PROJECT FINAL REPORT

FINAL PUBLISHABLE SUMMARY REPORT

Grant Agreement number:

Project acronym: START

Project title: Development of a retro-fitted dry-cleaning unit for agricultural film waste and inter-related web-based logistical software to reduce transport costs and improve the competitive position of organisations within the recycling supply chain.

Funding Scheme: FP7 Research for SMEs program, call SME - 2008 - 01

Period covered: from 1st December 2008 to 31st May 2012

Name, title and organisation of the scientific representative of the project's coordinator[1]:

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/Project website[2] address:

http://start.uk-matri.org

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the grant agreement

[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm ; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

Final Publishable Summary Report

Executive Summary

The overall industrial objective of the project is to develop a waste management technology to allow farmers to achieve their legislative requirements and allow waste management and reprocessing companies to make agricultural waste film recycling commercially viable. The technology developed used innovative dry-cleaning technologies to manufacture a transportable film cleaning unit that can be used to remove soilage from the film waste before transportation and the development of a logistical model and web-based software that will optimise the collection and recycling operations across a range of EU states.

Characterisation of film waste was investigated where representative agricultural waste film samples were supplied and analysed to ascertain the amount and type of soilage present and were then tested to study the effects of the variable strain rates on soilage adhesion to the film to determine the optimal conditions for soilage removal. Tests to determine the effects of turbulent airflow on the removal of soilage from the film were carried out on the film samples where it was noted that moisture on the film making it harder for the airflow to remove the soilage. The consortium found a very large difference in the quantity of soilage on the film and reviewed how the films should be collected and processed before they are sent to be re-cycled, which was determined:

- Mulch and tunnel film - very soiled and requires complete system preparation, to be directly collected off the field as a flat sheet.
- Silage and greenhouse film – free from stones and heavy soilage can be introduced at the shredder stage as manageable bundles.

The new premise was to develop a system which processed the mulch and tunnel film as a flat sheet collected directly from the field. Development trials of film preparation and soilage removal technologies were carried out and a three stage process was determined. First the film is collected from the field, then using brushes, rollers, stretching and air blowing technologies to initially clean and prepare for cutting where the film is reduced and further soilage separation carried out. The last operation carries out the final removal of soilage from the cut film and stores for recycling.

The prototyping of the START sub-units which include the roller stretcher, mill cutting rotor, and cyclone units were successfully carried out and integrated into the complete system.

During these trials extensive evaluation and validation was carried out by the consortium to improve the machine's functionality and performance. The prototype is now able to process a continuous film which is 1.6 m in maximum width and from 25 to 250 microns in thickness which the consortium agree has demonstrated 'proof of principle' from the original concept idea and is able to handle the majority of agricultural film formats available on the market.

Due to the START machine the cleaned waste film was able to skip the first washing phase and the first milling phase in the industrial recycling process. The films are directly fed into the second bath to complete the separation of soilage and other possible contaminants.

In order to allow the START technology to be implemented throughout the EU with the greatest impact a logistical model and web-based software to optimise the plastic film collection and recycling operations was developed. The top level overview of the START software where the basic requirements were identified and the aim of the software was to provide a means for managing all aspects of the collection and recycling process whilst providing all users with easy access and simple input of all relevant data. The principle users of the system defined were Farmers, Collection Agents / Drivers and Service Providers (System Administrators). The software accepts films and waste includes greenhouse, silage, tunnel & mulch types; however, new types can be easily added to the data structure. The software handles the farmer's collection requests; the collection agent and driver's scheduling; the optimised planning of routes through Google Maps and provides reporting on the collection process.

Logistical software trials were carried out to validate and optimise the functionality required, key additions were to provide a relationship between the farmer and geographical areas and also collection agent and geographical areas. All functionality is now included, a web based User model was completed where the consortium has satisfactorily trialled the latest version of the wed based software.

Finally to determine the potential benefits of using the START machine for the collection of agricultural film from the field Life Cycle Analysis (LCA) was carried out which concluded that the START machine will have a significantly positive environmental benefit. A Techno-Economic analysis was also carried out which concluded that the machine could provide an attractive return to whoever owns and operates with savings at the film recovery, transport and recycling stages.

The consortium were delighted and agreed that the project achieved its technological operational targets of the successful development of a ‘dry cleaning agricultural film’ START machine and web based logistical software to manage the collection of the agricultural waste films and reduce transportation costs with the ambition of achieving commercial exploitation.

Summary Description of Project Context & Objectives

The overall industrial objective of the project is to develop a waste management technology to allow farmers to achieve their legislative requirements and allow waste management and reprocessing companies to make agricultural waste film recycling commercially viable. The technology developed used innovative dry-cleaning technologies to manufacture a transportable film cleaning unit that can be used to remove soilage from the film waste before transportation. It was realised by the consortium that, although the START project is centred around the technical development of a retro-fittable enabling technology, the new dry-cleaning technology alone cannot be developed in isolation as the issue of non-hazardous agricultural film recycling is a complex EU-wide logistical problem involving technological, economic and environmental factors which are much broader than the consortium partners. The EU-wide logistical problem was addressed in parallel with the project also covered the technological development of a logistical model and web-based software that will have to be combined to optimise the collection and recycling operations across a range of EU states.

The technical work over the period (1st December 2008 – 31th May 2012) has been spread over the tasks in the following Work Packages:-

- WP 1: Characterisation and Scientific Investigation
- WP 2: Development of Logistical Software
- WP 3: Development of Film Preparation and Soilage Removal
- WP 4: Technical Integration
- WP 5: Technology Trials

The START 'Kick-off' meeting was successfully held at CESAP Limited, UK on Tuesday 11th November 2008 where partners attended and expressed much enthusiasm. During the project there have been regular quarterly meetings which have been hosted by various partners to discuss technical and management issues, to determine the work that needs to be done and allocate packages of work amongst the partners to best utilise each partner's areas of expertise. During this time a number of technical meetings also took place focusing on the specific developments of the project.
Characterisation of film waste was investigated where representative agricultural waste film samples were supplied and analysed to ascertain the amount and type of soilage present. The film samples are typically used for a) Greenhouse and tunnel films to protect crops b) Silage films to preserve silage and c) Mulch films to modify soil temperature, reduce weed growth, prevent moisture loss and improve crop yields, these having the greatest amount of soilage.
These film samples were then tested to study the effects of the variable strain rates on soilage adhesion to the film to determine the optimal conditions for soilage removal. This was very positive as a large percentage of the soilage was removed using an optimum strain rate (stretch) of the polymer. Tests to determine the effect of turbulent airflow on the removal of soilage from the film were carried out on the film samples. It was noted that moisture on the film making it harder for the airflow to remove the soilage and the higher moisture content makes a crust of soilage that adheres to the surface. From these test an empirical model was developed which determined the types of waste film and levels of soilage present in different geographical areas. The model also informs the user how mechanical deformation (stretching) and turbulent air flow affects the surface-soilage adhesion and gives the user optimised conditions for these parameters
Early in the project it was understood that in order to develop a system that will be efficient and acceptable to potential users, the design has to be focused on creating a system that

handles silage film (used film usually wrapped up in to large bundles) and mulch & low tunnels film (removed from ground by rolling up into untidy bundles).
A concept / prototype design of a film preparation and cutting unit was produced and evaluated. The initial premise was to process the film whether mulch or silage as a bundle and not to be fed into the system in a flat sheet. During this initial development the consortium gained considerable new knowledge and understanding about the waste films and how to handle it which changed their initial premise and developed a new focus regarding the priority of the films collected and how it should be processed before they were sent to be re-cycled. The consortium found a very large difference in the quantity of soilage on the film and reviewed how the films should be collected and processed before they are sent to be re-cycled, which was determined:

- Mulch and tunnel film - very soiled and requires complete system preparation, to be directly collected off the field as a flat sheet.
- Silage and greenhouse film – free from stones and heavy soilage can be introduced at the shredder stage as manageable bundles.

The new premise was to develop a system which processed the mulch and tunnel film as a flat sheet collected directly from the field.
Development trials of film preparation and soilage removal technologies were carried out and a three stage process was determined. First the mulch film is collected from the field using brushes, rollers, stretching and air blowing technologies to initially clean and prepare for cutting where the film is reduced and further soilage separation carried out. The last operation carries out the final removal of soilage from the cut film and stores for recycling. The machinery will be mobile and controlled by PLC and the speed will be synchronized to the speed of the tractor. The technologies and process stages of the START system were determined and input / output requirements defined, with a concept design developed. A trailer was identified as the mobile platform for the START system where the layout of the sub-units designed. During the development trials, to improve efficiency, feasibility, and safety, modifications have been carried out.
The prototyping of the START sub-units which include the roller stretcher, mill cutting rotor, and cyclone units were successfully carried out and integrated into the complete system. During this phase, the most challenging task has been to optimise how the film to be processed goes from one unit to the other. In order to let the film run smoothly on a continuous basis without breakage, the connecting components have been improved such as the mill hopper and its position, the power of the cyclone fan motor and the position of the three units. Further work on the machine structure was necessary to prevent the film from twisting around the cylinders. The various improvements allowed the film to run smoothly on a continuous basis and to be satisfactorily clean, as demonstrated by the functioning trials.
The prototype is power driven and the three units are connected to a switchboard, initial testing checked the correct function of each individual unit and their coordination and the necessary adjustments were made to let the various system components run in a synchronous way. This was controlled by a PLC which allows the operator to set the feeding speed and process variables so as to adapt them to the type of film used and optimize cleaning performance. During field trials a number of process variable set-ups were tested with the intention of finding the most suitable ones for a better cleaning action. An operating manual for the START machine was produced covering its working procedures, safety requirements and maintenance.
For the technology trials the prototype was mounted on a trailer. The trailer was equipped with a suitable frame on which the three components of the system were fixed. A certain number of trial sessions have been performed to verify and adjust the working conditions of the system. The data collected in the various trial sessions have been taken into account for generating final results. Different types of silage, mulch and tunnel films of variable thickness from 25 to 100 microns were initially tested. The films tested were contaminated with diverse types of soil (clay soil, sandy soil and mixed soil) and with different humidity content. The best results were obtained using thicker films with low-humidity sandy soil. Under such conditions about 80-90% of soilage was removed from film.

During these trials extensive evaluation and validation was carried out by the consortium to improve the machine's functionality and performance. On the basis of the experience acquired since the beginning of the project a number of necessary modifications were identified and implemented that have improved and made more efficient the machines operation. The prototype is now able to process a continuous film which is 1.6 m in maximum width and from 25 to 250 microns in thickness which the consortium agree has demonstrated 'proof of principle' from the original concept idea and is able to handle the majority of agricultural film formats available on the market.

The soilage waste removed from the agricultural film was analysed to identify the presence of possible contaminating and/or dangerous substances in the soilage itself. The absence of such substances has allowed us to determine that the best way of reusing it is the possibility of returning the soilage to the land from which it has been collected together with the film. This helps avoid the reduction in cultivated land fertility, transport-related problems and costs, possible post-treatment costs and landfill costs.

Due to the START machine the cleaned waste film was able to skip the first washing phase and the first milling phase in the industrial recycling process. The films are directly fed into the second bath to complete the separation of soilage and other possible contaminants. The trials show that the final quality of the granules obtained using this special type of feeding (dry-cleaned flakes) is totally equivalent to the one obtained using the two traditional milling stages and the two traditional cleaning stages with a consequent total saving in terms of industrial process costs of about 10-15%.

In order to allow technology to be implemented throughout the EU with the greatest impact, the START project developed a logistical model and web-based software to optimise the plastic film collection and recycling operations. An investigation of the value of using road-miles software was carried out where the collection vehicles would travel to collect plastic film waste from farms and return to an agricultural waste recycling centre. The vehicles would travel on predetermined routes that minimize journey length and time. To aid in the development, specification, visualisation, construction and documentation of the software system a technique known as Unified Modelling Language (UML) has been adopted. Also existing software packages were investigated which could be modified or configured to suit the START application.

The top level overview of the START software was developed where the basic requirements were identified and after much review although the preferred methodology was to integrate the bespoke route planning functionality into the IFFPG website it was agreed by the consortium that the decision was not to build upon the existing IFFPG system because the database and the entity relationships did not support the new functionality and it would have entailed re-writing much of the existing system to accommodate the necessary changes. It was decided to use the latest version of MySQL for the database and the latest version of ASP.Net for the software development platform. These were MySql Community Version 5.1 and Microsoft .Net version 3.5. The initial version of the web base software was developed:

http://start.pera.com/

The original specification suggested that the aim of the software was to provide a means for managing all aspects of the collection and recycling process whilst providing all users with easy access and simple input of all relevant data. The principle users of the system defined were Farmers, Collection Agents / Drivers and Service Providers (System Administrators). The software currently accepts films and waste includes greenhouse, silage, tunnel & mulch types; however, new types can be easily added to the data structure. The software handles the farmer's collection requests; the collection agent and driver's scheduling; the optimised planning of routes through Google Maps and provides reporting on the collection process.

Logistical software trials were carried out during the technical and management meetings with the consortium to validate and optimise the functionality required, key additions were to provide a relationship between the farmer and geographical areas and also collection agent and geographical areas. This should be automated and it was agreed that the Admin should be able to create those relationships. All functionality is now included, a web based User model was completed where the consortium has satisfactorily trialled the latest version of the

wed based software. Technical documentation for the Web based software has been produced.
Finally to determine the potential benefits of using the START machine for the collection of agricultural film from the field Life Cycle Analysis (LCA) was carried out. The findings compare two scenarios, without and with the use of the START prototype for collection of film. An LCA should be performed in line with the principles and procedures stated by the ISO 14040 series of standards, following current LCA practice and using SimaPro, a widely known LCA software tool. The system analysed focuses on the differences between operations involving the START machine and the status quo, and excludes those processes which are the same. The boundary for the analysis therefore starts with the collection of the film and adhering soil etc in the field, where the START machine partly cleans and shreds the film, and then covers the transport of the film and soil to the recycling facility, the recycling of the film, which involves fewer steps where the film has been processed by the START machine, and the transport of soil from the recycling facility to landfill. Overall, it was concluded that the START machine will have a significantly positive environmental benefit. A Techno-Economic analysis was also carried out which concluded that the machine could provide an attractive return to whoever owns and operates with savings at the film recovery, transport and recycling stages.
The consortium were delighted and agreed that the project achieved its technological operational targets of the successful development of a 'dry cleaning agricultural film' START machine and web based logistical software to manage the collection of the agricultural waste films and reduce transportation costs with the ambition of achieving commercial exploitation.

Beneficiary Number	Beneficiary Name	Beneficiary Short Name	Country	Type of Organisation	Date Entered Project	Date Exit Project
1 (Coord)	Packaging And Films Association	PAFA	UK	(SME-AG)	Month 1	Month 42
2	Adivalor	ADIVALOR	France	(SME-AG)	Month 7	Month 42
3	Italian Plastics Recyclers' Association	ASSORIMAP	Italy	(SME-AG)	Month 1	Month 42
4	Irish Farm Film Producers Group	IFFPG	Eire	(SME)	Month 1	Month 42
5	Eurofilm Mantzaris S.A.	EUROFILM	Greece	(SME)	Month 1	Month 42
6	Previero N.S.r.l.	PREVIERO	Italy	(SME)	Month 1	Month 42
7	S.C. Technosam S.R.L	TECHNO	Romania	(SME)	Month 1	Month 42
8	Plastika Kritis S.A.	PLASTIKA	Greece	(OTHER)	Month 1	Month 42
9	Digeco Systems	DIGECO	Eire	(SME)	Month 7	Month 42
10	UK Materials Technology Research Institute	MatRI	UK	(RTD-P)	Month 1	Month 42
11	ELKEDE. Technology and Design Centre SA	ELKEDE	Greece	(RTD-P)	Month 1	Month 33
12	Centro Europeo Sviluppo Applicazioni Plastiche	CESAP	Italy	(RTD-P)	Month 1	Month 42

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PROJECT FINAL REPORT

USE AND DISSEMINATION OF FOREGROUND REPORT

Grant Agreement number:

Project acronym: START

Project title: Development of a retro-fitted dry-cleaning unit for agricultural film waste and inter-related web-based logistical software to reduce transport costs and improve the competitive position of organisations within the recycling supply chain.

Funding Scheme: FP7 Research for SMEs program, call SME - 2008 - 01

Period covered: from 1st December 2008 to 31st May 2012

Name, title and organisation of the scientific representative of the project's coordinator[3]:

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/Project website[4] address:

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[3] Usually the contact person of the coordinator as specified in Art. 8.1. of the grant agreement

[4] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm ; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

1. Introduction

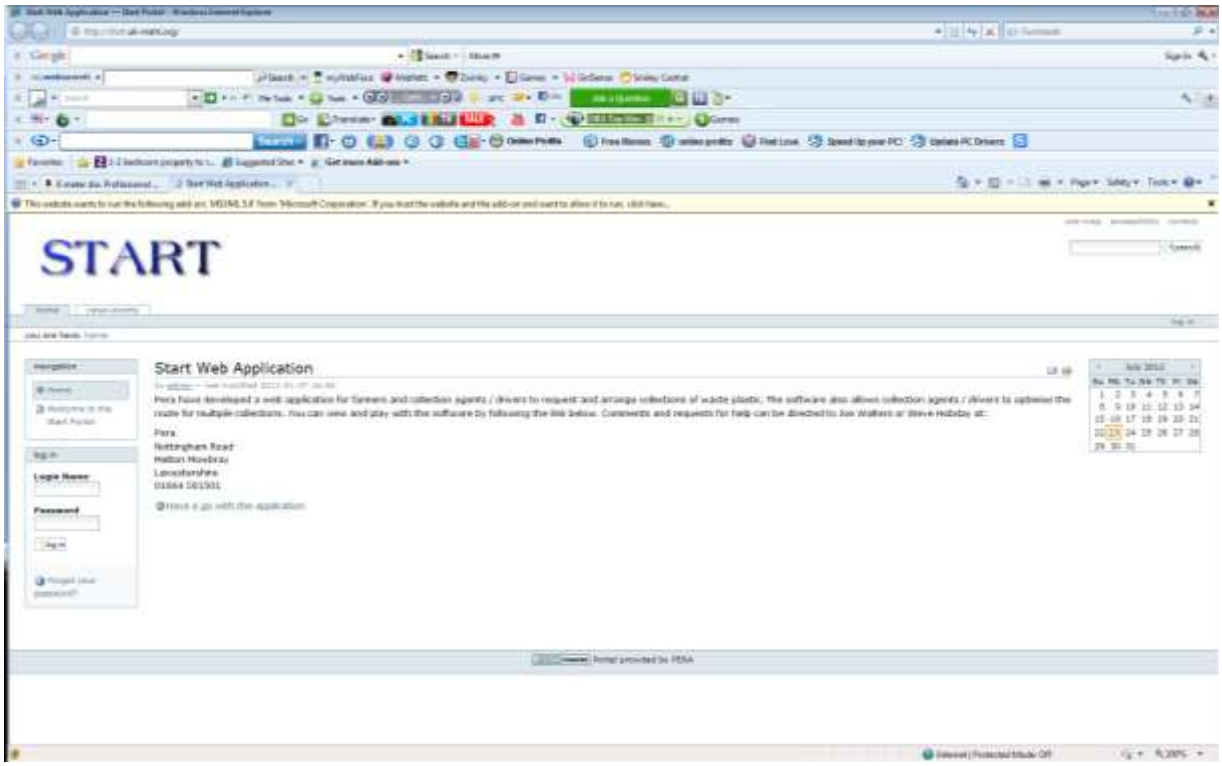
The overall industrial objective of the project is to develop a waste management technology to allow farmers to achieve their legislative requirements and allow waste management and reprocessing companies to make agricultural waste film recycling commercially viable. The technology developed used innovative dry-cleaning technologies to manufacture a transportable film cleaning unit that can be used to remove soilage from the film waste before transportation. It was realised by the consortium that, although the START project is centred around the technical development of a retro-fittable enabling technology, the new dry-cleaning technology alone cannot be developed in isolation as the issue of non-hazardous agricultural film recycling is a complex EU-wide logistical problem involving technological, economic and environmental factors which are much broader than the consortium partners. The EU-wide logistical problem was addressed in parallel with the project also covered the technological development of a logistical model and web-based software that will have to be combined to optimise the collection and recycling operations across a range of EU states.

The project START was concluded to have achieved its technological operational targets of the successful development of a ‘dry cleaning agricultural film’ START machine and web based logistical software to manage the collection of the agricultural waste films and reduce transportation costs. This technology will have a significantly positive environmental benefit and that the START machine could provide an attractive return to whoever owns and operates with savings at the film recovery, transport and recycling stages with the ambition of achieving commercial exploitation.

2. Plan for the Use and Dissemination of the Foreground

2.1 Section A (Public)

A project website http://start.uk-matri.org was set up at the beginning of the project with a password protected file store for the SME partners to access all project documentation.



Pera Technology

Case Study

START

Retro-fitted dry-cleaning unit for agricultural film waste

The START project is developing a dry cleaning unit that can be retro-fitted to machinery and logistical software, to reduce transport costs and improve recycling effectiveness within the farming industry.

Objectives

The agricultural sector within the EU generates some 720,000 tonnes of agricultural plastics film waste, which has proven difficult to recycle commercially due to the high levels of contamination and its wide geographical dispersion which lead to high transport costs. Recycling schemes must charge high fees in order to be financially sustainable. Hence many farmers use alternative, environmentally harmful, disposal methods, such as burning or land-filling, which do not take advantage of the latest value of recyclates and do not comply with current and future legislation.

Our project aims to significantly reducing transportation costs and making recycling schemes economically and environmentally sustainable.

Partners

- The Package & Film Association (PAFA)
- Elkedr Technology And Design Centre Sa
- Technosam Srl
- The UK Materials Technology Research Institute Limited
- Chambre D'agriculture Du Loiret
- Centro Europeo Sviluppo Applicazioni Plastiche Srl Consortile
- Associazione Nazionale Riciclatorie Rigeneratori Materie Plastiche
- Irish Farm Films Producers Group Limited
- Maurtzaris Ae - Furofilm
- Previero N. Srl
- Plastika Kritis Industrial & Trading Co. S.A.
- C.P. Community Publishing Ltd - Digeco Systems
- A.D.I.Valor

Funding

Sixth Framework Programme (FP6)

Agricultural films are vital to modern farming practices and without them high levels of food production could not be achieved. However, Europe generates 720,000 tonnes of used film, 265,000 tonnes of which are difficult to recycle due to soilage content.

The films themselves are highly engineered materials and represent a high value material that should be recycled at the end of life.

Across the EU, is it currently estimated that only 22% of agricultural films are recycled, due to contamination from soil, mud, stones, silage, pesticides and agricultural nutrients, which are contaminants to the recycling process. This leads to a lost opportunity for the agricultural and reprocessing sectors, with up to 80% of used film contaminated, also resulting in shipping large quantities of farmer's fields around Europe. >>

Applying science in a commercial world

Case Study
START

"The farming community consumes the equivalent of 720,000 tonnes of new thin films every year, generating 265,000 tonnes of waste. Across the EU, is it currently estimated that only 22% of agricultural films are recycled."

The START project is overcoming these issues and developing a novel approach to cleaning films, enabling a higher percentage of waste materials to be recycled.

This is happening through:

- The development of a waste management technology that allows farmers to achieve their recycling goals and enables the waste management and reprocessing companies to make agricultural waste film recycling commercially viable.
- The development of an innovative dry-cleaning technology to manufacture a transportable film cleaning unit that can be used to remove contaminated material from used film before transportation.
- The development of an inter-related logistical software to optimise the waste collection process and further minimise transport costs, energy usage and environmental impact.

The technology will achieve significantly lower environmental impacts compared to current methods of recycling and waste disposal.

These include:

- Improved air quality for breathing
- Reduced soil pollution
- Global warming
- Depletion of fossil fuel resources
- 86% reduction in tonne-kilometres
- Elimination of transport in shipping soil back to land.

Pera Technology

Applying science in a commercial world

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Section A (Public)

Template A1 – List of Scientific (peer reviewed) Publications Relating to the Foreground of the Project

No	Title	Main Author	Title of periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers	Open access to publication provided
1										
2										
3										

Template A2 – List of Dissemination Activities
Part 1 – Publications, Editorials and Papers

No	Type of Activities	Main Leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	website	MatRI	www.start.uk-matri.org	2008+	Europe	The website is primarily for dissemination purposes, the wider distribution of knowledge and public results. It is available for viewing by all interested parties	10,000s	Worldwide
2	Online journal	ASSORIMAP	Macplasonline – 2011-12	2011-2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
3	Journal	ASSORIMAP	Macplas – plastics & environment 2011-12 - editorial	2011 - 2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
4	Journal	ASSORIMAP	Tworzywa – 2012	2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
5	Online journal	ASSORIMAP	ASSORIMAP – members online journal	2011 - 2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
6	Seminar	ASSORIMAP	Formazione Agricoltura – seminar May 11 2012	11th May 2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
7	Journal	PAFA	Recycling and waste world - editorial"	2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
8	Leaflet for all events	MatRI	START case study	2012+	Europe	Farming, agricultural engineering and recycling community	1000s	Europe

Part 2 – Exhibitions, Seminars and Conferences

No	Type of Activities	Main Leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	Trade show	ASSORIMAP	EQUIPLAST	Nov 2011	Lyon, France	Farming, agricultural engineering and recycling community	1000s	France
2	Trade show	ASSORIMAP	K2010 – International trade show for Plastics & Rubber Worldwide	Oct 2010	Dusseldorf, Germany	Farming, agricultural engineering and recycling community	1000s	Europe
3	Trade show	ASSORIMAP	PLAST2012	May 2012	Milano, Italy	Farming, agricultural engineering and recycling community	1000s	Europe
4	Trade show	ASSORIMAP	PLASTIMAGEN	Oct 2011	Mexicocity, Mexico	Farming, agricultural engineering and recycling community	1000s	Worldwide
5	Trade show	ASSORIMAP	PLASTPOL2012	May 2012	Kielce, Poland	Farming, agricultural engineering and recycling community	1000s	Europe
6	Seminar	ADIVALOR	CIPA: international committee for plastic for agriculture, a presentation on European collecting schemes	16th May 2012	Tel Aviv, Israel	Farming, agricultural engineering and recycling community	1000s	Worldwide

Part 3 – Dissemination activities planned

No	Type of Activities	Main Leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	Journal	ADIVALOR	EuPR, European union of plastics recyclers	Q3 - Q4, 2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
2	Journal	ADIVALOR	EPRO: http://www.epro-plasticsrecycling.org	Q3 - Q4, 2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
3	Journal	ADIVALOR	APE Europe: plastics producer	Q3 - Q4, 2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
4	Journal	ADIVALOR	WG-Agricultural plastics or in the GM	Q3 - Q4, 2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
5	Journal	ADIVALOR	CPA seminar on the 12 and 13 of June (French committee for	Q3 - Q4, 2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
6	Journal	PAFA	Recycling and waste world - editorial”	2012	Europe	Farming, agricultural engineering and recycling community	1000s	Europe
7	Seminar	ADIVALOR	EPRO	13th June	Oslo	Farming, agricultural engineering and recycling community	100s	Norway

2.2 Section B (Confidential)

2.2.1 IPR Status

Barry Turner (PAFA) as Coordinator heading up the commercialisation of the project, and responsible for dissemination of the knowledge gained within the START Project as made the following statement regarding the IPR status.

"Due to the delay on completing the integration and technology trials we do not want to widely make known the technical details of the product in order to maximize our entrance to the market at a later date"

It is planned that the parties owning the IP to the START technology:

- Run additional controlled trials of the START machine to generate more firm reference data to validate performance and support statements and warranties given in marketing and technical literature
- Consider ways in which the estimated maintenance costs of the machine could be reduced.
- Obtain the data on costs, prices and charges.
- Consider use of dual business models involving both sale of machines as well as leasing. Leasing would require less capital from smaller farmers or collectors and could be more profitable in the medium term
- Carry out further market research by engaging with individual potential customers, which can also act as a marketing exercise to model the situation of such customers and demonstrate the financial returns to them. This will generate a more detailed body of data to build the business case and also develop sales pipelines.

IPR Schema

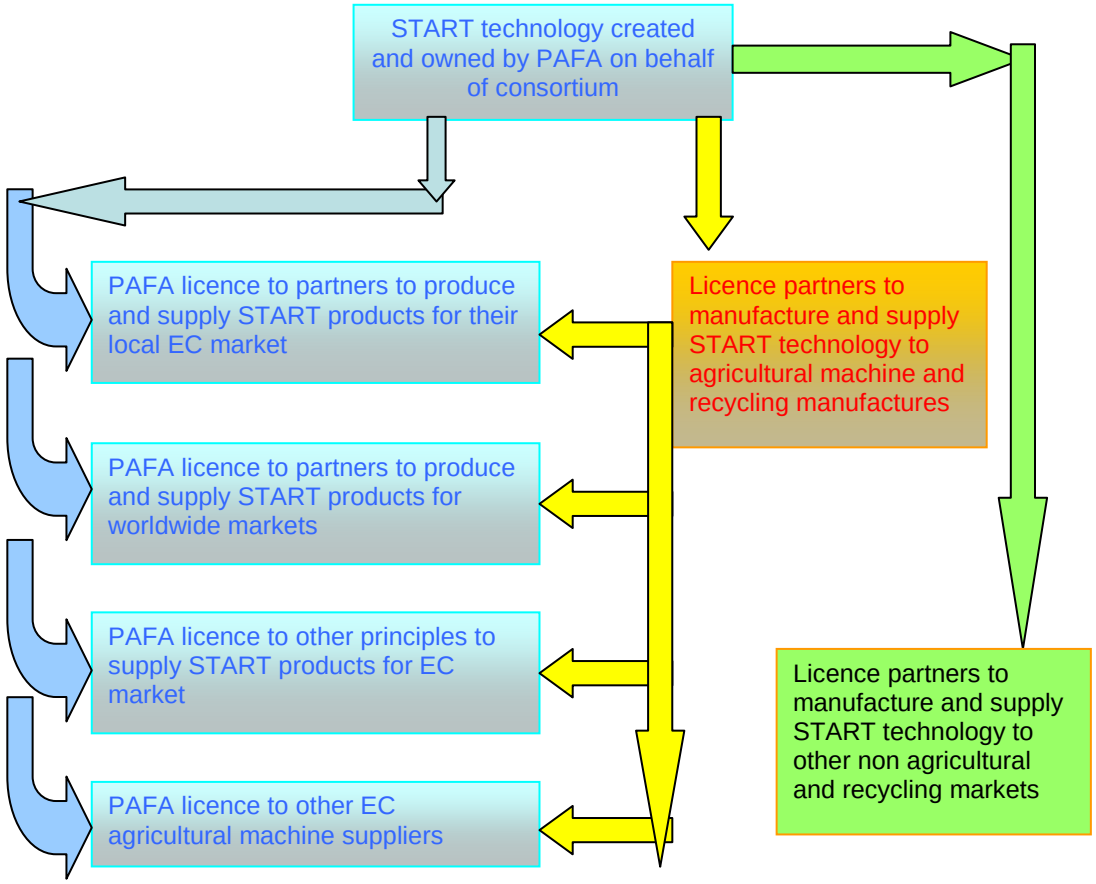

Table B1: List of Applications for Patent, Trademarks, Registered Designs

It was felt by the consortium that until the device has been successfully patented and performance criteria proven then it will be appropriate to start the formal marketing process to appoint partners to sell and market the device as well as those to manufacture it to ensure we achieve maximum coverage and sales. Clearly any manufacturing rights granted must ensure the device can endure the farming environment and maximum exploitation of the device in terms of sales coverage. Suitable partners will be identified and vetted to ensure 'maximum reach' both within a country and between countries. Licensing rights to manufacture and or sell will need to be considered as appropriate.

No new patent applications have been made, but it is currently believed that any competitive patents still allow the consortium freedom to operate.

Type of IP Rights	Confidential	Foreseen Embargo date	Application reference	Subject of Title of the application	Applicant (s) (as on the application)

Template B2 - Overview of Exploitable Foreground

Result Number	Description of Exploitable foreground	Confidential	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable, commercial or other use	Patents or other IPR exploitation (licenses)	Owners & Other Beneficiary(s) involved
1	Empirical models on the effects of processing conditions on soilage removal	Yes		Agricultural Analysis	2013		PAFA, ADIVALOR' ASSORIMAP, PREVIERO, TECHNO,
2	Web based logistics software	Yes		Software / Logistics	2013		PAFA, ADIVALOR' ASSORIMAP, IFFPG, EUROFILM, DIGECO
3	Film preparation & cutting prototype	Yes		Agricultural Machines/ Recycling	2013		PAFA, ADIVALOR' ASSORIMAP, PREVIERO, TECHNO,
4	Film/soilage separation prototype	Yes		Agricultural Machines/ Recycling	2013		PAFA, ADIVALOR' ASSORIMAP, PREVIERO, TECHNO,
5	Prototype integrated agricultural film dry-cleaning system	Yes		Agricultural Machines/ Recycling	2013		PAFA, ADIVALOR' ASSORIMAP, PREVIERO, TECHNO,

Empirical models on the effects of processing conditions on soilage removal
The empirical model is supported by a user manual that explains how to determine the types of waste film and levels of soilage present in different geographical areas. The model informs the user how mechanical deformation (stretching) and turbulent air flow affects the surface-soilage adhesion and gives the user optimised conditions for these parameters. The empirical model will allow the effects of the processing conditions on the soilage removal to be determined.

Web based logistics software
The web based logistical software manages all aspects of the collection and recycling process of the agricultural waste films and reduces transportation costs using bespoke route planning functionality, whilst providing all users with easy access and simple input of all relevant data. The principle users of the system defined are Farmers, Collection Agents / Drivers and Service Providers (System Administrators).

Film preparation & cutting prototype
The prototype mill cutting rotor shredder Unit is fed by either mulch and tunnel film as a flat sheet or silage or greenhouse film which are free from stones and heavy soilage and can be introduced at the shredder stage in manageable bundles. The films are drawn through and from the mill by the final prototype stage the Cyclone Unit which carries out the final removal of soilage from film.

Film/soilage separation prototype
The prototype stage of the roller stretching unit will collect the mulch and tunnel film which is very soiled directly off the field as a flat sheet using rollers, stretching and air blowing technologies for initial cleaning to prepare the film for the Mill Cutting Rotor Shredder Unit.

Prototype integrated agricultural film dry-cleaning system
The START prototype includes the roller stretcher, mill cutting rotor, and cyclone units which are integrated into the complete system that collects and manages the soiled agricultural film to run smoothly from one unit to the other on a continuous basis without breakage during cleaning and shredding. The prototype is power driven and controlled by a PLC which allows the operator to set the feeding speed and process variables so as to adapt them to the type of film used and optimize cleaning performance.

PROJECT FINAL REPORT

SOCIETAL IMPLICATIONS

Grant Agreement number:

Project acronym: START

Project title: Development of a retro-fitted dry-cleaning unit for agricultural film waste and inter-related web-based logistical software to reduce transport costs and improve the competitive position of organisations within the recycling supply chain.

Funding Scheme: FP7 Research for SMEs program, call SME - 2008 - 01

Period covered: from 1st December 2008 to 31st May 2012

Name, title and organisation of the scientific representative of the project's coordinator[5]:

Barry Turner
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Great Britain

Tel: +44-115-9598389
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Email:barry.turner@pifa.co.uk
Web:http://www.pafa.co.uk

/Project website[6] address:

http://start.uk-matri.org

[5] Usually the contact person of the coordinator as specified in Art. 8.1. of the grant agreement

[6] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm ; logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

Description of the Potential Impact
(Socioeconomic impact and the wider societal implications of the project so far, and the main dissemination activities and the exploitation of results)

Recycling schemes supported by local and national governments in the EC are dedicated and committed to achieving agricultural waste film recycling levels up to 70% from the 22% currently being realised. In Europe the agricultural sector consumes approximately 720,000 tonnes of plastics each year, of which LDPE/LLDPE based agricultural films represent approximately 520,000 tonnes with a market value of €1.6 Bn p.a. representing a total amount of used films of approximately 750,000 tons due to the soliage content (a mixture of soil, mud, stones, silage, pesticides and agricultural nutrients which are contaminants to the recycling process.) These films are invaluable to modern farming practices and without them high levels of food production cannot be achieved. However the farming community consume the equivalent of 130,000 tons of new thin films generating some 265,000 tonnes of plastics waste per year.

The films themselves are highly engineered materials and therefore represent a high value material that should be recycled at the end of life, but across the EU, is it currently estimated that only 22% of agricultural films are recycled, only a relatively small proportion of the available material, leading to a lost opportunity for the agricultural and reprocessing sectors. The used film that is transported can be up to 80% contaminated with soilage which results in also shipping large quantities of farmer's fields around Europe.

The overall technological aim of the START project is:

- To develop a waste management technology to allow the farmers to achieve their legislative requirements and enable the waste management and reprocessing companies to make agricultural waste film recycling commercially viable.
- To develop innovative dry-cleaning technologies to manufacture a transportable film cleaning unit that can be used to remove soilage from used film before transportation.
- To achieve increased stability and growth within the agricultural plastics recycling sector by significantly reducing the recycling transportation costs and making recycling schemes economically and environmentally sustainable.
- To develop inter-related logistical software to optimise the waste collection process and further minimise transport costs, energy usage and environmental impact.

Extensive trials and 'Life Cycle Analysis' has been performed on the START development which promises much smaller overall environmental impact (ecopoints) compared to status quo and by far the most dominant part is fuel use and emissions in transporting film and soil many kilometres. The main impact categories reduced are:

- Improved air quality for breathing
- Soil pollution
- Global warming
- Depletion of fossil fuel resources
- 86% reduction in tonne-kilometres
- Elimination of transport in shipping soil back to land.

The START project will contribute towards a range of EU societal objectives. The project will lead to greater conservation of resources and will move the agricultural sector towards greater sustainability in line with the strategic direction of the EU. Involvement in the research will lead to development of the knowledge based economy in-line with the Lisbon strategy. The specific legislation addressed includes:

- Reduction of landfill (>125,000 tonnes p.a.) and emissions from burning in line with the landfill directive (1999/31/EC)
- Reduction in CO2 emissions , >370 tonnes/year, due to reduced mass transport in line with the Kyoto protocol which was ratified by the EU in 2002.
- Reduction in vehicle emissions20, >400 tonnes/year, due to reduced transport (2003/76/EC)

Employment opportunities in European & Rest of World markets will benefit from the increased manufacture, sales and deployment of the 'dry cleaning agricultural film' START machine and web based logistical software to manage the collection of the agricultural waste films and reduce transportation costs, and will be either protected or created in the waste management and reprocessing sectors due to the inherent commercial advantages that the technology provides to the waste collection and reprocessing operations that will allow them to expand their commercial operations.

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*

Grant Agreement Number:	218335
Title of Project:	START
Name and Title of Coordinator:	Mr Barry Turner, PAFA

B Ethics

1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 *'Work Progress and Achievements'*	***Yes***
2. Please indicate whether your project involved any of the following issues (tick box) :	
RESEARCH ON HUMANS	
• Did the project involve children?	No
• Did the project involve patients?	No
• Did the project involve persons not able to give consent?	No
• Did the project involve adult healthy volunteers?	No
• Did the project involve Human genetic material?	No
• Did the project involve Human biological samples?	No
• Did the project involve Human data collection?	No
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	No
• Did the project involve Human Foetal Tissue / Cells?	No
• Did the project involve Human Embryonic Stem Cells (hESCs)?	No
• Did the project on human Embryonic Stem Cells involve cells in culture?	No
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	No
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	No
• Did the project involve tracking the location or observation of people?	No
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	No
• Were those animals transgenic small laboratory animals?	No
• Were those animals transgenic farm animals?	No
• Were those animals cloned farm animals?	No
• Were those animals non-human primates?	No
RESEARCH INVOLVING DEVELOPING COUNTRIES	

• Did the project involve the use of local resources (genetic, animal, plant etc)?	No
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	No
DUAL USE	
• Research having direct military use	No
• Research having the potential for terrorist abuse	No

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator		3
Work package leaders	1	5
Experienced researchers (i.e. PhD holders)	2	8
PhD Students	1	3
Other	4	8

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	**0**
Of which, indicate the number of men:	

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project? | | No

6. Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
NA	Design and implement an equal opportunity policy	○	○	○	○	○
NA	Set targets to achieve a gender balance in the workforce	○	○	○	○	○
NA	Organise conferences and workshops on gender	○	○	○	○	○
NA	Actions to improve work-life balance	○	○	○	○	○
NA	Other:					

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

○ Main discipline[7]: 2.1

1.1, 2.2

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)* | | Yes

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

○ No
○ Yes- in determining what research should be performed
○ Yes - in implementing the research
○ Yes, in communicating /disseminating / using the results of the project

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)? | | No

[7] Insert number from list below (Frascati Manual).

12. Did you engage with government / public bodies or policy makers (including international organisations)

Yes

Public bodies engaged with have included APE and in the Uk the National Farmers Union.

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

○ Yes –

13b If Yes, in which fields? - **Environment**

Agriculture		Energy		Human rights	
Audiovisual and Media		Enlargement		Information Society	
Budget		Enterprise		Institutional affairs	
Competition		Environment		Internal Market	
Consumers		External Relations		Justice, freedom and security	
Culture		External Trade		Public Health	
Customs		Fisheries and Maritime Affairs		Regional Policy	
Development Economic and Monetary Affairs		Food Safety		Research and Innovation	
		Foreign and Security Policy		Space	
Education, Training, Youth		Fraud		Taxation	
Employment and Social Affairs		Humanitarian aid		Transport	

13c If Yes, at which level?

YES
- ○ Local / regional levels
- ○ National level
- ○ European level – At this level, exceeding current BS/EN standards
- ○ International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	**14**
To how many of these is open access[8] provided?	**14**
How many of these are published in open access journals?	**14**
How many of these are published in open repositories?	**14**
To how many of these is open access not provided?	**None**
Please check all applicable reasons for not providing open access:	
❑ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[9]: ……	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*		**None**
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	**0**
	Registered design	**0**
	Other	**0**
17. How many spin-off companies were created / are planned as a direct result of the project?		**0**
Indicate the approximate number of additional jobs in these companies:		

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

X	Increase in employment, or	X	In small & medium-sized enterprises
❑	Safeguard employment, or	❑	In large companies
❑	Decrease in employment,	❑	None of the above / not relevant to the project
❑	Difficult to estimate / not possible to quantify		

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs:	*Indicate figure:*

[8] Open Access is defined as free of charge access for anyone via Internet.
[9] For instance: classification for security project.

Difficult to estimate / not possible to quantify	X

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

X	Press Release	X	Coverage in specialist press
❑	Media briefing	❑	Coverage in general (non-specialist) press
❑	TV coverage / report	❑	Coverage in national press
❑	Radio coverage / report	❑	Coverage in international press
X	Brochures /posters / flyers	X	Website for the general public / internet
❑	DVD /Film /Multimedia	X	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

Language of the coordinator	X	English, Italian
Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]

1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)

1.3 Chemical sciences (chemistry, other allied subjects)

1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)

1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY

2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as

geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]