



FP7-ICT-2013-11-619871

## BASTION

*Board and SoC Test Instrumentation for Ageing and No Failure Found*

Instrument: Collaborative Project

Thematic Priority: Information and Communication Technologies

### Dissemination workshops (Deliverable D5.4 part 3)

Due date of deliverable: August 31, 2016  
Ready for submission date: January 9, 2017

Start date of project: January 1, 2014

Duration: 40 months

Organisation name of lead contractor for this deliverable: Tallinn University of Technology

Revision 3.4

Project co-funded by the European Commission within the Seventh Framework Programme (2014-2016)		
Dissemination Level		
PU	Public	<input checked="" type="checkbox"/>
PP	Restricted to other programme participants (including the Commission Services)	<input type="checkbox"/>
RE	Restricted to a group specified by the consortium (including the Commission Services)	<input type="checkbox"/>
CO	Confidential, only for members of the consortium (including the Commission Services)	<input type="checkbox"/>

## **Notices**

For information, please contact Dr. Artur Jutman, e-mail: [artur@testonica.com](mailto:artur@testonica.com)

This document is intended to fulfil the contractual obligations of the BASTION project concerning deliverable D5.4 described in contract 619871.

© Copyright BASTION 2014-2017. All rights reserved.

## Table of Revisions

Version	Date	Description and reason	Author	Affected sections
3.0	December 6, 2016	Structure created and content added	M. Jenihhin	All
3.1	December 21, 2016	Update of introductory parts	A. Jutman	Introduction, Executive Summary
3.2	January 5, 2016	Updates about TESTA and NTF, general polishing	A. Jutman	Sections 2, 4; Introduction
3.3	January 6, 2016	Updates about RENS, finalizing the document	M. Jenihhin	All
3.4	January 9, 2016	Summary added	A. Jutman	Section 5

## Author, Beneficiary

Maksim Jenihhin, Tallinna Tehnikaulikool  
Jaan Raik, Tallinna Tehnikaulikool  
Artur Jutman, Testonica Lab  
Erik Larsson, Lund University  
Cristophe Lotz, ASTER Technologies  
Rene Krenz-Baath, Hamm-Lippstadt University of applied Sciences  
Matteo Sonza Reorda, Politecnico Torino  
Hans G. Kerkhoff, University of Twente  
Piet Engelke, Infineon

## Executive Summary

This document presents the third and the fourth BASTION Dissemination Workshops, both organized in 2016, the third year of the project. "1<sup>st</sup> International Test Standards Application Workshop - TESTA 2016" was run as a fringe workshop of the 21<sup>st</sup> IEEE European Test Symposium (ETS) in Amsterdam on May 26-27, 2016. The focus of TESTA was on the IEEE 1687 IJTAG standard and it was organized in cooperation with the leading groups and companies from EU and US actively running IJTAG-related research and development. "1<sup>st</sup> International Workshop on Resilience in Nanoelectronics Systems - RENS 2016" was run as a fringe workshop of the "24<sup>th</sup> IFIP/IEEE International Conference on Very Large Scale Integration (VLSI-SoC)", in Tallinn on September 28-29, 2016. It was held in cooperation with the EU projects H2020 RIA IMMORTAL and H2020 TWINN TUTORIAL. In addition, BASTION has organized a dissemination action dedicated to board-level test that was run by TL and ASTER at the industrial event "Nordic Test Forum 2016" in Vilnius, November 29-30, 2016.

## List of Abbreviations

DFT	- Design For Testability
ETS	- IEEE European Test Symposium
H2020	- European Union's Horizon 2020 Programme
IEEE	- Institute of Electrical and Electronics Engineers
IEEE 1687	- IEEE Std. 1687-2014 Standard for Access and Control of Instrumentation Embedded within a Semiconductor Device
IFIP	- International Federation for Information Processing
IJTAG	- Internal JTAG, a short name for IEEE Std. 1687-2014 Standard for Access and Control of Instrumentation Embedded within a Semiconductor Device
IST	- Information Society Technologies
JTAG	- Joint Test Action Group (also a board-level test methodology based on IEEE Std. 1149.1-2013)
NFF	- No Fault Found (a.k.a. No Trouble Found)
NTF	- Nordic Test Forum ( <a href="http://www.nordictestforum.org">www.nordictestforum.org</a> )
RENS	- Workshop on Resilience in Nanoelectronics Systems
TESTA	- International Test Standards Application Workshop
VLSI-SoC	- IFIP/IEEE International Conference on Very Large Scale Integration
URL	- Uniform Resource Locator

## Table of Contents

Table of Revisions .....	3
Author, Beneficiary.....	3
Executive Summary .....	3
List of Abbreviations .....	4
Table of Contents.....	5
1 Introduction.....	6
2 TESTA Workshop .....	8
2.1 Organization of the TESTA workshop.....	8
2.2 Workshop Organizers.....	9
2.3 Technical Program of the dissemination workshop .....	9
2.4 Results of TESTA .....	11
3 RENS Workshop.....	12
3.1 Organization of the RENS workshop.....	12
3.2 Workshop Organizers.....	12
3.3 Technical Program of the dissemination workshop .....	13
3.4 Results of RENS.....	14
4 Dissemination action at NTF 2016 .....	15
4.1 Results of the dissemination action at NTF'2016 .....	15
5 Summary .....	16

# 1 Introduction

According to the BASTION Description of Work, three dissemination workshops collocated with relevant conferences and events in the nanoelectronics field had to be organised by the consortium partners during the project duration, i.e. one per year. While the "BASTION 2014" was a fully BASTION consortium driven event, the "RAFES 2015" was already a co-operative action between BASTION, CLERECO and ELESIS projects. Both events were described in the first two parts of deliverable D5.4 submitted in 2014 and 2015 respectively. This part of D5.4 presents the events organized in 2016. Following the reviewer recommendations, we have continued in 2016 the active collaboration with external research groups, industrial community and projects in the EU and worldwide to achieve a higher impact of the dissemination activities.

In order to better address different focus groups, it has been decided to run three separate events in 2016 covering separately the main three focus areas of the BASTION research: IEEE 1687 IJTAG, aging and reliability, NFF and board-level test. As a result, the BASTION progress was disseminated in 2016 at the following three dedicated events.

First, the research related to *IJTAG-based system health monitoring, instrumentation and IEEE 1687 standard* was disseminated at the **TESTA 2016** workshop. "1<sup>st</sup> International Test Standards Application Workshop - TESTA 2016" was organized as a fringe workshop of the 21<sup>st</sup> IEEE European Test Symposium (ETS) in Amsterdam on May 26-27, 2016. ETS is the flagship event for the EU test community combining the frontier academic research with contributions from industry. The focus of TESTA was primarily on the IEEE 1687 IJTAG standard and it was organized in cooperation with the leading groups and companies from EU and US actively running IJTAG-related research and development.

Second, BASTION research on *the reliability, fault resilience and fault management* was disseminated at the **RENS 2016** workshop. "1<sup>st</sup> International Workshop on Resilience in Nanoelectronics Systems - RENS 2016" was organized as a fringe workshop of the "24<sup>th</sup> IFIP/IEEE International Conference on Very Large Scale Integration (VLSI-SoC)", in Tallinn on September 28-29, 2016. VLSI-SoC is a highly reputable international event with an established community representing the regions world-wide. The workshop was held in cooperation with two other EU projects H2020 RIA IMMORTAL and H2020 TWINN TUTORIAL, external panellists and invited speakers coming from Mexico and Germany.

Third, the research related to the *board-level test and NFF* was disseminated at a dedicated **BASTION dissemination action** run at "Nordic Test Forum 2016", which is the major regional industrial event on board-level test run each time in different countries of Northern Europe. This time it took place in Vilnius on November 29-30, 2016. The BASTION dissemination action was built upon two presentations given by TL and ASTER and related exhibition booth run by TL.

Clear partitioning of BASTION dissemination actions into three focus topics allowed to increase the impact of the dissemination activities by collaborating with respective focus groups and consortia and delivering the information directly to the right audience. As a result, all these events had a high dissemination impact, established

new collaborations and served for sustainable exploitation of the BASTION research results also beyond the duration of the action. E.g. the next edition of the TESTA workshop will be organized with ETS 2017, will have a broader coverage of the test standards and will have the BASTION project coordinator serving as the General Chair. The details of the TESTA and RENS workshops and the NTF dissemination action are presented in the next sections.

## 2 TESTA Workshop

The idea of a fringe workshop at ETS'2016 devoted to DFT standards has been first expressed by Martin Keim (Mentor Graphics) who finally served as the General Chair of TESTA'2016. Martin invited several BASTION partners to participate in the workshop organization. He also suggested that TESTA could be a good dissemination opportunity for BASTION consortium, which as he said, was known to actively contribute to the research around IEEE 1687. As a result, three BASTION partners actively contributed to the organization serving the roles of *Vice General Chair*, *Program Co-Chair*, and *Embedded Tutorial Co-Chair*. Six out of 8 BASTION partners presented their work during the workshop giving 5 regular presentations and one embedded tutorial. Most of these contributions (incl. the tutorial) reported collaborative work between several BASTION partners. As a result, 50% of the TESTA program except the invited/keynote speech was contributed by BASTION consortium giving this event de-facto the status of BASTION dissemination workshop.

### 2.1 Organization of the TESTA workshop

From the perspective of the BASTION consortium, the third dissemination workshop had the following main **aims**:

- Focus on IEEE 1687, which represents a large part of the BASTION's scope;
- Disseminate the results of BASTION project;
- Share the research and development agenda of BASTION project;
- Learn from and exchange information with the adjacent research communities and the key industrial players active in IEEE 1687;
- Receive feedback from the academic and industrial communities;
- Brainstorm with leading experts.

**Scope and Mission.** In general, the workshop provided an open framework for exchanging ideas especially on the best practices around recently released test standards such as IEEE 1687-2014. The following contributions were encouraged by TESTA organizers:

- reports on first-time usage of the new standard;
- research exploring the best usage of features defined in the standard:
- lessons-learned, what works, what doesn't;
- how the standard was incorporated into existing or new DFT methodologies;
- how the new standards like the upcoming IEEE P1838, future IEEE P1687.1, IEEE 1149.1-2013 as well as IEEE 1500-2005 interact with each other, or with related standards;
- latest R&D results and progress achieved, including FP7 BASTION project (<http://fp7-bastion.eu/>) activities..

**Outline of the Workshop.** The 1.5-day long workshop featured novel work along above outlined scope. Besides regular presentations, the workshop featured an invited talk, embedded tutorials as well as a panel session.



## 2.2 Workshop Organizers

The TESTA workshop organization was a joint effort of the following organizations and consortia:

- BASTION consortium
- The following non-BASTION companies:
  - Mentor Graphics, USA (one of the top three EDA vendors worldwide)
  - Cisco Systems, CA, USA
  - IBM, USA
  - AMD, CA, USA
  - NXP Semiconductors, The Netherlands
  - Broadcom, CA, USA
  - JTAG Technologies, The Netherlands
  - SiliconAid, Austin, TX, USA
  - ASSET Intertech, TX, USA
- The following non-BASTION research groups:
  - University of Stuttgart
  - TIMA Laboratory

The **Executive Committee** of TESTA'2016 is listed below:

*General Chair:*

Martin Keim – Mentor Graphics

*Informal Proceedings:*

Michael Kochte – University of Stuttgart

*Vice General Chair:*

Artur Jutman – Testonica Lab

*Organizing Committee:*

Al Crouch – SiliconAid

*Program Chair:*

Erik Larsson – Lund University

Bill Eklow – Cisco

Artur Jutman – Testonica Lab

Bill Eklow – Cisco

Christian Zoellin – IBM

Erik Larsson – Lund University

Ivo Steverink – JTAG Technologies

Jeff Rearick – AMD

*Embedded Tutorial Chair:*

Michele Portolan – TIMA Laboratory

Rene Krenz-Baath – HSHL

John Potter – ASSET Intertech

Ken Posse – Broadcom

Martin Keim – Mentor Graphics

*BASTION Liaison:*

Artur Jutman – Testonica Lab

Michael Kochte – University of Stuttgart

Michele Portolan – TIMA Laboratory

Rene Krenz-Baath – HSHL

*P1687.1 Liaison:*

Al Crouch – SiliconAid

Tom Waayers – NXP

*1149.1 Liaison:*

Ivo Steverink – JTAG Technologies

## 2.3 Technical Program of the dissemination workshop

The final agenda of the TESTA 2016 workshop is provided below. The roles of BASTION partners are highlighted by the green background. Additional information about the workshop is available at the ETS 2016 web site:

<http://www.ets16.nl/workshops/>

## Program

Thursday, May 26, 2016

16:30-16:45 **Opening:** Martin Keim

16:45-17:00 Introduction of all attendees

17:00-17:45 Scope and Purpose of IEEE P1687.1 – An Overview *Jeff Rearick*

17:45-18:30 **TUTORIAL 1** - System Level Coordination of Multiple-Standard DfT

*Michele Portolan*

18:30-18:45 Refreshments

18:45-21:00 **Panel with Reception** (food & bar) moderated by *Jeff Rearick*

Friday, May 27, 2016

**08:30-10:00 SESSION 1 Chair:** Adit Singh, Auburn, USA

- Interactive mixed-signal testing through 1687 *Michele Portolan, Manuel Barragan, Hani Malloug and Salvador Mir*

- Integration of IJTAG Test and Trim Islands in I<sup>2</sup>C Legacy Designs *Hans Martin von Staudt and Alexios Spyronasios*

- **Towards a suite of IEEE 1687 benchmark networks** *Anton Tsertov, Artur Jutman, Sergei Devadze, Matteo Sonza Reorda, Erik Larsson, Rene Krenz-Baath, Farrokh Ghani Zadegan and Riccardo Cantoro*

10:00-10:30 Coffee

**10:30-12:00 SESSION 2 Chair:** Juergen Schloeffel, Mentor Graphics, Germany

- IEEE1687 Bottom-up Test Development and Debug Methodology *Mahmoud Abdalwahab and Tom Waayers*

- One Hierarchical, Hybrid Scan & IJTAG Access Network to Rule them All *Martin Keim, JF Cote, Albert Au, Artur Pogiel, Aubin Roy, Jonathan Gaudet, Luc Romain and Wei Zou*

- Autonomous Testing for 3D-ICs with IEEE Std. 1687 *Jin-Cun Ye, Michael Kochte, Kuen-Jong Lee and Hans-Joachim Wunderlich*

12:00-13:00 Lunch

**13:00-13:45 TUTORIAL 2 - In-Field System-Health Monitoring based on IEEE 1687** *Artur Jutman and Erik Larsson*

13:45-14:15 Coffee

**14:15-16:15 SESSION 3 Chair:** Kim Petersen, HDC, Sweden

- **Retargeting Challenges in IEEE 1687 Networks** *Farrokh Ghani Zadegan, Rene Krenz-Baath, Erik Larsson and Artur Jutman*

- **Test, Validation and Diagnosis of IEEE 1687 Networks** *Riccardo Cantoro, Matteo Sonza Reorda, Farrokh Ghani Zadegan, Erik Larsson, Artur Jutman and Sergei Devadze*

- **Online Management of Temperature Health Monitors using the IEEE 1687 Standard** *Ghazanfar Ali, Ahmed Badawy and Hans Kerkhoff*

- **On Safety and Security Aspects of IEEE 1687 Networks** *Matthias Beck and Piet Engelke*

**16:15 Closing**

## **2.4 Results of TESTA**

TESTA 2016 had 29 pre-registered attendees plus ca. 5 participants joining the same day, whereas BASTION was represented by 10 people and the rest were external participants. Industrial participation at the workshop was at a good level represented by 12 registered attendees.

BASTION research results contributed to 50% of the TESTA workshop's regular program (incl. tutorials) and covered the following IJTAG-related topics:

- IJTAG infrastructure for system health monitoring;
- Test, validation and diagnosis of IJTAG networks;
- Safety and security of IEEE 1687;
- IJTAG benchmark networks.

The next edition of the TESTA workshop will be organized with ETS 2017, will have a broader coverage of the test standards and will give BASTION consortium another opportunity to report the latest final results. BASTION *project coordinator* will be serving as the *General Chair* of TESTA'2017.

## 3 RENS Workshop

### 3.1 Organization of the RENS workshop

From the perspective of the BASTION consortium, the fourth dissemination workshop had the following main **aims**:

- Focus on reliability, fault resilience and fault tolerance, which represents a large part of the BASTION's scope;
- Disseminate the results of BASTION project;
- Share the research and development agenda of BASTION project;
- Learn from and exchange information with the adjacent research communities
- Receive feedback from the academic and industrial communities;
- Brainstorm with leading experts.

**Scope.** Advanced multifunctional computing systems realized in nanoelectronic technologies hold the promise of a significant increase of the computational capability that will offer end-users ever improving services and functionalities (e.g., next generation mobile devices, cloud services, embedded systems etc.). However, the same path that is leading technologies toward these remarkable achievements is also making electronic devices increasingly unreliable posing a threat to our society that is depending on the computers and electronic devices in every aspect of human activities. Hence new techniques introducing resilience into the nanoelectronics systems taking into account the specific requirements of different domains are urgently needed.

This tutorial-style workshop delivers a broad overview of the cutting-edge topics in the area of nanoelectronic systems' resilience. It provides a unique chance to join experts from three on-going European projects as well as researchers working in the area of reliable electronic system design. The topics that will be covered include, but are not limited to, aging modelling, life-time prediction, error-checking, embedded instruments for system health monitoring, fault management, resilient many-core architectures, design validation/verification and automated debug.

### 3.2 Workshop Organizers

The workshop was held in cooperation with two other EU projects H2020 RIA IMMORTAL and H2020 TWINN TUTORIAL and external panellists and invited speakers coming from Mexico and Germany.

The **Executive Committee** is listed below:

General Chair

Matteo Sonza Reorda, Pol. di Torino, IT

Program Chairs

Artur Jutman, Testonica Lab, ET

Jaan Raik, Tallinn UT, ET

Organization

Maksim Jenihhin, Tallinn UT, ET

Program Committee

E. Arbel, IBM

R. Bloem, Graz UT

G. Fey, DLR

S. Hamdioui, Delft UT

A. Jutman, Testonica

H. Kerkhoff, U. Twente

R. Krenz-Baath, Hamm-Lippstadt

E. Larsson, U. Lund

C. Laudert, Infineon  
C. Lotz, Aster  
J. Raik, Tallinn UT

M. Sonza Reorda, Pol. Torino  
K. Sunesen, Recore

### 3.3 *Technical Program of the dissemination workshop*

The agenda of the RENS 2016 workshop is provided below. The roles of BASTION partners are highlighted by the green background. Additional information about the workshop is available at the VLSI-SoC 2016 and RENS own web sites:

<http://ati.ttu.ee/rens2016/>

<http://ati.ttu.ee/vlsi-soc2016/index.php?page=59>

#### **Program**

*Wednesday, September 28*

15:45 - 16:30 **Welcome and Overview** *Matteo Sonza Reorda, Politecnico di Torino, Italy; Artur Jutman, Testonica Lab, Estonia; Jaan Raik, Tallinn UT, Estonia*

16:30 - 18:00 **Keynote** IC Technology and Computing: The Good, The Bad and The Challenging, *Said Hamdioui, Delft UT, Netherlands*

18:00 - 18:15 Coffee Break

18:15 - 19:30 **Wine and Cheese Panel**

*Moderator: Artur Jutman, Testonica Lab, Estonia*

19:30 - 22:00 Welcome Reception

*Thursday, September 29*

9:00 - 9:30 **Invited talk** Screening Reliability Defects in Emerging Technology Nodes, *Victor Champac, INAOE, Mexico*

9:30 - 10:30 **Embedded tutorial** Highly dependable many-core SoCs by lifetime prediction and embedded instrumentation, *Hans Kerkhoff, University of Twente, Netherlands; Kim Sunesen, Gerard Rauwerda, Recore Systems, Netherlands*

10:30 - 11:00 Coffee break / **Poster session**

11:00 - 11:30 **Embedded tutorial** Advances in checker verification *Eli Arbel, Shiri Moran, IBM, Israel; Roderick Bloem, Franz Röck, Graz UT, Austria; Jaan Raik, Ranganathan Hariharan Tallinn UT, Estonia*

11:30 - 12:30 **Embedded tutorial** Stress measurement for burn-in testing, *Paolo Bernardi, Politecnico di Torino, Italy*

12:30 - 14:00 Lunch

14:00 - 14:30 **Invited talk** Migrating from circuit level error correction to system level error resilience, *Heinrich Theodor Vierhaus, BTU Cottbus-Senftenberg, Germany*

14:30 - 15:30 **Embedded tutorial** Tool Support for Design Understanding *Heinz Riener, Jan Malburg, Görschwin Fey German Aerospace Center (DLR) / University of Bremen, Germany*

15:30 - 16:00 Coffee break / **Poster session** (continues)

16:00 - 16:30 **Invited talk Angel's Approach to Digital Testing with Decision Diagrams, Raimund Ubar, Tallinn UT, Estonia**

16:30 - 16:40 **Closing**

### 3.4 Results of RENS

RENS 2016 provided a unique chance to join experts from three on-going European projects BASTION, IMMORTAL and TUTORIAL that address several reliability challenges. The topics that were covered included fault modelling in forthcoming technologies, verification and design understand, reliability evaluation and enhancement techniques including aging issues.



Figure 2.1. Lively RENS 2016 Panel discussions with Prof. Champac from Mexico



Figure 2.2 Artur Jutman presents BASTION project to the RENS 2016 audience

The workshop had 35 registered participants from different regions of the world including an invited speaker from Mexico prof. Victor Champac. One of the key results was a panel organized by BASTION entitled "*Failure resilience today vs. tomorrow: evolution or revolution?*". The latter has encouraged lively discussions.

On the whole, RENS has achieved significant dissemination of research results produced in BASTION.

## 4 Dissemination action at NTF 2016

Following the success of the 1<sup>st</sup> BASTION dissemination workshop co-located with NTF'2014 in Sweden (see version 1 of D5.4), BASTION co-ordinator made an update of BASTION progress in the area of board and system-level test and NFF at NTF'2015 in Oslo, Norway. In 2016 the BASTION consortium decided to run a dissemination action at NTF'2016 in Vilnius, Lithuania. The dissemination action comprised two regular presentations and a table-top demo of embedded instrumentation for high-performance test (results of WP2 and WP4). The following talks were given by BASTION partners:

- Test Coverage 4.0: How to build a consistent design to test flow in order to deliver defect-free PCBA *Christophe Lotz, Aster Technologies.*
- Screening out marginal defects and outliers passing functional test *Artur Jutman, Sergei Odintsov, Testonica Lab.*

### 4.1 Results of the dissemination action at NTF'2016

Nordic Test Forum is a major event for test professionals in the Nordic area and Baltic states with main emphasis on issues relevant to production managers, engineers and technicians working in the fields of test, inspection and validation of electronics. Every year the TestForum is attended by key people from the industrial test community as well as by international vendors of test and measurement equipment and solutions.

NTF'2016 had 62 attendees from 14 countries of Europe, America and Asia, whereas BASTION was represented by 3 participants. NTF'2016 was mainly the industrial event with only 2 participants coming from academia.

Both presentations were evaluated by the attendees above the average in terms of quality and interest. The table-top demo was intensively attended non-stop during coffee-breaks and exhibition slots of the NTF'2016 program. The action generated new contacts and business leads. Hence, it will definitely have a positive impact on the exploitation and commercialization of the BASTION technology.

## 5 Summary

Deliverable D5.4 is a combination of three separate documents describing organization of BASTION dissemination workshops in years 2014, 2015, and 2016 respectively. To get the full picture, one has to read all the three documents. The current document is the third and final part of D5.4.

During the project duration, BASTION consortium has organized four dissemination workshops: one in 2014, one in 2015 and two in 2016. While the "BASTION 2014" was a fully BASTION consortium driven event, the "RAFES 2015" was already a co-operative action between BASTION, CLERECO and ELESIS projects. Following the reviewer recommendations, we have continued in 2016 the active collaboration with external research groups, industrial community and projects in the EU and worldwide to achieve a higher impact of the dissemination activities. In order to better address different focus groups, it has been decided to run three separate events in 2016: two workshops and one dissemination action.

The "1st International Test Standards Application Workshop - TESTA 2016" was focused on the IEEE 1687 IJTAG standard and it was organized in cooperation with the leading groups and companies from EU and US actively running IJTAG-related R&D. The "1st International Workshop on Resilience in Nanoelectronics Systems - RENS 2016" was held in cooperation with the EU projects H2020 RIA IMMORTAL and H2020 TWINN TUTORIAL and it was focused on reliability, fault resilience and fault tolerance. In addition, BASTION has organized a dissemination action dedicated to board-level test and NFF at the industrial event "Nordic Test Forum 2016".

Clear partitioning of BASTION dissemination actions into three focus topics allowed to increase the impact of the dissemination activities by collaborating with respective focus groups and consortia and delivering the information directly to the right audience.