



CHOSen

Project Report

DELIVERABLE NO	D5.2a
DELIVERABLE TITLE	Intermediate Report on Dissemination & Exploitation Plan and Activities
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DISCLOSURE LEVEL	Public
VERSION	V1.0 – final

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1 Abstract

This deliverable, called Intermediate Report on Dissemination and Exploitation Plan and Activities, describes in great detail the timing and the coordination of the actions dedicated to:

- dissemination
- exploitation,
- networking

The document provides an overview on all measures concerning these topics that were performed in the first two years of the CHOSeN project. They are listed for each partner of the consortium in the following chapters.

Academic research institutions and universities detail their plans for dissemination of results through active participation in publication processes including in conferences and journals. All partners also detail their activities towards networking, such as workshops to encourage hands-on interfacing with CHOSeN technology, internal presentations and discussions with other departments within the same entity and “CHOSeN Days” to allow potential adopters of CHOSeN technology to get to know the benefits of the advances achieved within the project.

2 Dissemination of Knowledge and Networking

One of the major goals of the CHOSeN project is to create technology which is useful and applicable in real-world and industrial situations. For this reason, the consortium sees the task of knowledge dissemination as being of high importance. CHOSeN strives to inform potentially interested entities about the technological and conceptual advances achieved within the project on many different levels, where each partner does their part as fitting their role in the project.

In order to be successful in dissemination this knowledge, a highly integrated network of contacts and communication channels is required. This is the only way to achieve penetration into departments and institutions which would be able to adopt CHOSeN concepts and advances, thus giving CHOSeN a positive impact on industry and academia. In order to create and maintain this network, each partner is actively pursuing networking and dissemination activities based on their profile as a partner.

2.1 Industrial Partners

The industrial partners of the CHOSeN project have begun disseminating the concepts of the project internally to other departments. These partners are as follows:

- Infineon Technologies Austria AG
- Centro Ricerche Fiat
- EADS Deutschland GmbH

This is evident in the past and planned meetings as listed and discussed in the next section. The goal of the dissemination plans for the industrial partners are to bring the concepts and technology within the project from the research stage in which it is currently in, to practical applications. For this process, external assistance from other departments within the industrial partners is required. Also this process will only take place if the internal bodies of the industrial partners realize that they have a vested interest in the success of the transfer.

2.2 Small and Medium Enterprises

Within the CHOSeN project, the SMEs are aligning their knowledge dissemination by enhancing digital property awareness in the general public. The SMEs involved are as follows:

- ACORDE Technologies S.A.
- Ardaco, a.s.

This involves planned presentations and participation in workshops in order to create networking contacts and to inform about the practical applications of CHOSeN knowledge, concepts and technology. Furthermore, they will be looking to publish the work done within the framework of the project at notable conferences in order to raise awareness of their abilities within the community as a marketing strategy.

2.3 Universities and Research Institutions

The university and research institution partners of the CHOSeN project are planning to disseminate knowledge and build communication pathways and networks using conferences and workshops as venues. Academic partners in the project are as follows:

- Commissariat à l'Energie Atomique
- Vienna University of Technology
- Technische Universität Braunschweig
- Graz University of Technology
- Karlsruhe Institute of Technology

Publication of project concepts, achievements and results at notable conferences lead directly to discussion on the topics, which result in a wide dissemination of the information generated within the project in academic circles. Along these lines, further PhD and M.Sc. theses will be published within the CHOSeN framework, further concept dissemination and discussion.

Furthermore, workshops which are planned will provide academic colleagues with an interface to the practical side of CHOSeN developments and facilitate direct discussions between chosen academic partners and colleagues, resulting in the creation of dissemination channels.

2.4 Consortium as a Whole

Although the dissemination and networking interests and opportunities differ from partner to partner, the consortium as a whole is also working cooperatively to host special events to further the dissemination of knowledge and networking level of the CHOSeN project as a whole. Specifically, a networking and information dissemination event called "CHOSeN Days" is being planned for spring, 2011. This event will promote and facilitate communication between CHOSeN industrial partners and potential contacts which would be in a position to adopt CHOSeN technology in different application scenarios and fields. "CHOSeN Days" will demonstrate CHOSeN technology and concepts to potential adopters, spreading awareness of the advances achieved.

Furthermore, poster and demonstration sessions are planned at notable conferences in which all partners will take part. These will illustrate the CHOSeN project from a bird's-eye perspective, allowing potential technology adopters and academic cooperation partners to perceive the impact of the project as a whole, and not just smaller portions.

3 Exploitation Plan and Activities

3.1 Exploitation Plan and Activities of the Industrial Partners

3.1.1 Infineon Technologies Austria AG

3.1.1.1 Dissemination and Exploitation in detail

Infineon highly appreciates the excellent opportunity offered by the CHOSeN project and the cooperation-partners to extend the portfolio of semiconductor solutions by preparing the technology base and launching of Wireless Sensor Networks (WSN) in the new application-fields automotive and aeronautic.

Infineon as semiconductor manufacturer is currently offering Radio-Frequency Identification Devices (RFID) that allow writing, storing and reading chunks of information. These components are battery-less, for which they are also called passive. These contactless memory products are being used everyday by millions of people within electronic tickets and access control systems, as loyalty cards and within brand protection schemes. Infineon's RFID products are used to efficiently and securely trace and manage products and assets globally. All products in Infineon's product range are compliant to globally agreed standards and frequencies.

Infineon is further developing and offering a number of low-power active wireless communication systems which are used for remote keyless entry (RKE) and in Tire Pressure Monitoring Systems (TPMS) for our cars, in remote controls in our homes, or in safety applications in our offices. These products meet harsh industrial and automotive requirements and operate at frequencies below 1GHz carrier frequency. These products have in common that they target huge, but very specific niche markets. In order to grow in particular in non-automotive markets, Infineon envisages to develop a more generic and universal solution than existing solutions for low-power wireless networking functions, thereby extending the addressable market substantially to other application domains. The CHOSeN developments target the support of flexible and low-power MAC layer protocol processing and the co-integration with PHY and RF-functions, which constitutes Infineon's' core contribution and results to be exploited within the CHOSeN project.

In terms of external dissemination relevant papers were submitted and published, mainly together with consortium partner TUG, at several renowned international conferences:

- Josef Prainsack and Klaus Witrissal*: “*Performance of a Limiting Amplifier in White and Colored Noise*”, in IEEE MTT-S International Microwave Workshop on Wireless Sensing, Local Positioning, and RFID ([IMWS 2009](#)), Cavtat, Croatia, September 2009
- Rainer Matischek, Markus Dielacher, Martin Flatscher, Thomas Herndl and Josef Prainsack: “*Optimized Protocol Processing for a Low-Power Wireless Sensor Node*”, in Proceedings of the International Conference on Architecture of Computing Systems ([ARCS 2010](#)), Hannover, Germany, February 2010
- Markus Dielacher, Martin Flatscher, Josef Prainsack, Rainer Matischek, Thomas Herndl and Wolfgang Pribyl*: “*A BAW based Transceiver used as Wake-Up Receiver*”, in Proceedings of the International Conference on Architecture of Computing Systems ([ARCS 2010](#)), Hannover, Germany, February 2010
- Josef Prainsack and Klaus Witrissal*: “*Optimum Receiver Based on Single Bit Quantization*”, in the Eleventh IEEE International Workshop on Signal Processing Advances in Wireless Communications ([SPAWC 2010](#)), Marrakech, Morocco, June 2010

* These authors are not working for IFAT but for the consortium partner TUG

3.1.2 Centro Ricerche Fiat

Through the research and development carried out within CHOSeN project, an ADAS application based on a new WSN platform will be realized, in order to test and validate the integration of a wireless sensor network capable of supporting demanding applications (e.g. low latency, reliability of the data delivery).

The automotive market is quite resistive to the introduction of new technologies; therefore their robustness and performance must be proved in challenging conditions, even worse than the ones of the real applications. For these reasons we can claim that the main outcome of the CHOSeN Project for CRF (as a Car Maker R&D centre) will be the introduction and usage of a cooperative and not trivial WSN in a vehicle prototype.

Indeed CRF has already produced a previous prototype (outcome of a FIAT funded project), whose main scope was to test the possibility of having a 802.15.4 communication within the vehicle, so it was an early stage analysis of the applicability of the WSN technology in the automotive environment.

3.1.2.1 Conducted dissemination activities:

5/02/2009 Organization of Workshop “*Smart Sensors on Wireless Car: Presentation of the CHOSeN Project*”, Trento, Italy

Program:

Morning Session: “*WSN Specification*”, Chairman: Ovidiu VERMESAN

- PhD Dr. Ovidiu VERMESAN Senior Research Scientist in SINTEF ICT. Oslo, NORWAY *"Ubiquitous Wireless Sensor Networks and Future 'Internet of Things'"*
- Prof. Renzo AZARO University of Trento. Trento, ITALY *"Radio-Frequency Interfaces in WSNs: requirements, State-of-the-art and Future Trends"*
- Andreas SCHMIDT CREATE-NET. Trento, ITALY *"Scaling security concepts for WSNs"*
- Amy Lynn MURPHY Fondazione Bruno Kessler. Trento, ITALY *"Programming WSNs with data sharing abstractions"*
- Pierre Damien BERGER CEA LETI, Commissariat à l'Energie Atomique. Grenoble, FRANCE *"Mechanical Vibrations Energy Harvesting and Power Management"*
- Michele CORRÀ University of Trento. Trento, ITALY *"Hardware platforms for WSN design: RF components and microcontrollers"*
- Claudio BOREAN ZIGBEE Alliance, Telecom Italia. Torino, ITALY *"ZigBee Wireless Sensor Networks"*

Afternoon Session: *"Devices & Application"*, Chairman: Claudio BOREAN

- Jorge PEREIRA European Commission. Brussels, BELGIUM *"Major Challenges in Monitoring and Control for the Automotive Industry"*
- Giuliana ZENNARO CRF Trento branch, Trento, ITALY *"Assessing Coexistence versus Convergence in Heterogeneous Wireless Sensor Networks: The CHOSEN Project"*
- Nicola PETTA CRF. Orbassano (TO), ITALY *"Wireless in Car"*
- Michael HELLENSCHMIDT Fraunhofer IGD. Darmstadt, GERMANY *"From Sand to Applications: the integrated WASP approach"*
- Manuel BENEDETTI University of Trento. Trento, ITALY *"Passive Localization and Tracking of Moving Targets in a WSN Infrastructured Environment"*
- Prof. Gian Piero PICCO University of Trento. Trento, ITALY *"Trentino Research & Innovation for Tunnel Monitoring"*

5-6/03/2009 Participation at *"WSN&Co – Concertation Meeting on Wireless Sensor Networks and Cooperating Objects"*, Brussels, Belgium

7/10/2009 *Networked Monitoring and Control and the PPPs*, Brussels, Belgium

15/04/2010 *Panel on Industrial Challenges in Cyber-Physical Systems*

3.1.3 EADS Deutschland GmbH

The wireless sensing and communication technology developed during the CHOSen project will be shown and demonstrated at several meetings with key persons from the business units of EADS. Particularly Airbus and Military Air Systems are interested in distributed wireless sensors for load and impact measurements.

3.1.3.1 Past & Planned internal dissemination activities in 2010:

03/2010 *Meeting with Airbus EDSWNG (NDT & Mechanical Test Germany)*

Topic: Door surrounding structural health monitoring with wireless sensors

03/2010 *Meeting with Airbus EVDM, EVICA, EVICS (Flight and Integration Tests)*

Topic: Wireless Flight Test Installation

04/2010 *Meeting with Military Air Systems MEG01_MAS (Aircraft Engineering - Projects)*

Topic: Wireless Impact Detection Sensors

9/4/2010 *EADS R&T Network*

Upstream Research Project – Advanced Wireless Communication, EADS IW, Ottobrunn

Business Units: EADS DS/DCS, DS/DE, MBDA, Airbus

EADS IW presented wireless activities including public funded projects:

- Wireless Channel Measurements and Models
- Low-Power Wireless Sensor Nodes
- Efficient Power-aware communication protocols
- OPNET simulation framework

6-7/5/2010 *TOP3 Workshop 2010, Airbus, Toulouse*

Objectives:

Main objectives of the TOP3 workshop were...

- to share mutual visibility on running TOP3 projects as well as future technology needs of Airbus (roadmap) and TOP3 potential contributions,
- to agree on future subjects and focal points to follow up preparations of new TOP3 projects

Content:

- Three simultaneous specialist sessions have been conducted to agree on future subjects
- Potential contributions, technical proposals and focal points have been summed up in a mapping table

In OPD Session: *Introduction of Wireless Sensing Topics and Activities by EADS IW*

- Wireless Channel Measurements and Models
- Low-Power Wireless Sensor Nodes
- Efficient Power-aware communication protocols
- OPNET simulation framework

3.1.4 ACORDE Technologies S.A.

ACORDE will exploit the CHOSeN project results by distributing system and hardware integration concepts related to wireless sensor networks for aeronautic and automotive environments.

ACORDE is a system integrator, which has been working also in the consortium cooperating with the chips manufacturer (Infineon), the end user related companies (like EADS or CRF), and security expert partners like Ardaco.

Dissemination of the knowledge with contributions to conferences, workshops and publications is also envisaged within the project, and ACORDE R&D department is also interested in enhancing its publication list.

3.1.5 Ardaco, a.s.

The dissemination and exploitation of CHOSeN technology within Ardaco was as follows:

07/2009 Internal presentation

Department directors of Ardaco, technical team

09/2009 (updated 01/2010) Internal presentation on notice board in Ardaco premises

Used for presentation to our visitors

11/2009 Internal presentation to product and sales department

Silvester Gal – product and sales manager (Silvester.Gal@Ardaco.com),

Juraj Hajek – project manager (Juraj.Hajek@Ardaco.com)

04/2010 Internal presentation to product and sales department

Mr. Richard Margala – product and sales director (Richard.Margala@Ardaco.com).

3.2 Exploitation Plan and Activities of the Research Institutes

3.2.1 Commissariat a l'Energie Atomique

According to the assigned work in the project LETI focuses on two major aspects of the physical layer of the Wireless Sensor Network. These are the channel models in aeronautic and automotive applications and the design of compact antennas. Exploitation is planned and conducted separately.

Concerning the channel characterization, LETI intends to communicate on the measurement methodology as well as the channel modeling. First results in the automotive application were already published in a paper and a poster at the 4th European Conference on Antennas and Propagation EuCAP 2010 in Barcelona, Spain:

- Raffaele D'Errico, Lionel Rudant and Julien Keignart: "Channel Characterization for Intra-Vehicle WSNs in the ISM Bands", in Proceedings of the Fourth European Conference on Antennas and Propagation ([EuCAP2010](#)), Barcelona, Spain, April 2010

3.3 *Exploitation Plan and Activities of the University Institutes*

3.3.1 Vienna University of Technology

Subsequent master-theses in the field of power management and signal processing were announced and master students have been found that will handle the topics in the next year. The ongoing CHOSeN-project is integrated in the teaching at the university, in more detail the project part of deepening courses for bachelor- and master-level students are based on wireless communication networks and contain some aspects of the CHOSeN-project. Currently some aspects of the project have already been integrated in a master-level course about digital integrated circuits, with next year some aspects of the project will be integrated into medium-level assignments in a laboratory course in digital design.

Two PhD-theses are currently under development in the scope of this project, two master theses are about to begin in July and August respectively. Currently also a small group of students is working with wireless technology and digital design in a master deepening course using the FPGA-platform developed in the scope of this project.

Significant outcomes of the research will be handed in at topic- and time-appropriate scientific conferences (e.g. ITS, IEEE, DEC, TRA, DATE, SIGDOC, ISCAS ...). At least one paper will be published before the end of the year regarding the wakeup receiver which is now for the first time available as an integrated solution.

The Vienna University of Technology is also a potential location to host a workshop aiming at the dissemination and discussion of the findings in CHOSeN with interested third parties.

3.3.2 Technische Universität Braunschweig

During the last two reporting periods, there were several activities concerning internal and external dissemination and exploitation conducted by the DUS group at the TU Braunschweig. The results of the work will be taken to the new group at KIT for further research (see 3.3.4 for further details).

In addition to the PhD thesis supported by the CHOSeN project, there were several student activities in this specific field. Among others, a master and a bachelor thesis were conducted in the scope of the project. They focused on further improvements on the gateway and middleware platform for distributed sensor networks, developed at the TUBS. These topics were also covered in basic and advanced lectures.

Several papers were submitted and published at renowned conference in the field of wireless sensor networks:

- Rayan Merched El Masri, Stephan Sigg and Michael Beigl: *"An asymptotically optimal approach to the distributed adaptive transmit beamforming in wireless sensor networks"*, in Proceedings of the 16th European Wireless Conference ([EW2010](#)), Lucca, Italy, April 2010
- Dawud Gordon, Florian Witt, Hedda Schmidtke and Michael Beigl: *"A Long-Term Sensory Logging Device for Subject Monitoring"*, in Workshop for Situation Recognition and Medical Data Analysis in Pervasive Health Environments ([PervaSense 2010](#)), Munich, Germany, March 2010
- Stephan Sigg, Rayan Merched El Masri, Julian Ristau and Michael Beigl: *"Limitations, performance and instrumentation of closed-loop feedback based distributed adaptive transmit beamforming in WSNs"*, in Fifth International Conference on Intelligent Sensors, Sensor Networks and Information Processing - Symposium on Adaptive Sensing, Control, and Optimization in Sensor Networks ([ISSNIP 2009](#)), Melbourne, Australia, December 2009
- Stephan Sigg and Michael Beigl: *"Algorithmic approaches to distributed adaptive transmit beamforming"*, in Fifth International Conference on Intelligent Sensors, Sensor Networks and Information Processing - Symposium on Theoretical and Practical Aspects of Large-scale Wireless Sensor Networks([ISSNIP 2009](#)), Melbourne, Australia, December 2009
- Stephan Sigg and Michael Beigl: *"Algorithms for closed-loop feedback based distributed adaptive beamforming in wireless sensor networks"*, in Fifth International Conference on Intelligent Sensors, Sensor Networks and Information Processing - Symposium on Adaptive Sensing, Control, and Optimization in Sensor Networks ([ISSNIP 2009](#)), Melbourne, Australia, December 2009
- Dawud Gordon and Michael Beigl: *"D-Bridge: A Platform for Developing Low-Cost WSN Product Solutions"*, in Proceedings of the Sixth International Conference on Networked Sensing Systems ([INSS09](#)), Pittsburgh, Pennsylvania, pages 62-65, IEEE, June 2009
- Dawud Gordon, Michael Beigl and Masayuki Iwai: *"A Study on the Use of Wireless Sensor Networks in a Retail Store"*, in Workshop at the Conference on Pervasive Computing 2009 ([Pervasive09](#)), Nara, Japan, May 2009
- Stephan Sigg and Michael Beigl: *"Collaborative Transmission in Wireless Sensor Networks by a (1+1)-EA"*, in Proceedings of the 8th International Workshop on Applications and Services in Wireless Networks ([ASWN2008](#)), Kassel, Germany, October 2008
- Stephan Sigg and Michael Beigl: *"Randomized Collaborative Transmission of Smart Objects"*, in 2nd International Workshop on Design and Integration Principles for Smart Objects ([DIPSO2008](#)) in conjunction with Ubicomp 2008, Seoul, Korea, September 2008

The TUBS participates at several other projects in the field of wireless distributed systems. People working for the FP7-projects CHOSeN, FRONTS, WISEBED and GINSENG and a few smaller local projects share the same building. Besides many informal meetings between colleagues discussing the ongoing research in

their specific projects, a periodical meeting has been established: About every second month the local partners of all the addressed projects meet and discuss current WSN research topics in general and related to the specific FP7-projects.

Meetings occurred specifically on the following dates:

- 11.03.2009
- 08.07.2009
- 15.09.2009
- 07.01.2010
- 02.06.2010

Since the TUBS is ending its participation in the CHOSeN consortium after the second reporting period, there will be no further actions on dissemination and exploitation by this partner.

3.3.3 Graz University of Technology

The TU Graz, represented by the institute of electronics, is engaging bachelor and master students dealing with objectives covered within the CHOSeN project. It is planned to intensify the research efforts by means of master projects, master theses, and PhD theses in the field of ultra low power design issues with respect to topics relevant for the CHOSeN hardware platform.

Currently, there are two master theses in their final phase focusing on the implementation of autonomous transaction and scheduling activities as well as an analog integrated low power real time clock required for ultra low power standby modes of the CHOSeN transceiver.

A master student is implementing basic cryptographic features on the CHOSeN FPGA demonstrator board (in the context of a student project). Based on the results of the project a master thesis is announced addressing enhanced cryptographic functionalities under the constraint of quite limited resources omnipresent in wireless sensor network technologies.

Additionally, there is also an ongoing PhD thesis related to analog chip design topics covered within the CHOSeN project. Other master and/or PhD theses or projects will be offered on demand in the case of relevant topics and objectives arise.

The outcome of our research activities within the scope of CHOSeN will be incorporated into various lectures in order to improve the knowledge in the field of analog and digital chip design in general as well as wireless sensor network technologies. In particular, results of our activities within the CHOSeN project will be discussed in the master lecture “Selected Topics of Advanced Analog Chip Design” in the next winter term 2010/11.

During the last months we have been focusing on our most intensive part of the project namely the IC development of the CHOSeN ASIC for the tape-out, end of May 2010. Therefore our dissemination activities have been focused on publications in cooperation with our consortium partner IFAT at following conferences:

- Markus Dielacher, Martin Flatscher, Josef Prainsack, Rainer Matischek, Thomas Herndl and Wolfgang Pribyl*: "*A BAW based Transceiver used as Wake-Up Receiver*", in Proceedings of the International Conference on Architecture of Computing Systems ([ARCS 2010](#)), Hannover, Germany, February 2010
- Josef Prainsack and Klaus Witrals*: "*Optimum Receiver Based on Single Bit Quantization*", in the Eleventh IEEE International Workshop on Signal Processing Advances in Wireless Communications ([SPAWC 2010](#)), Marrakech, Morocco, June 2010
- Josef Prainsack and Klaus Witrals*: "*Performance of a Limiting Amplifier in White and Colored Noise*", in IEEE MTT-S International Microwave Workshop on Wireless Sensing, Local Positioning, and RFID ([IMWS 2009](#)), Cavtat, Croatia, September 2010

Concerning our further internal as well as external dissemination process a few points need to be mentioned. We attended as external consultant the Infineon internal event "Innovations Days" (27.11.2009) at the companies site in Graz (Austria). Besides we assisted as cooperation partner during the development process various coordination meetings with Infineon.

More publications are planned depending on the progress of our research and development activities and will be handled in appropriate topic specific conferences and journals.

3.3.4 Karlsruhe Institute of Technology

In the coming review period the group for Pervasive Computing Systems at the KIT is preparing several publications of research results in communication protocols and middleware platform application. Specifically we are planning to publish results of the CHOSeN simulation environment based on new MAC Layer protocols supporting the wake-up radio in a scaling network environment. Furthermore, publications have been submitted on the CHOSeN middleware platform and its applications.

A workshop demonstrating the use of the middleware platform as well as scalable wake-up radio protocols was held at the International Conference on Networked Sensing Systems 2010 in Kassel, Germany. In this session, it was possible for international scientist to evaluate CHOSeN technology for other applications. Especially the hands-on approach with the CHOSeN Middleware node encouraged the participants to get in touch with the project.

In this vein other applications of CHOSeN technology will also be evaluated, including teaching and prototyping applications of the middleware and node platforms together with other academic institutions, as well as low-power industrial monitoring applications of the communication protocols. Novel concepts of the distributed middleware such as the quality of service attributes and scalability and adaptability are planned for publication in 2010. Along these lines, further PhD and M.Sc. theses on the topics of scalable wireless communication protocols and QoS based distributed middleware will be published within the CHOSeN framework, furthering concept dissemination and discussion. Currently there are two PhD-candidates working within the scope of the project.

There are several other FP7-projects related to WSNs which KIT participates in. Further contact to the other working groups will be established in the next weeks. The goal is to meet regularly to discuss current WSN research topics in general and related to the specific FP7-projects.

4 Conclusion

This document contains the plans of the CHOSeN consortium for exploitation of CHOSeN technology as well as dissemination of CHOSeN results in the form of scientific publications. The CHOSeN consortium is quite varied in terms of partner types as well as exploitation and dissemination goals. None the less, we have demonstrated that they are working constructively together to maximize the impact of the CHOSeN project, both in terms of the dissemination of results and methods as well as industrial application and education. We have also shown that they have concrete plans to continue to constructively work together to maximize the impact of the project insights.

The consortium is working together to disseminate project concepts and insights and to exploit CHOSeN technology as it becomes available. Channels of communication for networking with potential adopters of technology in order to facilitate exploitation are open and others are being actively searched for. Dissemination has already begun, and will be increasing over the remaining period of the project, with planned workshops, industrial department meetings and CHOSeN Days events, as well as conference and journal publications.