INFORMATION SOCIETY TECHNOLOGIES (IST) PROGRAMME

FRICTION

FP6 - IST - 2004 - 4 - 027006

Deliverable 12: Plan for Use and Dissemination of Knowledge

Dissemination	Section 1: **CO** Section 2: **CO** Section 3: **PU**
Work package	WP8 Dissemination
Authors	Ari Tuononen
Due date	31.12.2008
Delivery date	26.03.2009
Status	Final
This document	FRICTION_Deliverable_D12.doc
Short description	This deliverable describes the usage and dissemination activities undertaken in the project. Publications submitted in the project are listed and partner-specific dissemination plans are described.

Section 3 – Publishable results

Part 1 Project and results overview

3.1.1 Project summary

EC PROGRAMME:	**FP6-IST**
PROJECT TITLE:	**On-board Measurement of Friction and Road Slipperiness to Enhance the Performance of Integrated and Cooperative Safety Systems**
PROJECT ACRONYM:	**FRICTION**
CONTRACT NUMBER :	**027006**
PROJECT WEB SITE (if any) :	**friction.vtt.fi**
COORDINATOR:	
Coordinator's name	**Pertti Peussa**
Coordinator e-mail	**pertti.peussa@vtt.fi**
Coordinator telephone	**+358 20 722 3601**
Coordinator organisation name	**Technical Research Centre of Finland**
Coordinator organisation full address	VTT Technical Research Centre of Finland P.O. Box 1000 FI-02044 VTT **FINLAND**
PARTNERS NAMES :	Centro Ricerche FIAT S.C.p.A. IBEO Automobile Sensor GmbH Rheinisch-WestfaelischeTechnischeHochschule Aachen Magneti Marelli Sistemi Elettronici S.p.A. Nokian Tyres plc Pirelli Tyre S.p.A Helsinki University of Technology VOLVO Technology Corporation VDO Automotive AG
EC PROJECT OFFICER:	
EC PO name	**Fabrizio Minarini**
EC PO e-mail	**fabrizio.minarini@ec.europa.eu**
EC Directorate General	**INFSO**

3.1.2 Overview of main project results

Table 1.2

No.	Self-descriptive title of the result	Category A, B or C*	Partner(s) owning the result(s) (referring in particular to specific patents, copyrights, etc.) & involved in their further use
1	IcOR – Camera based road state monitoring system	A	VTT
2	Friction fusion overall architecture and software modules: Decision Fusion Data Gateway Vehicle Feature Fusion (VFF) Environmental Feature Fusion (EFF) Tyre Feature Fusion (TFF)	A – For the overall architecture C – for the software code in modules	VTT as main architect of the fusion and owner for most of the software in the "Full Model" Simulink model for the Audi development vehicle. VDO, CRF, IBEO, TKK contribution and ownership inside the Full Model: VDO and CRF have their separate blocks inside the VFF module. IBEO has contributed to a number of blocks inside EFF. TKK for the whole TFF module. IKA has implemented the Data Gateway for the development vehicle. The other vehicle owners (CRF, VTEC) have also their data gateway and HMI implementations as well as modified versions of software blocks.
3	Sensor fusion algorithm for estimation of maximum friction coefficient	A	TKK
4	Development platform vehicle	A	IKA
5	Automotive radar technology for road condition detection	A	VTT
6	Tyre sensor development platform	A	TKK

*__A__: results are usable outside the consortium
*__B__: results are usable within the consortium
*__C__: results are non usable

Part 2 Description of each result

PARTS 2 OF TYPE A RESULTS WILL BE DISSEMINATED BY THE COMMISSION.

3.2.1.1 Description of the result(s), one form per result

No. & TITLE OF RESULT (same as in table 1.2)

No.	Self-descriptive title of the result
1	IcOR – Camera based road state monitoring system

Fields marked with * are mandatory

CONTACT PERSON FOR THIS RESULT

Title*	IcOR – Camera based road state monitoring system
Family name*	Kutila
First name*	Matti
Position	Senior Research Scientist
Organisation*	VTT Technical Research Centre of Finland
Address	P.O. Box 1300
Post Code	FI-33101
City*	Tampere
Country*	**FINLAND**
Telephone	+358 20 722 3619
Fax	
E-mail*	matti.kutila@vtt.fi
URL	
Specific Result URL	

SUMMARY* *(200 words maximum)*

Provide an overview of the result which gives the reader an immediate impression of the nature of the result, its relevance and its potential; Briefly describe the current status/applications of the result (if appropriate) with non confidential information on entities potentially involved.

The system gives a real-time measurement of the road surface status, and is able to distinguish between dry, wet or icy conditions. It is composed of two cameras and a processing module for image analysis. The system can be mounted in a vehicle to monitor the road ahead.

The method employs images acquired via horizontal and vertical polarisation filters. When light is reflected from an icy or wet surface, the intensity of the horizontal polarisation accentuates compared to the "normal" situation. In addition to this polarisation methodology, the system also performs graininess analysis, which is used to distinguish whether the road surface is wet or icy.

The system is enables provision of proactive warning for a driver 50 – 100 m ahead of the vehicle instead of analysing actual tyre rotations. The system also works when the vehicle speed and acceleration is zero or very low, thus the tyres do not have to rotate due to analysis.

SUBJECT DESCRIPTORS*

Please categorise the result using codes from Annex 2 (maximum: 5)

Subject descriptors codes	310	563	623	656	

CURRENT STAGE OF DEVELOPMENT

Please tick one category only (X)

Scientific and/or Technical knowledge (Basic research)	
Guidelines, methodologies, technical drawings	
Software code	
Experimental development stage (laboratory prototype)	x
Prototype/demonstrator available for testing	
Results of demonstration trials available	
Other (please specify.):	

INTELLECTUAL PROPERTY RIGHTS

Please tick appropriate boxes (X)

Type of IPR	
Patent applied for	
Patent granted	
Patent search carried out	
Licence agreement(s) reached	
Partnership / other contractual agreement(s)	
Exclusive rights	
Registered design	

Trademark applications	
Copyrights registered	
Secret know-how	
Other - please specify :	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 3 (maximum 5).

Market application sectors	60	34			

3.2.1.2 Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT*

Please tick appropriate boxes (X) corresponding to your needs.

R&D	Further research or development	x	**FIN**	Financial support	x
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	
MAN	Manufacturing agreement		**PPP**	Private-public partnership	x
MKT	Marketing	x	**INFO**	Information exchange	
JV	Joint venture		**CONS**	Available for consultancy	
			Other	(please specify)	

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Please, clearly describe your input, the value and interest of the applications and the dissemination and use opportunities that you can offer to your potential partner.

The laboratory level IcOR system already exists and it can be supplied to the further evaluation to any interest groups. The software is also available in order to get familiar with the system's functionality.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Please, clearly describe the profile and the expected input from the external partner(s).

Performance of the IcOR system is not sufficient to detect road status alone. Instead additional road state related measures are needed (e.g. tyre rotation, temperature) which are available in the vehicle busses. Therefore, it is highly desired that the partner(s) have knowledge about access to the in-vehicle data and co-operative vehicle systems.

3.2.2.1 Description of the result(s), one form per result

No. & TITLE OF RESULT (same as in table 1.2)

No.	Self-descriptive title of the result
2	Friction fusion overall architecture and software modules

Fields marked with * are mandatory

CONTACT PERSON FOR THIS RESULT

Title*	Mr
Family name*	Koskinen
First name*	Sami
Position	Research Scientist
Organisation*	VTT
Address	P.O.Box 1300
Post Code	33101
City*	Tampere
Country*	**Finland**
Telephone	+358 40 823 8022
Fax	
E-mail*	sami.koskinen@vtt.fi
URL	
Specific Result URL	

SUMMARY* *(200 words maximum)*

Developed fusion model for friction estimation including the general architecture and separate software modules:
Decision Fusion
Data Gateway
Vehicle Feature Fusion (VFF)
Environmental Feature Fusion (EFF)
Tyre Feature Fusion (TFF)

The model consists of the main architecture implemented by VTT and software modules provided by several partners. By combining several algorithms and sensing methods the full model was capable of near-continuous friction estimation on tested road surfaces. The performance and structure of the model is further described in the Final Deliverable and in D11.

The model has been available for the partners during the project but the ownership of the modules belong to different organizations and their use after the project has to be agreed with the owners. The full model is available for Friction related publications also after the project as long as the project, partners and a description of their contribution to the model are also mentioned.

SUBJECT DESCRIPTORS*
Please categorise the result using codes from Annex 2 (maximum: 5)

Subject descriptors codes					

CURRENT STAGE OF DEVELOPMENT
Please tick one category only (X)

Scientific and/or Technical knowledge (Basic research)	
Guidelines, methodologies, technical drawings	
Software code	x
Experimental development stage (laboratory prototype)	
Prototype/demonstrator available for testing	
Results of demonstration trials available	
Other (please specify.):	

INTELLECTUAL PROPERTY RIGHTS

Please tick appropriate boxes (X)

Type of IPR	
Patent applied for	
Patent granted	
Patent search carried out	
Licence agreement(s) reached	

Partnership / other contractual agreement(s)	x
Exclusive rights	
Registered design	
Trademark applications	
Copyrights registered	
Secret know-how	
Other - please specify :	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 3 (maximum 5).

Market application sectors					

3.2.2.2 Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT*

Please tick appropriate boxes (X) corresponding to your needs.

R&D	Further research or development	x	**FIN**	Financial support	
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	
MAN	Manufacturing agreement	x	**PPP**	Private-public partnership	
MKT	Marketing		**INFO**	Information exchange	
JV	Joint venture		**CONS**	Available for consultancy	
			Other	(please specify)	

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Please, clearly describe your input, the value and interest of the applications and the dissemination and use opportunities that you can offer to your potential partner.

The fusion approach clearly shows potential to be a (small) part of several applications in ADAS and autonomous driving development.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Please, clearly describe the profile and the expected input from the external partner(s).

-

3.2.3.1 Description of the result(s), one form per result

No. & TITLE OF RESULT (same as in table 1.2)

No.	Self-descriptive title of the result
3	Sensor fusion algorithm for estimation of maximum friction coefficient

Fields marked with * are mandatory

CONTACT PERSON FOR THIS RESULT

Title*	Mr.
Family name*	Tuononen
First name*	Ari
Position	Researcher
Organisation*	Helsinki University of Technology
Address	Laboratory of Automotive Engineering, P.O.Box 4300
Post Code	02015 TKK
City*	Espoo
Country*	**Finland**
Telephone	+358 505604702
Fax	+358 4513469
E-mail*	ari.tuononen@tkk.fi
URL	www.tkk.fi
Specific Result URL	

SUMMARY* *(200 words maximum)*

The result combines vehicle sensors and environmental information in order to estimate maximum friction potential in all driving condition.

The estimation based on purely vehicle sensor cannot predict maximum friction coefficient unless certain amount of friction used. On the other hand, environmental sensor can classify effectively road surfaces, but cannot evaluate the performance of certain vehicle on it. The result utilises heuristic information about the signals and thus it can extend the operating range of the existing friction estimation systems.

SUBJECT DESCRIPTORS*
Please categorise the result using codes from Annex 2 (maximum: 5)

Subject descriptors	338	465	631	635	636

CURRENT STAGE OF DEVELOPMENT
Please tick one category only (X)

Scientific and/or Technical knowledge (Basic research)	X
Guidelines, methodologies, technical drawings	
Software code	
Experimental development stage (laboratory prototype)	
Prototype/demonstrator available for testing	
Results of demonstration trials available	
Other (please specify.):	

INTELLECTUAL PROPERTY RIGHTS

Please tick appropriate boxes (X)

Type of IPR	
Patent applied for	X
Patent granted	
Patent search carried out	X
Licence agreement(s) reached	
Partnership / other contractual agreement(s)	
Exclusive rights	
Registered design	
Trademark applications	
Copyrights registered	
Secret know-how	X
Other - please specify :	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 3 (maximum 5).

Market application sectors	29	34	60		

3.2.3.2 Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT*

Please tick appropriate boxes (X) corresponding to your needs.

R&D	Further research or development	X	**FIN**	Financial support	X
LIC	Licence agreement	X	**VC**	Venture capital/spin-off funding	X
MAN	Manufacturing agreement		**PPP**	Private-public partnership	X
MKT	Marketing		**INFO**	Information exchange	
JV	Joint venture	X	**CONS**	Available for consultancy	X
			Other	(please specify)	

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Please, clearly describe your input, the value and interest of the applications and the dissemination and use opportunities that you can offer to your potential partner.

TKK can offer knowledge of tyre and vehicle behaviour in all relevant driving conditions. The result will be tested and further developed in near future.

TKK is the greatest technical university in Finland and can contribute in many technological areas related to this invention.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Please, clearly describe the profile and the expected input from the external partner(s).

The experienced partner with hands-on information about parameterisation of vehicle based friction estimation is needed. A partner who can finalize the result to a product and can bring the product out to the market is needed.

3.2.4.1 Description of the result(s), one form per result

No. & TITLE OF RESULT (same as in table 1.2)

No.	Self-descriptive title of the result
4	Development platform vehicle

Fields marked with * are mandatory

CONTACT PERSON FOR THIS RESULT

Title*	
Family name*	Huesemann
First name*	Thomas
Position	
Organisation*	Institut für Kraftfahrzeuge
Address	Steinbachstr. 7
Post Code	52074
City*	Aachen
Country*	**Germany**
Telephone	0241 / 8025600
Fax	0241 / 8022147
E-mail*	huesemann@ika.rwth-aachen.de
URL	www.ika.rwth-aachen.de
Specific Result URL	

SUMMARY* *(200 words maximum)*

Within the friction project a development platform vehicle was set up with sensor systems, data processing units, power supply and active systems that enabled the development of prototype sensor systems and software code for sensor fusion systems.
Furthermore the car was used to demonstrate a friction estimation system using various types of vehicle based sensors and environmental sensors.

This vehicle will be used for further research purposes based on various vehicle and environmental sensors and advanced driver assistance applications. Within the project a validated vehicle model was set up and can be used for offline system testing.
The modularity allows the easy implementation of further sensor systems or active driving dynamics control systems.
By this development platform an active vehicle based safety system will be developed online and offline.

SUBJECT DESCRIPTORS*
Please categorise the result using codes from Annex 2 (maximum: 5)

Subject descriptors codes	120	137	297	309	546

CURRENT STAGE OF DEVELOPMENT
Please tick one category only (X)

Scientific and/or Technical knowledge (Basic research)	
Guidelines, methodologies, technical drawings	
Software code	
Experimental development stage (laboratory prototype)	
Prototype/demonstrator available for testing	X
Results of demonstration trials available	
Other (please specify.):	

INTELLECTUAL PROPERTY RIGHTS

Please tick appropriate boxes (X)

Type of IPR	
Patent applied for	
Patent granted	
Patent search carried out	
Licence agreement(s) reached	
Partnership / other contractual agreement(s)	
Exclusive rights	
Registered design	
Trademark applications	

Copyrights registered	
Secret know-how	
Other - please specify :	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 3 (maximum 5).

Market application sectors	34	35	60		

3.2.4.2 Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT*

Please tick appropriate boxes (X) corresponding to your needs.

R&D	Further research or development	X	**FIN**	Financial support	
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	
MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing		**INFO**	Information exchange	
JV	Joint venture	X	**CONS**	Available for consultancy	X
			Other	(please specify)	

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Please, clearly describe your input, the value and interest of the applications and the dissemination and use opportunities that you can offer to your potential partner.

The development platform vehicle can be used for various vehicle based sensor systems or active driver assistance safety systems. By the possibility of using the car on the road and using the corresponding computer simulation model, algorithms and controllers can be easily developed, improved and validated: Offline and online.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Please, clearly describe the profile and the expected input from the external partner(s).

Additional partners should be involved in sensor technology and vehicle based sensor systems as well as in vehicle dynamics control systems or advanced driver assistance systems. They should have interest in vehicle dynamics and road safety systems. Partners might be public or private research institutes or commercial R&D or engineering companies as well as car manufacturers or the vehicle supply industry.

3.2.5.1 Description of the result(s), one form per result

No. & TITLE OF RESULT (same as in table 1.2)

No.	Self-descriptive title of the result
5	Automotive radar technology for road condition detection

Fields marked with * are mandatory

CONTACT PERSON FOR THIS RESULT

Title*	Dr
Family name*	Varpula
First name*	Timo
Position	Technology Manager
Organisation*	VTT
Address	P.O.Box 1000 Tietotie 3,
Post Code	02044 VTT
City*	Espoo
Country*	**Finland**
Telephone	+358 40 58 111 34
Fax	+358 20 722 7012
E-mail*	timo.varpula@vtt.fi
URL	www.vtt.fi
Specific Result URL	

SUMMARY* *(200 words maximum)*

Provide an overview of the result which gives the reader an immediate impression of the nature of the result, its relevance and its potential; Briefly describe the current status/applications of the result (if appropriate) with non confidential information on entities potentially involved.

Potential of the 24 and 77 GHz automotive radar technologies for detecting low-friction spots caused by water, ice or snow on asphalt was studies. Backscattering properties of dry, wet and icy asphalt were studied in laboratory conditions and backscattering properties of dry, icy and snowy asphalt were studied in field experiments. In addition, the effect of water to the backscattering properties of asphalt was studied with a surface scattering model. The results show that low friction spots can be detected with radar by comparing backscattered signals at different polarizations. With some hardware and software modifications, the degree of generity of the automotive radar sensor will be increased. The sensor could be used for blind spot detection, automatic cruise control, road condition detection.

SUBJECT DESCRIPTORS*

Please categorise the result using codes from Annex 2 (maximum: 5)

Subject descriptors codes	656	546	412		

CURRENT STAGE OF DEVELOPMENT

Please tick one category only (X)

Scientific and/or Technical knowledge (Basic research)	
Guidelines, methodologies, technical drawings	
Software code	
Experimental development stage (laboratory prototype)	X
Prototype/demonstrator available for testing	
Results of demonstration trials available	
Other (please specify.):	

INTELLECTUAL PROPERTY RIGHTS

Please tick appropriate boxes (X)

Type of IPR	
Patent applied for	X
Patent granted	
Patent search carried out	X
Licence agreement(s) reached	
Partnership / other contractual agreement(s)	
Exclusive rights	
Registered design	
Trademark applications	

Copyrights registered	
Secret know-how	X
Other - please specify :	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 3 (maximum 5).

Market application sectors	32	34			

3.2.5.2 Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT*

Please tick appropriate boxes (X) corresponding to your needs.

R&D	Further research or development	X	**FIN**	Financial support	
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	
MAN	Manufacturing agreement		**PPP**	Private-public partnership	
MKT	Marketing		**INFO**	Information exchange	X
JV	Joint venture		**CONS**	Available for consultancy	
			Other	(please specify)	

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Please, clearly describe your input, the value and interest of the applications and the dissemination and use opportunities that you can offer to your potential partner.

We propose the development of the automate radar so that it can detect road conditions. VTT has experience in millimetre wave and radar technology, e.g. European Space Agency's external laboratory MilliLab is part of our laboratory. We have modern laboratory equipment and test facilities that allow us to characterise devices and components up to the frequency of 110 GHz. We are an experienced developer of antennas, electronics, other hardware and embedded software.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Please, clearly describe the profile and the expected input from the external partner(s).

We are looking for an industrial partner who can develop the radar further in a joint effort and bring the product out to the market.

3.2.6.1 Description of the result(s), one form per result

No. & TITLE OF RESULT (same as in table 1.2)

No.	Self-descriptive title of the result
6	Tyre sensor development platform

Fields marked with * are mandatory

CONTACT PERSON FOR THIS RESULT

Title*	Mr.
Family name*	Tuononen
First name*	Ari
Position	Researcher
Organisation*	Helsinki University of Technology
Address	Laboratory of Automotive Engineering, P.O.Box 4300
Post Code	02015 TKK
City*	Espoo
Country*	**Finland**
Telephone	+358 505604702
Fax	+358 4513469
E-mail*	ari.tuononen@tkk.fi
URL	www.tkk.fi
Specific Result URL	

SUMMARY* *(200 words maximum)*

TKK has state of the art research equipment to develop tyre sensors in tyre test rig or in test vehicles. The in-depth research to the optical tyre sensor has brought along a lot of practical knowledge about the performance of different tyre sensor concepts. For the optical tyre sensor there is a real-time capable software available for the 3-dimensional tyre force estimation and aquaplaning detection.

SUBJECT DESCRIPTORS*

Please categorise the result using codes from Annex 2 (maximum: 5)

Subject descriptors	338	465	631	635	636

CURRENT STAGE OF DEVELOPMENT

Please tick one category only (X)

Scientific and/or Technical knowledge (Basic research)	X
Guidelines, methodologies, technical drawings	
Software code	
Experimental development stage (laboratory prototype)	
Prototype/demonstrator available for testing	
Results of demonstration trials available	
Other (please specify.):	

INTELLECTUAL PROPERTY RIGHTS

Please tick appropriate boxes (X)

Type of IPR	
Patent applied for	
Patent granted	
Patent search carried out	X
Licence agreement(s) reached	
Partnership / other contractual agreement(s)	
Exclusive rights	
Registered design	
Trademark applications	
Copyrights registered	
Secret know-how	X
Other - please specify :	

MARKET APPLICATION SECTORS

Please describe the possible sectors for application using the NACE classification in Annex 3 (maximum 5).

Market application sectors	29	34	60		

3.2.6.2 Further collaboration, dissemination and use of the result

COLLABORATIONS SOUGHT*

Please tick appropriate boxes (X) corresponding to your needs.

R&D	Further research or development	X	**FIN**	Financial support	X
LIC	Licence agreement		**VC**	Venture capital/spin-off funding	X
MAN	Manufacturing agreement		**PPP**	Private-public partnership	X
MKT	Marketing		**INFO**	Information exchange	
JV	Joint venture	X	**CONS**	Available for consultancy	X
			Other	(please specify)	

POTENTIAL OFFERED FOR FURTHER DISSEMINATION AND USE

Please, clearly describe your input, the value and interest of the applications and the dissemination and use opportunities that you can offer to your potential partner.

TKK has published algorithms for the real time tyre force estimation based on optical sensing. Thus TKK has undoubtedly competence to further improve it or to adapt knowledge to the other possible tyre sensor concepts.

TKK is the largest technical university in Finland and can contribute in many technological areas related to this result.

PROFILE OF ADDITIONAL PARTNER(S) FOR FURTHER DISSEMINATION AND USE

Please, clearly describe the profile and the expected input from the external partner(s).

A partner who develops control systems for the vehicles could bring additional value to the on-going research

Annexes

-