A. (2010) Why Participatory Design?

Jacob, N. (2010) Universal Design. Participatory Design and Production

Jhunjunwala, A. (2010) TeNeT group's Journey and Focus on Rural India in context of Today's Energy Crisis

Kannan, L. (2010) User-centric Designs (Vortex experiences of iterative design)

Kawlra, A. (2010) User-centric design of ICT for Agriculture. Conference presentation made jointly with NAIP Project Team, RTBI

Kawlra, A. and Subramanian, S. (2010) Farm(er) Specific Advisory Project Design

Kumar, D., Gonsalves, T.A., Raina, G. (2010) Usability Study of Mobile Payments

Murthy, H. and Bhuvanesware, M. (2010) Online Tutorials: User Interface Design

Prashant, S. (2010) Beginning to End – a continuous relationship. Rural Healthcare Initiatives

Rönkkö, K., Helgeson, B., Messeter, J. and Linde, P. (2010) Real World Inventions [affiliation: BTH and Malmö University, Sweden]

Svensson, M. (2010) Networking at School [affiliation: Lund University, Sweden]

Uniphore Team (2010) Experiences of developing mobile services for rural markets

Vaidyanathan, L. (2010) Building Inclusive Rural Business Models

Zepernick, H.-J. and Engelke, U. (2010) Quality of Mobile Multimedia Experience.

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