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Confidential

Horizontal Research Activities involving SMES
Co-operative research

A Smart Homogenization Approach improving process Knowledge and papERmaking competitiveness (SHAKER)

Final Activity Report

EUCraft projectnr.: SHAKER-COOP-CT-2004-032352

Period covered:	Oct. 1st, 2006 - September 30, 2008
Start date of project:	October 1st,2006
Duration:	24 months
Date of preparation:	October 2008
Project coordinator name:	Leon Joore
Project coordinator organisation name:	Millvision B.V.

Millvision is a research and consultancy organisation specialised in process and product optimisation and innovation in the paper & board industry and environment & infrastructure.

CONTENT

Publishable executive summary

1. PROJECT EXECUTION

Efforts of the paper and board mills have already lead to a more closed water system, which, produce the accumulation of dissolved and colloidal material (DCM) in the water systems. At unexpected moments, there occur disturbances in the paper production process, like stickies explosions, anionic trash, scaling, corrosion etc., that have unknown causes. The result hereof is that the produced paper is not within specifications and the paper machine has to be stopped to clean the whole system. The downtime caused by unstable wet-end systems is about 8-30 hours, leading to a loss of 24-90 kEUR per stop. Therefore **paper mills need** to optimize and stabilize their wet-end system with sustainable management principles if they want to remain competitive. This is especially important for **SME's** because of the **need to compete** in the same market with large mills that profit from the scale economy.

The objective of this project is to investigate the enhancement of sustainable management for stock (wood), energy (natural gas and green house effect) and water by stabilization of the wet-end system of paper production based on a low cost sustainable concept. The **scientific objective** is to investigate, from an applied point of view, the source and behaviour of disturbing substances and the most important causes for sudden explosions of these disturbances within paper mills. The **technical objective** is to achieve further reduction of energy and natural gas (20%), water (20%), wood (5%) and chemical consumption (25%) combined with an improvement in runnability, flexibility, productivity, and product quality. This objective will be achieved by process intensification towards just-in-time-production management, which will lead to a cost reduction of 10 EUR/ton of paper and to an increase in paper production capacity (5-10 %) and a decrease of off-spec production (30 %). The **social and policy objectives** are to decrease usage of natural resources and environmental effects (on nature and human), to improve or maintain employability at supplier SME's and to improve working conditions (health, trachea and skin). Both supplier and end-user SME's fulfil an important role within the European economy and therefore to the competitiveness compared to USA, Far East and South America.

The paper value chain has a strong influence on the European economy. Only in the EU countries (not including the eastern countreris) the total annual turnover represents over 73 billion euros, with an **average growth of 3%.** There are over 850 companies with over 1200 mills, the capital investment is **4.5 billion euros** a year, the sector employs about 250.000 perolpe directly and **3.5 million people** indirectly and the total paper production is over 90 million tonnes, representing one third of the world production. SMEs represent a substantial part of this sector being one of the industrial sectors where consolidation takes place at slow level compared with other important European industrial sectors , and it is expected that at the end of the consolidation process **500 SMEs** will still continue in market niches based on a study carried out in 2003 by Price Waterhouse consultancy services. The last 2 years this process develops as foreseen in 2003. This indicates that any action to reduce cost in papermaking will have a significant direct impact on the SMEs. This project addressed the specific problem of cost saving of a group of SME and non SME papermills, specially related to improve runnability of the papermachine. It was carried out by a multinational consortium formed by 5 SMES, 2 nonSMEs and 3 RTDs of which 1 is an SME.

1.1 PROJECT OBJECTIVES

The general objective of this project was to develop a new sensor based wet-end homogenisation concept for papermaking industry, which is specific need of a group a SMEs from different countries for improvement of runnability and by that for cost reduction. Last 2 years this runnability issue is very hot because it is linked with the energy costs of the mill; and energy prices were/are very high.
This objective was addressed by a group of RTD performers (with complementary expertises) that carried out the majority of the required scientific and technological research while SMEs took care of the application and/or validation of the concept. This new concept, called a sensor based hyperboloid mixing concept, could be applied in a cost reduction program via process and product improvement at the mills. This cocenpt will contribute to the competitiveness of the mills. This objective:

- Supported SMEs to respond to the pressures for continuous innovation and technological adaptation by delivering a new concept that will be used in the mills to improve runnability and by that for cost reduction;
- Facilitated co-operation in research activities between SMEs and RTD performers at national and international level;
- Enabled SMEs to benefit from the advantages of networking for innovation;
- The publication of the results, after being protected, contributes to increase the potential impact of the project.

The specific objectives of the project were:

- To develop a new sensor based wet-end homogenisation concept making use of the hyperboloid technology;
- To generate knowledge on water/pulp suspension mixing and visualise with CFD;
- To generate knowledge on the detrimental substances in the white water/pulp suspensions causing process disturbances;
- To explore the potential applications of the concept to improve runnability and product quality;
- To disseminate and exploit the results obtained in the project through a plan for using and disseminating of knowledge.

1.2 CONTRACTORS INVOLVED

Table 1 shows the contractors list and indicates their main characteristics.

Table 1: Contractors list

Partic. Role	*Partic. Type*	*Partic. No.*	*Participant name*	*Participant short name*	*Country*	*Date enter project*	*Date exit project*
CO	RTD	1	Millvision B.V.	MV	NL	1	24
CR	SME	2	Inven Technology Benelux B.V.	INVEN	NL	1	24
CR	SME	3	Invent Umwelt- und Verfahrenstechnik AG	IUV	D	1	24
CR	SME	4	Juan Romani Esteve SA	JURESA	E	1	24
CR	SME	5	J. Tönnesman & Vogel GmbH	TONNES	D	1	24
CR	SME	6	Papelera del Principado SA	PAPRINSA	E	1	24
CR	OTH	7	Goricane Paper mill	GORICANE	SI	1	24
CR	OTH	8	Oudegem Papier N.V.	OUDEGEM	B	1	24
CR	RTD	9	Papiertechnische Stiftung	PTS	D	1	24
CR	RTD	10	Universidad Complutense de Madrid	UCM	E	1	24

1.3 COORDINATOR CONTACT DETAILS

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1.4 WORK PERFORMED, RESULTS ACHIEVED AND INTENTIONS FOR USE AND IMPACT

As this project is the first step towards a possible commercialisation of the new concept, the work started with a market research and the definition of proper routes for dissemination and exploitation of the results obtained during the project. This task required strong collaboration and commitment between the SMEs. At the same time the scientific backgrounds for the principal components for process disturbances were found and translated into a sensor based hyperboloid mixing concept for wet-end and process water tank applications. In contrast with the proposal the long testing period of the concept wasn't performed in a so called parallel process approach but in a full scale process tank at a SME paper mill. The performance was also evaluated towards paper machine runnability and for a much longer time.

The fundamental research in the beginning of the project was focused on the destabilisation conditions of the disturbing substances and places where disturbances occur. The influence of different process parameters like pH, conductivity, cationic demand is examined, as well as the importance of disturbing substances accumulation on wet-end stability. It has been assessed that contaminants accumulation is reached at four days after the start-up of a paper machine. The values of the different parameters increase significantly after four days. Therefore it is very important to separate the water loops to keep the PM loop clean and to reduce the consumption of wet-end chemicals.
Considering the whole results it was possible to select the optimal conditions for the wet end, from the point of view of flocculation, formation, retention and stability of the process.

The sensor based (right) mixing concept is based on the hyperboloid mixing technology (see Figure 1), which is controlled by the difference of two conductivity sensors. The difference is a measure for gradients in water and pulp suspension; mostly caused by micro biology rest products. These gradients are responsible for certain process disturbances and machine fouling with runnability and even web brakes as a result. The optimum speed was found in the order of 77 rpm.

Figure 1: Hyperboloid mixer with micro and macro turbulances (left); Two sensors at different heights in non fouling design housing (right)

Although the device can be used for many applications in which water and pulp suspensions behaviour is important, in order to demonstrate the usefulness of the new device only one potential application was studied: the potential use in process water storage tanks.

The effect of the mixing speed regarding the difference between the upper and lower sensor was evaluated as well as the effect on the behaviour of the water/pulp suspension in terms of the level of micro stickies and depositions. The conductivity sensors used were sensitive in the working field of papermaking conditions, low cost and robust and because of that selected and designed to a non-fouling combi-sensor.

Once the concept was tested and verified on laboratory scale (WP3) the concept was upgraded and implemented in the process tank at paper mill Tönnesmann (mainly WP4). Both implementation traject as well as developing of the test protocol and the interpretation of the gained results were carried out in good collaboration with all partners. The extra long testing period gave the opportunity to validate the concept and cover a broad range of different process conditions; several logistic product cycles as well the seasons effect.

The following end results of the project have been achieved:

- Creation of knowledge in the causes or principal components for process disturbances (namely conductivity and anion trash) in white water applications;
- Creation of knowledge in complex suspension that could be applied in other areas like pulp stock or other industrial sectors: food processing, cosmetic, polymer science etc.
- Generation/further development of a new method for the determination of micro-stickies;
- CFD modelling of the test process tank based on real rheological measurements;
- A robust sensor based hyperboloid mixing concept;

Furthermore, the results achieved so far were:

- Besides the on-line process monitoring as foreseen in the proposal, also controlling trials were performed to investigate effects of dilution and additives changes on the runnability and paper properties;
- Discussions in the Steering Committee Meeting were used in a paper. An article on stickie measurements have been published in a PTS conference proceeding;

Part of the project results can be used directly by the SME paper mills involved in the project in their own industrial plants, with the benefit of cost saving, maintenance and other cost saving related issues.

The direct expected applications and potentially patentable ideas form the obtained results are:

- A novel sensor based hyperboloid mixing concept, two of the SMEs will have the task to commercialise this concept worldwide. The CA will define the share in the patent and benefits of the other SMEs. It will be protected by a patent application;
- Technical information (e.g. manual of the concept) in WP3 will be protected by copyright. An edition of 800 units is expected to be edited and sold worldwide.

To ensure that the SME contractors will assimilate and exploit the results of the project, different actions were carried out as follows:

- A market analysis to define adequate routes to guarantee successful exploitation and dissemination of the results;
- Training seminars were accomplished to the partners to understand the operation of the new concept in terms of mixing theory, CFD and wet-end chemistry;
- Part of the results have been presented in several congresses and published in proceeding. Furthermore, more results will be published in form of articles and in congresses.

2. DISSEMINATION AND USE

The **knowledge arising form the work** of the SHAKER project is the **joint property** of the SME contractors according to the CA that includes the agreement among them on the allocation and the terms of exercising the ownership of the knowledge.

A project web-page was made immediately after approval of the proposal. This was an efficient way to disseminate the existence and objectives of the SHAKER project (supported by the EU commission) to the EU scientific Community and Industrial Sector. The SHAKER web-page has also facilitated the rapid exchange of information with a potential interest for all project partners. Advantage of the facilities provided by the MV servers were taken for maintenance of this web-page, whose link is http://shaker.millvisionweb.eu.

In order to disseminate the fundamental and technical knowledge generated during the project advanced technical and scientific paper have been published or are in preparation.

Via local paper branche seminars like in Spain, Belgium, Germany and The Netherlands several poster presentations were performed. This is a first step in the marketing strategy to increase potential exploitation for the new mixing concept developed during the project with the aim to link knowledge of the owners to users (papermakers at first).

All deliverables have been already accomplished in order to guarantee the protection of the knowledge and the adequate dissemination:

- D5 Process inventory; month 11
- D8 Concept plan for using and dissemination of knowledge; month 12
- D16 SHAKER web-page; month 1
- Final activity report 1 period; month 13
- Final management report 1 period; month 13
- Project brochure; month 2

Furthermore, on-site training actions have been undertaken by IUV, INVEN, UCM and MV.

There have been also disseminated scientific and technical results through different actions, being important examples, the following ones:

- A presentation and paper by MV in the proceedings of the PTS Stickie symposium in April 2007 in Dresden (GER);
- Two times a year on the seminars of the paper branche education institute Vapa in 2007 and 2008 in Apeldoorn (NL);
- On presentation during a workshop of the water platform of the paper mill association in 2008 (by OUDEGEM), Belgium;
- Several project informations in the Newspaper of MV and the Newsletter paper magazine from PTS in 2007 and 2008 (NL + GER).

Section 1
Project objectives and major achievements

1. MAIN PROJECT OBJECTIVES AND PROJECT PROGRESS IN RELATION TO THE STATE OF THE ART

The basic idea of the SHAKER concept came from Mr. Jan Backer, the manager of INVEN Technology Benelux (INVEN, SME supplier involved in the project) after participating in the CRAFT project WaCoPaC (EU no: CRAF199-70164). He came to the conclusion that after taking a big effort to close water loops and white water conditioning, the next logical step would be the integration of the wet-end system with an improved homogenization. The homogenization of the wet-end and its optimization will deal with the source of the problems. So instead of taking a big effort to deal with instability problems, efforts will be taken to avoid these instabilities. He asked Millvision (MV, coordinator of the project, RTD performer and SME) to develop the final concept proposal based on his idea which is based on the integrated management of wet end and water within the paper mills.

Efforts of the mills have already lead to a more closed water system, which, produce the accumulation of dissolved and colloidal material (DCM) in the water systems. At unexpected moments, there occur disturbances in the paper production process, like stickies explosions, anionic trash, scaling, corrosion etc., that have unknown causes. The result hereof is that the produced paper is not within specifications and the paper machine has to be stopped to clean the whole system. The downtime caused by unstable wet-end systems is about 8-30 hours, leading to a loss of 24-90 kEUR per stop. Therefore **paper mills need** to optimize and stabilize their wet-end system with sustainable management principles if they want to remain competitive. This is especially important for **SME's** because of the **need to compete** in the same market with large mills that profit from the scale economy.

The project will contribute to the goals of the European Community; specifically:

- improved competitiveness of the European industry compared to USA and Asia (actually Asia and USA have about 60% of the world market, the EU-share is under pressure);
- employment in the paper industry remains stable or possibly increases;
- improved quality of work;
- more sustainable production of paper (reduced amounts of waste, reduced consumption of chemicals, further closure of water loops).
- Knowledge base production.

The concept contributes to the EU policies of IPPC, paperBREF, the packaging directive and the safety regulation regarding white water aerosols with respect to skill diseases like super sensitivity and trachea problems. Besides that it has a smart contribution to the competitiveness of EU papermaking industry compared to Japan, Asia and the United States of America.

- In principle almost all EU paper mills do have wet-end instabilities.
- EU-policy towards further recycling of water and raw materials (like recovered paper) will increase the wet-end instability.
- Particular SME paper mills have often older paper and board machines and stock preparation systems, which are more sensitive for wet-end instabilities.

- Complementary experiences and knowledge from the EU-wide partners leads to transnational co-operation.
- EU wide cooperation will shorten the time-to-market and speed up the market penetration time. We can internationally disseminate the concept instead of regionally.

The objective of this project is to investigate the enhancement of sustainable management for stock (wood), energy (natural gas and green house effect) and water by stabilization of the wet-end system of paper production based on a low cost sustainable concept. The **scientific objective** is to investigate, from an applied point of view, the source and behaviour of disturbing substances and the most important causes for sudden explosions of these disturbances within paper mills. The **technical objective** is to achieve further reduction of energy and natural gas (20%), water (20%), wood (5%) and chemical consumption (25%) combined with an improvement in runnability, flexibility, productivity, and product quality. This objective will be achieved by process intensification towards just-in-time-production management, which will lead to a cost reduction of 10 EUR/ton of paper and to an increase in paper production capacity (5-10 %) and a decrease of off-spec production (30 %). The **social and policy objectives** are to decrease usage of natural resources and environmental effects (on nature and human), to improve or maintain employability at supplier SME's and to improve working conditions (health, trachea and skin). Both supplier and end-user SME's fulfil an important role within the European economy and therefore to the competitiveness compared to USA, Far East and South America.

The objectives will be realized by implementation of a low cost sustainable concept for the stabilization of the **wet-end system** of the paper production process (**in-process treatment**).

The expected **final achievements** of this project are:
- To solve the problem of process instability, especially wet-end instability, of a group of SME's.
- In-mill tested product and process based homogenization concept, which is applicable for the paper industry and can be transferred to other industries.
- Increase of scientific and practical knowledge about constant wet-end systems towards chest-free papermaking (flexible) and transfer that knowledge directly to the industry.
- Increase of sustainability and competitiveness of European paper production industry, specially helping the SME's to keep in the market.

The intention of the SHAKER concept is not to solve all the water related problems but to **avoid** them (**preventive action**). The cause of process instability is bad homogenization of pulp and water within storage/dilution tanks. In dead zones of tanks, certain parts of (inner) tank walls etc., long residence times occur and create an increase of e.g. anaerobic biological activity. This causes gradients of micro organisms, degradation products (VFAs) and will finally generate the mentioned problems. All have a dissolved and colloidal nature. Furthermore, there are some mill practices that may destabilise this dissolved and colloidal material existing very limited information to this respect.

Therefore this concept is a different approach to former adapted improvement options, because the **SHAKER concept deals with the source of the problems** and not with the consequences being the problems itself.

The main innovations of the concept are:

- An integrated wet-end homogenization concept dealing with the **source** of the disturbances.
- An optimal mixed (machine) chest towards a constant wet-end system.
- A concept, which is exploitable to other parts of the paper production process towards a chest-free papermaking.
- A system to stabilize paper making process and hence an improved product quality

The main objectives are:

- the investigation of the source and behaviour of disturbing substances (WP1);
- the sensitivity to micro-shocks (scientific knowledge generation and transfer: WP1);
- a reduction of 20% of water, 20% of energy, and 10% of chemicals, leading to a cost reduction of 10 EUR/ton of paper for SME paper mills (WP2, WP3, WP4 and 5); and
- a development of an estimated market of our concept of about 10 million EUR/year for the SME suppliers.

2. SUMMARY OF THE WORK PERFORMED

This project is the first step towards the commercialisation of the new concept. Therefore, the work started with a market research and the definition of proper routes for dissemination and exploitation of the results obtained during the project, WP7. This task was led by IUV.

This task required strong collaboration and commitment between the SMEs, because marketing the new concept, in a new market (for IUV), is not easy, especially because papermakers were not familiar with the hyperboloid mixing in particular for in-mill applications. During the project it seems to be necessary to find other applications in the paper industry to make a bigger market potential and by that interest for the suppliers. Both in-mill water and pulp applications is a very serious market potential.
The big advantage of the new mixing concept is that the device is sensor based and because of its vertical working low in energy consumption in comparisons with horizontal (high speed) propellers.

IUV and INVEN in particular presented the basics of the concept during several poster sessions in the Netherlands, Belgium and Germany; see also the deliverables in WP7.

Contacts were established with participants in other projects in the field of pulp and paper processing, with national and European associations. The concept was presented in a steering committee meeting of the European project Nodeszelos, and as result, contacts were established with several (SME) mill contractor of the project. Furthermore, the concept was presented during the kick-off meetings in other EU projects like NATUBAR and SERECARB both in the framework of ERANET/SUSPRISE (March 31 and April 2 in Munich, GER, 2008).
IUV and INVEN in particular presented the basics of the concept during several poster sessions in the Netherlands, Belgium and Germany; see also the deliverables in WP7.

As WP 0 was finished in the first period, the work carried out during this second period has consisted in finishing the WP1, WP2, WP3, WP6 and WP7, and the entire WP4 and WP5 has been carried out in this period.

Within WP1 (fundamental research work) was performed by mainly the RTDs UCM, PTS and MV. During this period the more fundamental research, mainly done by UCM, was focussed on the dissolved and colloidal fraction and in particular the fraction which is responsible for the wet-end instabilities. Via sound experimental work in both laboratories as in-mill surrounding the principal components conductivity and anionic trash were found. Via on-line monitoring a better insight in the locations where the disturbances occur was developed. Mainly PAPRINSA and JURESA delivered the most input.
Besides this more parameter related research the existing disturbing substances as found in the participating paper mills (mainly OUDEGEM, TONNES and GORICANE) were in depth investigated, mainly by PTS and MV.

In WP2 applied research was performed to investigate the overall process units and make a kind of a chemical fingerprint of the processes as well as some on-line monitoring activities with FBRM or NIR. This gives a better insight in the developing

of the disturbing matter like deposits. Parallel to this work a process inventory was made for all participating paper mills. The simulation models of the processes of the mills were finalised in WP2; with actual process data.

In WP3 a wet-end control system, based on sensor controlled hyperboloid mixing, has been developed. The basis for the concept was studied by means of a literature study, which is performed by IUV, to understand more about the mixing of fluids and pulp suspensions. This was important in the dissemination of "mixing' knowledge within the project consortium. The other reason was that we need this background for the CFD (computational fluid dynamics) simulation of the concept in WP4.
Based on the outcome of WP1 in particular the found principal components were translated into in the market available sensors. INVEN makes a selection and modified and delivered a robust anti fouling conductivity sensor combination. Some small tests were performed to get some first experiences with the concept in laboratory as the cold and hot commissioning in practise.

WP4 was in this reporting period the most interesting WP. First there was a (further) developing stage of the stickie method in particular; all partners were involved. PTS, UCM and MV in the analytics, and all the paper mills in the use and validation of the sensor. By this method the effects, in combination with the deposition tester of UCM, of the concept can be evaluated both for the unit operation (process tank) as well as the effect on runnability of the paper machine. In the second part a CFD model was made of the process tank were in the long term trial was foreseen (IUV). The figures were based on really measured pulp viscosities (MV, TONNES, and INVEN). During the experimental period adjustments were done in terms of mixer speed, data sampling etc. as well as laboratory work related to check the robustness of the concept (both mixer and sensors). Parallel to the monitoring of the mentioned process tank also the paper machine behaviour has been watched.

Once the concept was working in practise a start was made with the technological and economical evaluation of the concept in WP5. The brainstorm session during the final project meeting in Madrid was an important input as well as assessment by all participating papermakers.

In WP 6 the project management was covered as well as the maintaining of the SHAKER project web-page.

In WP 7 the market analysis was finalised and the concept plan for using and dissemination of knowledge (D8, PUDK) were upgraded to a final PUDK, mainly by IUV Mr. Walter Steidl (D20).

In summary, the following expected end results from this project have been achieved:

- Routes for adequate plan for using and dissemination of knowledge (D8, D20);
- A prototype of the sensors controlled hyperboloid mixing concept;
- Insurance of the protection of knowledge through technical report copyrights (operational manual);
- Process inventories and models with WinGEMS for all mills (D5 and D6);

- Training seminar for the new concept at paper mill Tönnesmann (by IUV, INVEN);
- Literature study on fluid and suspension “mixing” (in WP3)
- A new method for stickies determination (in WP4);
- CFD model of the process tank “Kollergangbehälter” (WP4);
- Proper exploitation plan;
- Generation of knowledge on pulp/white water suspensions; papers in preparation;
- Validation of the hyperboloid concept;
- Interactive and maintained SHAKER website (MV);
- Efficient project coordination.

Major achievements are the following deliverables already accomplished:

Table 2: Deliverables

D1	Definition report
D2	Summary WP0
D3	Sub-report principal process disturbing components
D4	Summary WP1
D5	Process inventories
D5B	Monitoring and system check
D6	WinGems simulation models papermills
D7	Summary WP2
D8	Concept plan for using and dissemination of knowledge
D9	Prototype homogenisation concept
D10	Summary WP3
D11	Operation manual homogenisation concept
D12	Sub-report complete overview technical behaviour homogenisation concept
D13	Summary WP4
D14	Overview (technological and economical) homogenisation concept
D15	Summary WP5
D16	Shaker web-page
D17	Market analysis

D18	Patent application process
D19	Summary WP7
D20	Plan for using and dissemination of knowledge
DI	Shaker project brochure
DII	Shaker poster
DIII	Final management report (incl. Audit certificates)
DIV	Final Activity report
DV	Second activity report
DVI	Periodic management report
DVII	Periodic report on the distribution of the community's contribution

3. CONTRACTORS INVOLVED IN THIS PERIOD

Table 2 shows the contractors list and indicates their main characteristics.

Table 2: List of participants

Partic. Role	*Partic. Type*	*Partic. No.*	*Participant name*	*Participant short name*	*Country*	*Date enter project*	*Date exit project*
CO	RTD	1	Millvision B.V.	MV	NL	1	24
CR	SME	2	Inven Technology Benelux B.V.	INVEN	NL	1	24
CR	SME	3	Invent Umwelt- und Verfahrenstechnik AG	IUV	D	1	24
CR	SME	4	Juan Romani Esteve SA	JURESA	E	1	24
CR	SME	5	J. Tönnesman & Vogel GmbH	TONNES	D	1	24
CR	SME	6	Papelera del Principado SA	PAPRINSA	E	1	24
CR	OTH	7	Goricane Paper mill	GORICANE	SI	1	24
CR	OTH	8	Oudegem Papier N.V.	OUDEGEM	B	1	24
CR	RTD	9	Papiertechnische Stiftung	PTS	D	1	24
CR	RTD	10	Universidad Complutense de Madrid	UCM	E	1	24

Section 2
Work package progress of the period

1. INTRODUCTION

The **activities carried out in this project were:** a market research study, standardisation of the used methods via a definition report, fundamental (UCM mainly in the mills and in more detail in the laboratory) and applied research (PTS, MV mainly in the mills) related to the disturbing substances, process inventory and process modelling of the paper mill partners. It has also included management and activities to ensure proper dissemination and exploitation of the obtained project results. This S&T approach has enabled the project to achieve its objectives in research and innovation.

This project is divided in 7 **work packages**; all tasks **are integrated** in a **coherent program**. A general overview is given in Figure 2.

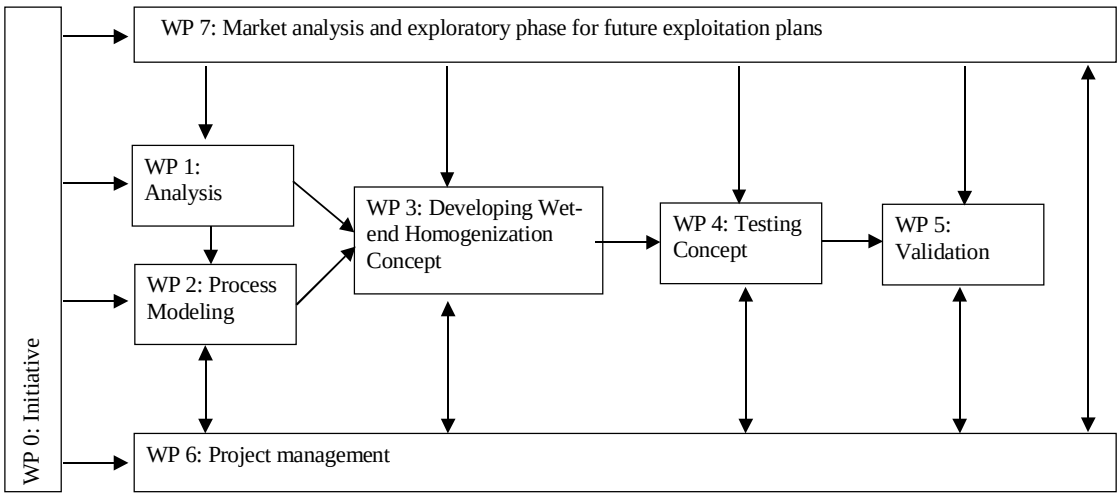

Figure 2: Project overview, Work packages interrelation

2. OVERVIEW OF THE ACTIONS CARRIED OUT IN THE REPORTING PERIOD

During the first period, WP0 was finished. WP1 is elongated with the focus on FBRM and NIR work at UCM as well as on more fundamental work at lab scale (task 1.1); WP2 is elongated with the focus on task 2.2 the modelling of the last mills, mainly OUDEGEM because of machine rebuilt. WP 3 and WP 4 were partly combined as earlier described to work more efficiently and on a more relevant scale. Because of that the entry date of the WP4 was a little earlier. WP6 and WP7 were started and ongoing throughout the duration of the project. WP 5 was started in this reporting period. The (plus/minus) changes are shown in the project Gantt diagram, in Table 3, which includes the updates in red.

The detailed objectives, description of the work, deliverables and expected results are given for WP1, WP2, WP3, WP4, and WP7 in the structure table done according to the EU rules, WP0 and WP6 has not been included since that these WP deliverables were already successfully concluded during the first year of the project. All the work packages and their leaders during the first period are summarised in table 4.

The list of deliverables promised and successfully accomplished for this period is compiled in table 4. The elongation of WP1 towards the second period, because of the too late delivering of the spare parts of the FBRM and the decision to continue with the fundamental work, has the positive effect that beside the wet-end monitoring also a controlling experiment can be done; we will get more results than expected. The focus is FBRM as on-line retention measurement for controlling to retention aid dosage. Both retention/dewatering as well as formation will be optimised; in particular via MV, UCM and JURESA.

The availability of the special tank (Kollergangbehälter) at paper mill Tönnesmann allows us the combination of WP3 and WP4 that leads to more relevant results than expected; the steering committee makes this decision. This was already reported in the first reporting period. WP4 has been started earlier than foreseen which gives us more time for in-mill testing and interpretation. The effect of the mixer concept was foreseen in a so called parallel process approach now we have researched the concept in a real ‘full scale’ situation which will show us better the real added value of the concept c.q basics for a better calculation for the return on investment.

Table 3: Project Grantt diagram

Project Bar chart
Acronym: SHAKER
Contract No: COOP-CT-2004-0323352

		1st year												2nd year											
WP	Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
0	Initiative	D1	D2																						
1	Analysis							D3																	
2	Process Modeling			D4		D5		D6		D7		D8													
3	Developing Wet-End Homogenization Concept													D9											
4	Testing concept																				D10				
5	Validation																						D11 D12		
6	Project management		D13										D14 D15												D16
7	Market analysis / Exploitation												D17												D18 D19
	Reports for EU commision												x												x
	Meetings	x						x					x						x						x

D9: Deliverable with protection of knowledge
D1, D3, D5, D6, D10, D11, D12, D14: Deliverables as technical reports
D2, D4, D7, D8, D13, D15, D19: Deliverables as dissemination activity
D9: Deliverables as prototypes "homogenisation concept"
D16, D17, D18, D20: Deliverable as marketing tools (market analysis, patent, website), Mid-term and final Activity and Management Reports

Table 4: Workpackage list for the entire project

Work-package No	Work package title	Lead contractor Short Name	Person-months	Start month	End month	Deliverable No
0	Initiative	MV Leon Joore	3.8	1	2	D1-D2
1	Analysis	UCM Angeles Blanco	51.5	2	7	D3-D4
2	Process Modeling	MV Leon Joore	24.5	2	11	D5-D7
3	Developing Wet-end Homogenization Concept	IUV Walter Steidl	18.5	9	13	D9-D10
4	Testing Concept	TONNES Caspar Tönnesmann	38.5	12	23	D11-D13
5	Validation	INVEN Jan Backer	14.5	19	22	D14-D15
6	Project management	MV Leon Joore	17.5	2	24	D16
7	Market analysis and Exploratory phase for future exploitation plans	IUV Walter Steidl	8	2	24	D17- D20
	TOTAL		**177**			

Table 5: Deliverables list accomplished during the project

Del. no.	Deliverable Name	WP no.	Date due*	Actual/Forecast Delivery date*	Estimated Indicative Person-months	Used Indicative person-months	Lead contractor
D1	Definition report	0	2	2	6	6	MV
D2	Summary WP0	0	3	3			MV
D3	Sub-report principal components	1	18	19	51	48	UCM
D4	Summary WP1	1	18	19	0	0	UCM
D5	Process inventories	2	11	12	1	2	MV
D5B	Process inventory Extra report	2	18	19	11	12	MV
D6	WinGEMS simulation	2	16	18	12	11	MV
D7	Summary WP2	2	16	18	0	0	MV
D8	Concept PUDK	7	12	13	1	1	IUV
D9	Prototype homogenisation concept	3	13	13	18	18	IUV
D10	Summary WP3	3	13	13	0	0	IUV
D11	Operation manual concept	4	20	14	0	0	IUV/INVEN
D12	Sub report overview technological behaviour	4	20	22	36	41	TONNES
D13	Summary WP4	4	20	24	0	0	TONNES
D14	Overview concept	5	22	24	15	14	INVEN
D15	Summary WP5	5	22	24	0	0	INVEN
D16	SHAKER web-page	6	1	1	0.2	0.2	MV
D17	Market analysis	7	24	22	2.5	1.5	IUV
D18	Patent application	7	24	24	0	0	IUV
D19	Summary WP7	7	24	24	0	0	IUV
D20	PUDK	7	24	24	5	6.5	IUV
Other	Project: brochure poster	7	2	1			MV PTS
	Activity & management Reports	6	24	24	17	19	MV, UCM

*Month

3. WORK PACKAGE 0 – PROGRESS OF THE PERIOD

Work package 0. - Initiative

ACTUAL STATUS: Finished in time

Work package number	0	**Start date or starting event:**			1
Participant Short Name	MV	INVEN	IUV	JURESA	TONNES
Person-months per participant	1,5	0.2	0.2	0.2	0.2
Participant Short Name	PAPRINSA	GORICANE	OUDEGEM	PTS	UCM
Person-months per participant	0.2	0.2	0.2	0.2	0.2

Objectives

- Evaluation of the starting points of the project with respect to the technical progress and any other relevant developments.
- Evaluation of the consortium commitment, detailed specification of tasks to be studied.

Starting point of work

Organising the kick-off (KO) meeting at Apeldoorn (NL) with all the project partners. During the KO meeting appointments were made for managerial aspects like communication plan, planning meetings, as well as more technological aspects like the standardisation of the used methods as well as the approach for the fundamental and applied research**.**

Description of work performed

Task 0.1 Managerial

- Evaluation of project starting points;

Task 0.2 Definition

- Definition of methods for monitoring and analyzing;
- Inventory of available information, cases and pilots to be studied.

Task 0.3Review and assessment

Task 0.1 and 0.2

The kick-off meeting was well organised as all partners were there. The communication plan, and a standard format for the definitions report was already prepared and discussed during this meeting. A demonstration was given with the WinGEMS model.

Task 0.3 review and assessment/Deviation and corrective actions

There were no deviations within this WP. Deliverables and milestones have been successfully accomplished.

Deliverables

- Definition report (D1);
- Summary WP 0 (D2);

Milestones and expected result

- Kick-off meeting;
- Updated and operational project plan including definition report (within 1 month after kick-off).

4. WORK PACKAGE 1 – PROGRESS OF THE PERIOD

Work package 1. – Analysis

ACTUAL STATUS: finished with delay

Work package number	1	**Start date or starting event:**			2
Participant Short Name	MV	INVEN	IUV	JURESA	TONNES
Person-months per participant	2	-	-	3,5	3,5
Participant Short Name	PAPRINSA	GORICANE	OUDEGEM	PTS	UCM
Person-months per participant	3,5	3,5	3,5	9	22

Objectives
Analyze the stability of the papermaking process and get a better idea of the reasons of process disturbances and analyze the composition and behavior of the disturbing substances.

Starting point of work
During the kick-off meeting appointments were made to start with the technical visits for planning the applied research activities in the mills; task 1.1. The fundamental research activities were planned with the analysis of the detrimental substances in particular both in the laboratory (UCM) and in the mills (MV/PTS/UCM); task 1.2.

Description of work performed
Task 1.1 Monitoring paper production process
MV, PTS and UCM have made technical mill visits to study the stability of the dynamic papermaking process via (semi) on-line monitoring of the process in strategically places with sensors like Near-Infra Read (NIR) Spectroscopy, Focused Beam Reflectance Measurement (FBRM), conductivity and cationic demand etc. to get an insight in the frequency and place where disturbances occur.
During this reporting period MV and PTS performed applied research at paper mills Tönnesmann, and OUDEGEM. UCM make mill research at PAPRINSA and JURESA.
Besides monitoring work also control work (as part of WP4) have been performed and reported in this deliverable. In particular the FBRM is used at JURESA and PAPRINSA to evaluate the effects of (over) polymer dosing and the effects on retention/dewatering and formation of the web. This in-depth work was not foreseen in this work package but necessary as decide by the steering committee. The gained knowledge is also used in the laboratory work of task 1.2

Task 1.2 Analysis of disturbing substances
PTS is performing a chemical analysis on the characterization of the disturbing substances e.g. by using NIR, GC MS etc. and some conventional techniques like extraction for stickies and deposits. PTS has VPK studied in this reporting period.
UCM is performing researched on the fundamental behaviour of the disturbing substances and its destabilization. They focus on the quantification of microstickies and secondary stickies, produced these last ones by destabilization of DCM, by wet end chemicals, due to process shocks e.g. dilution waters, chemical incompatibility, carry over of soap, etc. They found the principal components for the sudden growth of secondary stickies. The cationic demand and conductivity microshocks are crucial in relation to dilution of process waters and pulps. During the elongation time of this WP they have repeat most of the work and also measured with the then available FBRM device.

Task 1.3 Review and assessment / Deviation and corrective actions
The elongation as mentioned in the first period report was necessary for performing, monitoring all the experiments and for data interpretation and repeating of some experiments; the fundamental work was mainly performed by UCM and partners JURESA and PAPRINSA.
The instability of the wet-end of JURESA and PAPRINSA was complex and the steering committee decided to make a, really in-depth study which was not foreseen in the proposal, by changing additives dosing and water dilution in relation to retention and formation properties; this process was followed or controlled by on-line monitoring. The trails have a very high risk on web brakes!
The delay as caused by the rebuilt of the paper machine of OUDEGEM asks for a elongation as described in the first activity report. All work was mainly by PTS and MV. This elongation gives us the opportunity to perform good deposit analysis from a stabilised system and also a good preparation for some on-line trials in WP2 by INVEN.

Deliverables
- D3: Subreport principal process disturbing components
- D4: Summary WP1

Milestones and expected result
- Principal circumstances causing microshocks and principal components which are most sensitive for microshocks.
- Characteristics and destabilization conditions of the disturbing substances.

Accomplished.

5. WORK PACKAGE 2 – PROGRESS OF THE PERIOD

Work package 2. – Process modelling

ACTUAL STATUS: Finished with delay

Work package number	2	**Start date or starting event:**			2
Participant Short Name	MV	INVEN	IUV	JURESA	TONNES
Person-months per participant	5.5	-	2.5	3	3
Participant Short Name	PAPRINSA	GORICANE	OUDEGEM	PTS	UCM
Person-months per participant	3	3	3	0,5	0,5

Objectives
Complete overview of paper production systems of Juan Romani Esteve, Papelera Del Principado, Tönnesman & Vogel, Goricane Paper mill and Oudegem Papier by use of static process modelling.

Starting point of work
The Steering Committee decided to combine the information gathering from the paper mills for WP 2, task 2.1. Therefore, a paper mill survey was developed and completed for all the mills. This information will be used for task 2.1 (process inventory) and 2.2 (modelling).

Description of work performed
Task 2.1 Process inventory
To perform a good process inventory of the paper mills a papermill survey has been developed. Most relevant information has been collected by a good cooperation between the RTDs, the papermills and the suppliers; D5. It is containing papertechnological aspects about production, raw materials, additives and so on and of course some basic information related to available mixing systems. Within the process inventory a wet-end survey of TONNES, GORICANE and VPK was carried out by PTS. Furthermore microstickies and FBRM measurements were carried out in these paper mills by MV. This resulted in deliverable 5B, as described below.

Task 2.2 Dynamic/static process modelling
Modelling of the production process of the mills with the simulation software WinGEMS: MV, IUV and UCM. MV in particular has finished four WinGEMS simulation models of paper mill TONNES, GORICANE, OUDEGEM and PAPRINSA.

Task 2.3 Risk management
High risk level: Within the concept the simulation of the concentration development or concentration evaluation is an important part of the total solution for further improving the process and product stability. The development of a model of the wet-end or the approach flow is based on some real measurements during papermaking. A lot of paper mills produce tissue, paper or board based on recovered paper which will lead to many process fluctuations due to its heterogeneity. This phenomena can lead to inaccurate measurements and by that to wrong predictions and therefore process and product problems. This problem can be minimized by a good validation of the model. The models of both PAPRINSA and OUDEGEM shows good reproducibility with papermaking practise.

Task 2.4 Review and assessment / Deviation and corrective actions

The steering committee decide that the wet-end problems of JURESA will not be solved by the modelling work. That's why the meeting decided to perform a more in-depth study, in stead of the modelling work, in the wet-end by adjusting additives dosing and water dilution in order to understand the wet-end of JURESA via on-line monitoring of effects; see also task 1.1

The WinGEMS models give a good picture over the loads over the process. It will not give information over the fluids dynamics in the tanks which is necessary to know for the mixing concept. That's why the SCM decided to perform a in-depth CFD (computational fluid dynamics) modelling of the Kollergangbehälter of Tönnesmann as well; performed by IUV. See also WP4.

In contrast with the proposal the deliverable D5 got a second part namely 5B. Within the process inventories there was also carried out some in-mill research regarding the on-line monitoring research and the chemical fingerprints (system check chemistry) of the process of OUDEGEM, TONNES and GORICANE, which was described in the proposal but not dedicated to a deliverable.

Deliverables

- D5 part B: Monitoring & system check chemistry
- D6 process models;
- D7 summary of WP2;

Milestones and expected result

- Simulation models of the mills;

Accomplished.

6. WORK PACKAGE 3 – PROGRESS OF THE PERIOD

Work package 3. – Homogenisation concept

ACTUAL STATUS: Finalised in time

Work package number	3	**Start date or starting event:**			9
Participant Short Name	MV	INVEN	IUV	JURESA	TONNES
Person-months per participant	2.5	3	3.5	-	-
Participant Short Name	PAPRINSA	GORICANE	OUDEGEM	PTS	UCM
Person-months per participant	-	-	-	2.5	6.5

Objectives
A Wet-end Control System consisting of sensors for monitoring and a process model determining mixing behavior and/or chemical dosing.

Starting point of work
During the second SCM discussions were made regarding the further development and selection for the sensors necessary for controlling the mixing concept. By technical calculations, based on the WinGEMS and CFD model (see WP4) of mainly Tönnesmann, the hyperboloid mixing concept has been designed for the test tank "Kollergangsbehälter" in stead of a parallel process tank (IBC) at the paper mill.

Description of work performed
Task 3.1 Selection and further development of sensor(s) and mixing equipment
INVEN make a lot of effort to design and develop, based on an existing conductivity device, a robust combined sensor house (2 sensors) on two heights for measuring the difference between upper and lower sensors as input signal for the hyperboloid mixer speed.

Task 3.2 Development of Wet-end Homogenization Concept
IUV performed a desk study to mixing theory as a basis for a better understanding of the computational fluid dynamics as performed in WP4 as well as the real concept design for the process tank called Kolergangbehälter. Based on task 3.1 and 3.2 a more concrete prototype of the concept was made.

Task 3.3 Validation of Wet-end Homogenization Concept (laboratory scale)
Both hyperboloid mixer and the sensors skid were tested at resp. the laboratory of IUV and INVEN, on a cold commissioning level. The same for the frequenz controller and data logger of the system. The test were in compliance with the conditions at the paper mill TONNES. After installation in the process tank the first tests were performed like a hot commissioning. There were no real technical problems. The first results were presented during the third SCM meeting in Ljubljana.

Task 3.4 Risk management
There were no problems observed except one. The level in the tank is depending on the water consumption c.q. water production of the disperger press. In case the level is too high there is no problem but in case the level is too low one of the sensors could became dry and by that increase the difference between the upper and lower sensor signal. This problem has been solved with a setting of the maximum range of the difference of the sensors signals.

Task 3.5 Review and assessment / Deviation and corrective actions
Besides the evaluation on process tank level there is also the change to research the paper technological aspects like effects on runnability etc. This wasn't possible with the parallel process approach as described in the proposal. This is very strong point for this project because the step towards the paper industry market will be smaller because of concrete results under papermaking conditions.
In contrast with the proposal TONNES has contributed to this workpackage, because the installation of the concept was planned for the Tönnesmann paper mill and therefore the input of the TONNES stuff was needed.

Deliverables
- D9 Prototype homogenization concept
- D10 Summary of WP3

Milestones and expected result
- Wet-end Homogenization Concept;
- Mid-term meeting (M3).

Accomplished.

7. WORK PACKAGE 4 – PROGRESS OF THE PERIOD

Work package 4. – In-mill testing of concept

ACTUAL STATUS: Finalised

Work package number	4	**Start date or starting event:**			12
Participant Short Name	MV	INVEN	IUV	JURESA	TONNES
Person-months per participant	2.5	5	5	5	5
Participant Short Name	PAPRINSA	GORICANE	OUDEGEM	PTS	UCM
Person-months per participant	5	4.5	4	1	1

Objectives
Testing and optimizing the concept on longer term behaviour at paper mill.

Starting point of work
After performing the process inventory and the modelling (WP 2.1 and 2.2.) we found that a special tank called 'Kollergangbehälter' is divided into two equal parts with the same feed. This gives us the opportunity to perform the work on laboratory scale direct into semi-full scale under real papermakers conditions. One part is used for the mixing tests and the other part functions as a reference. That's why we started a little bit earlier with this phase and got 3 months extra for testing on this scale.

Description of work performed
Task 4.1. Preparation of testing
The hyperboloid mixer was designed according to the dimensions of the mentioned tank. During the SCM 3 meeting in Ljubljana the test protocol was discussed as well as the steps in the development and use of the stickie method; all participating paper mills were involved. The stickie method was necessary to evaluate the performance of the concept; this in combination with the existing deposition tester. Computational fluid dynamics were used to get a better visualisation why we need a hyperboloid mixing concept; by IUV. Special rheological measures were performed to define water/pulp viscosity figures belonging to the water/pulp suspension of the process tank (Kollergangbehälter); on the Advanced pulp and paper laboratory APPL of MV. This work was not foreseen in the proposal but necessary to make good CFD models of the tank.

Task 4.2 In process testing
After some pre-testing in WP3 and the SCM meeting the long term testing was focussed on different aspects namely water/pulp suspension characteristics like consistency and ash measurements, mixing speed hyperboloid mixer, measurements of micro stickies level and deposition behaviour as well as monitoring of process aspects like web brakes as indicator for runnability. This period was about 1 year!

Task 4.3 Risk management
As mentioned in the first report period the maxium of the mixer was about 100 rpm to avoid air input in the suspension. Within the year of testing no foam was observed and under control.

Task 4.4 Review and assessment / Deviation and corrective actions
To get a good CFD model there was a need to model with real water/pulp suspension data. MV made pulp rheological research and the data were used in the CFD. This was not foreseen in the proposal but the steering committee meeting 4 at VPK decided to do this. The high tech CFD graphs will be used in the marketing of the concept. The bigger scale and longer testing period resulted in more costs for TONNES but the director Mr.Caspar Tönnesmann really wants this to see long term effects. During the first SCM meeting the consortium planned to have the WP4 mainly performed at GORICANE but during the following SCM the meeting decides to perform the trial at TONNES. This WP started earlier and takes 3 months longer, so there was a really long term testing period!

Deliverables
- D11 Operation manual homogenisation concept;
- D12 Sub-report complete overview technical behaviour homogenisation concept;
- D13 Summary of WP4

Milestones and expected result
Prototype of Wet-end Homogenization Concept SHAKER, on full scale level;
Accomplished.

8. WORK PACKAGE 5 – PROGRESS OF THE PERIOD

Work package 5. – Validation of the concept

ACTUAL STATUS: Finalised in time

Work package number	5	**Start date or starting event:**			19
Participant Short Name	MV	INVEN	IUV	JURESA	TONNES
Person-months per participant	2	1.5	1	1	1
Participant Short Name	PAPRINSA	GORICANE	OUDEGEM	PTS	UCM
Person-months per participant	1	1	1	2	3

Objectives
Technological and economic evaluation and validation of the Wet-end Homogenization Concept

Description of work
Task 5.1 Validation of concept
Based on trials of 1 year in-mill testing an optimum mixing speed of ca. 77 rpm was found; several lower (50) and higher speeds (100) were evaluated. The process tank, as process unit, has been evaluated were hyperboloid mixer was on and off. The comparison gives the information that the micro-stickie level was not affected but the behaviour of the available dissolved and colloidals are; about 15 % less deposition. The costs and the benefits were pinpointed and it seems that the Return On Investment ROI is within industrial criteria of 1 year.

Task 5.2 Translation towards other papermills
The steering committee decided to make a translation from the TONNES results towards the other mills. For the recovered papermills this new concept is very interesting because of the fact that it seems to have a preventive working regarding the prevention of deposits (scaling and stickies) combined with a very low energy consumption compared to traditional propeller or injector mixers by a factor two.
At the beginning of the project it was expected that the wet-end of the GORICANE mill was stable because of a recent rebuilt of the process, during the project black spots, from deadzones(!), from the system came into the paper with paper quality loss as a result. So, in short even for modern virgin paper mills this concept could bring solutions. All partners were involved.

Task 5.3 Review and assessment
The obtained results during the tests were discussed between the researchers and the papermakers. The long term test was performed according the test protocol and no big problems occur; technically there was just 1 time an inspection where the sensor skid was taken out. The hyperboloid was maintenance free for the whole year!

Deliverables
- D14 Revised overview of wet-end system;
- D15 Summary WP 5;

Milestones and expected result
- Validated Wet-end Homogenization Concept SHAKER

Accomplished.

9. WORK PACKAGE 6 PROGRESS OF THE PERIOD

Work package 6. – Project management

ACTUAL STATUS: Finalised

Work package number	6	**Start date or starting event:**			1
Participant Short Name	MV	INVEN	IUV	JURESA	TONNES
Person-months per participant	8	0.5	0.5	0.5	0.5
Participant Short Name	PAPRINSA	GORICANE	OUDEGEM	PTS	UCM
Person-months per participant	0.5	0.5	0.5	1	4

Objectives
To ensure an efficient project management as well as adequate exploitation and dissemination plans and the final publication of the work.

Starting point of work
Both scientific and project management started already before the kick-off meeting. During the kick-off meeting (SCM1) all managerial aspects has been discussed.

Description of work performed
Task 6.1 Management
This work package will include all the necessary activities to obtain an efficient project management and to ensure proper exploitation and dissemination plans for the obtained results during the project life. Summarized it will include:

- Planning and coordination of the technical activities of the project.
- Overall legal, contractual, financial and administrative management.
- Coordination of knowledge management and innovation related activities.
- Communication strategy, Meetings organization.
- Development of manuals and training material for operators and academic students.

The project will be managed by Steering Committee with one representative from each of the partners plus the coordinator who will chair the group.
SHAKER management will be divided into scientific management carried out by Mrs. Prof. Dr. Angeles Blanco from UCM, who will take care of the proper scientific work, and into overall project management carried out by the coordinator Mr. Leon Joore from Millvision.
In the reporting period 5 SCMs (Apeldoorn, The Netherlands, Menden (Germany), Ljubljana, Slovenia, and Gent, Belgium and Madrid, Spain) were organised The host for the first meeting was MV, for the second TONNES, the third GORICANE, the fourth OUDEGEM, and the final meeting UCM.

Task 6.2 SHAKER web page
A SHAKER web page is available since the second month of the project; www.shaker.millvisionweb.eu. The front page is for public to give them common information over the project and the consortium. Al other information is available for the partners with own usernames and passwords. In the mean time all information for the SCM1 till SCM 5 is on it.
The site was maintained by MV.

Deliverables

- SHAKER web page (D16);

Milestones and expected result

- Efficient project coordination;
- All necessary activity and management reports;

Accomplished.

10. WORK PACKAGE 7 PROGRESS OF THE PERIOD

Work package 7. – Market analysis

ACTUAL STATUS: Finalised in time

Work package number	7	**Start date or starting event:**			1
Participant Short Name	MV	INVEN	IUV	JURESA	TONNES
Person-months per participant	1.5	1	1.5	0.5	0.5
Participant Short Name	PAPRINSA	GORICANE	OUDEGEM	PTS	UCM
Person-months per participant	0.5	0.5	0.5	0.5	0.5

Objectives
To ensure the adequate dissemination and the exploitation of the results obtained trough out the project taking into account the needs of the consumers and the end users.

Starting point of work
From the kick-off meeting there was a focus on market research, dissemination of the results as well as starting with the exploitation plan.

Description of work performed
This work package is considered as an early action to the future development of the new concept and consequently of the results obtained in WP 1, 2, 3, 4 and 5. It will guaranty the adequate exploitation and dissemination plans for the project results. During the whole project the development of the cost price of the concept will be monitored to ensure a proper payback time.

Task 7.1 Market research
A market analysis has been made with the focus on the EU countries Netherlands, Germany, France and Scandinavia.

Task 7.2 Dissemination and exploitation plans
Both dissemination and exploitations were prepared. The D8, delivered and approved in the first reporting period, has been upgraded into a final deliverable D20. At the end of the project when all results were available and interpretated the steering committee meeting (UCM, Madrid) decided to investigate a patent submission by the IUV patent expert; status on going.

7.3 Review and assessment
Based on the results and the experience in particular with WP1 and WP4 the concept seems promising from a technological perspective. Also the economic perspective is within papermakers actual industrial R.O.I's criteria.
During the project there were several activities for the dissemination by means of simple project brochures, posters and the website. During the final meeting the papermakers were enthusiastic about the performance both in a technical (no maintenance) as technological way; the concept is working now for over 1 year.

A critical point will be the next investment of the second hyperboloid mixer, more upstream towards the paper machine, at paper mill Tönnesmann. That decision will be expected at the end of the year. Besides the management also the operators have a good feeling about the concept.

This mill can then act as a launching customer and real benefits can be measured and used as U.S.P's for papermaking.

Parallel to this decision a lot of dissemination activities will be carried out; in the beginning by the individual supplier SMEs as well by the RTDs. The papermakers SMEs and non SMEs present the poster during their National paper events or association meetings. After the decision has been made related to the patent, professional product/concept brochure will be developed and supported with a multimedia CDROM. There is a business case.

Deliverables

- D 8 Concept plan for using and dissemination of knowledge (D8);
- D17 Market analysis;
- D18 Patent application (under investigation);
- D19 Summary WP7;
- D20 Plan for using and dissemination of knowledge;

Milestones and expected result

- Identification of market segment for the project results and demands;
- Routes for adequate market introduction;

Accomplised.

Section 3
Consortium management

1. SUMMARY OF THE MANAGEMENT ACTIVITIES

To ensure the maintenance of the consortium agreement the following activities have been carried out:

- Planning and coordination of the technical activities of the project carried out during this period.
- Overseeing science issues related to the research activities conducted within the project.
- The overall legal, contractual, financial and administrative management.
- Coordination of knowledge management and innovation related activities.
- Organizing meetings.
- Reporting.

2. MAIN CHANGES CARRIED OUT BY THE CONSORTIUM MANAGEMENT

During the first period of the project we had a delay from a supplier (lps) that have to provide us with several components for the particle size distribution analyser based on laser (FBRM). UCM need this device for the process monitoring at the two Spanish paper mills; WP1.1. Because of efficiency reasons the modelling of the Spanish papermills is combined with the technical process measurements of WP2.1. The delay was discussed in the SCM and approved.

The SCM1 choose within WP2 to start with the modelling of paper mill Tönnesmann to get the process information in-time for WP3 and WP4; the model was ready before the SCM2 at Tönnesmann. The second modelling was Goricane because the SCM3 would be held at that mill. The validation of the model of OUDEGEM has been delayed because of a big rebuilt of the paper machine at the end of 2007.

Maurice Coremans left Millvision at the end of the first reporting period. He was a working group leader of WP2. The consortium took the decision and replace him by Mr. Leon Joore (MV).
Dr. R. Grenz (PTS) was replaced by Ms. Cornelia Lumpe of PTS. Dr. Grenz was member of the steering committee. The consortium approved the replacement by Ms. Cornelia Lumpe M.Sc.
Mr. Piet van Acker (OUDEGEM) was member of the steering committee and was replaced by Ms. Ann Deschildre M.Sc. The consortium agreed and approved.
Mr. Rueda (JURESA) has left the company and will be replaced as member of the steering committee by the director of the mill mr. Antoni Morros. The steering committee have approved this. Mr. Perdih (Goricane) has left the company and was member of the steering committee, He was replaced by Mr. Ales Pavlin. The steering committee has approved this.
All new SC members were high educated and experienced and have a good commitment to the concept.

In WP4 Mr. Ales Pavlin of GORICANE was the WP leader. Since the long term test was not performed on his mill Mr. Caspar Tönnesmann as managing director of TONNES was suggested to replace him. The steering committee has approved this.

Mr Caspar Tönnesmann is high educated and experienced as paper mill director; he has a good commitment to the concept.

From the PTS side Ms. Cornelia Lumpe was member of the steering committee of the Shaker project. She left the institute at 0ctober 1st and started the new SME research & consultancy company Millvision GmbH in Germany; a new SME initiative from Millvision B.V. in the Netherlands. Dr. Dominik Stumm takes her place. Dr. Stumm is high educated and experienced. The Steering committee approved this.

3. CONSORTIUM MANAGEMENT STRUCTURE

The project is managed by **a Steering Committee (SC).** Members of the SC during the project were:

- Prof. Dr. Angeles Blanco, UCM
- Dr. Grenz, Ms. Cornelia Lumpe and Dr. Dominik Stumm, PTS
- Mr. Ruede, Antonio Morros JURESA
- Javier Farré, PAPRINSA.
- Caspar Tönnesmann, TONNES
- Jan Backer, INVEN
- Walther Steidl, IUV
- Piet van Acker, Ann DeSchildre, OUDEGEM
- Dr. Perdih, Ales Pavlin, Goricane
- Leon Joore, MV, Coordinator

The SC was chaired by the co-ordinator who represented the highest level of decision making within the project. **The SC (kick-off) has met on November 27-28 in Apeldoorn (The Netherlands) and on March 14-15 2007 in Menden (Germany). SCM3 was held on October 15 and 16 2007 in Ljubljana (Slovenia) , the SCM4 was held on March 19 and 20 2008 in Gent (Belgium), and the final SCM5 meeting was held on October 7 and 8 2008 in Madrid (Spain).**

Furthermore, the project is organised in 7 work packages, each one has a **WP leader responsible for the performance of the work** conducted in the corresponding WP as well as to ensure the achievement of the deliverables. This **has ensured** that the **work programme** for a task was prepared, and that during the task, the progress was reported to the coordinator. WP leaders during the first year of the project are summarized on table 3.

Table 6: Workpackage leaders

Work-package No	Work package title	Lead contractor Short Name	Person-months	Start month	End month	Deliverable No
0	Initiative	MV Leon Joore	3.8	1	2	D1-D2
1	Analysis	UCM Angeles Blanco	51.5	2	7	D3-D4
2	Process Moddeling	MV Leon Joore	24.5	2	18	D5-D7 + extra sub-report D5B
3	Developing Wet-end Homogenization Concept	IUV Walter Steidl	18.5	9	13	D9-D10
4	Testing Concept	TONNES Caspar Tönnesmann	38.5	12	22	D11-D13
5	Validation	INVEN Jan Backer	14.5	19	22	D14-D15
6	Project management	MV Leon Joore	17.5	2	24	D16
7	Market analysis and Exploratory phase for future exploitation plans	IUV Walter Steidl	8	2	24	D17- D20
	TOTAL		177			

4. PROJECT TIME TABLE AND STATUS INCLUDING UPDATES AND CHANGES

The project timetable and status including updates and changes are included in the project bar chart and status in table 6.

Table 3: Project bar chart and status

Project Bar chart
Acronym: SHAKER
Contract No: COOP-CT-2004-0323352

		1st year												2nd year											
WP	**Description**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
0	Initiative																								
1	Analysis																								
2	Process Modeling																								
3	Developing Wet-End Homogenization Concept																								
4	Testing concept																								
5	Validation																								
6	Project management																								
7	Market analysis / Exploitation																								

5. COMMUNICATION STRATEGY WITHIN THE CONSORTIUM

Interactive management meetings and technical meetings have played **an important role** in the **communication strategy and in monitoring progress of the project**. **Partners** have been kept **fully informed** about the project status and the planning issues which were important to them. All information (minutes of meetings, visit reports, work package reports, relevant publications, etc.) was communicated to the project co-ordinator, who was responsible for transferring this information to other partners. The project coordinator uses CIRCA for the exchange of project information with the EU scientific and legal officers; and vice versa.

Since documents and reports have often been compiled from parts that have been provided by different partners it was necessary to **use a common standard for the exchange of software files**. The following formats were used:

- text files Microsoft Word,
- spreadsheet: Microsoft Excel, and
- figures: Microsoft Power Point.

E-mail and fax have been used to exchange documents. The **website** of the **project (http://www.millvision.nl with button SHAKER)** has been a useful tool to further ensure efficient exchange of information**.** The website **is focus on marketing and dissemination** of the progress and results of the project and it summarised many of the technical papers' titles relating to the obtained results.

5.1 MEETING ORGANIZATION

The following SC and technical meetings have been accomplished to maximise interaction between partners:

- SCM1: meeting and technical meeting November 27 th -28 th 2006, Apeldoorn, The Netherlands, MV is host;
- SCM2: meeting and technical meeting March 14th and 15th 2007, Menden, Germany, TONNES is host;
- SCM3: meeting and technical meeting October 15th-16th 2007, Ljubljana, Slovenia, GORICANE is host;
- SCM4: meeting and technical meeting March 19th-20th 2008, Gent and Dendermonde, Belgium, OUDEGEM is host;
- SCM5: meeting and technical meeting: October 7th-8th 2008, Madrid, Spain, UCM is host.

During this period, a member of the consortium acted as a **Scientific Secretary** in order **to allow** all the **partners** to have **the minutes of each meeting at its end.** In the meeting held in Ljubljana a **technical visit** to the Slovenian paper research institute and a mill visit were carried out. In the meeting held in Gent a technical visit was made to the papermill Oudegem/VPK. During the final meeting in Spain a technical visits was made to the advanced flocculation laboratories of the UCM. Minutes of the meetings and relevant information were included in the web page.

Beside these project meetings, several technical discussion meetings and works have been carried out at SME sites and Universities (between partners).

Till now technical meetings were performed in this project:

1. MV, PTS, INVEN, IUV to TONNES;
2. MV, PTS to GORICANE;
3. MV, UCM to PAPRINSA;
4. MV, UCM to JURESA;
5. MV to OUDEGEM;
6. MV, PTS, UCM, INVEN, IUV to TONNES (several times long term testing);
7. MV to PTS (2 times deposits analysis and technical meeting);
8. PTS to GORICANE (2 times deposits analysis);
9. UCM to PAPRINSA (several times on-line testing);
10. UCM to JURESA (several times on-line testing);
11. MV to JURESA (2 times process analysis)
12. MV to PAPRINSA (2)
13. INVEN, IUV, PTS to OUDEGEM (several times, on-line testing);

5.2 REPORTING:

The layout and detailed content of the reports has followed the Commission guidance notes and guidelines for project report preparation under VI framework. The co-ordinator, on behalf of the consortium has been responsible to submit to the Commission, by electronic and regular mail (and CIRCA), within the period established by the contract, the following reports:

- The first and second period activity report;
- The first and second period management report;
- The final activity report;
- The final management report;
- A report on each contractor on the distribution of the financial contributions to the community made at the end of the project.

5.3 MANAGEMENT OF KNOWLEDGE AND IPR

SHAKER management has not only been focused towards the RTD work, but also towards the protection, publication and utilization of the knowledge generated, which took an **important role in the management** of this consortium during the whole life of the project.
One of the **fundamental activities** in the SHAKER **project has been** the **management of intellectual property and exploitation of results,** which is a **consequence** of the **RTD** program undertaken in the project. At the end of the project when all results were discussed and when a interpretation took place the SCM decide to investigate a submission of an application patent; status ongoing.

To safeguard intellectual protection right the following actions have been already discussed during the second period of the project:

- **Technical drawings/design, copyright**: for WP4. (basics from the prototype manual under copyright)
- Patent option based on performance; under investigation with patent office.

Section 4
Other issues

It is remarkable the involvement of SME in many activities during the project, during the second period it should be specially notice the following contributions:

- Tönnesmann, they have actively contributed in the development of the papermill survey. Their enthusiasm resulted in an early implementation of the concept in the special tank "Kollergangbahalter". Their must be made a lot of technical tank adaptations to install the device because of less height available above tank; their commitment is perfect.

  Within WP3 and 4 INVEN (NL), IUV (GER) and TONNES (GER) were working well together during the long term testing period at papermill Tönnesmann.

  -INVEN, they have actively contributed to select, design and made the best sensor combination for controlling the hyperboloid mixer concept of IUV. A lot of technical visits has been made to monitor the results on-site and read-out the data logger

- IUV, they have actively contributed to the design and realisation of the hyperboloid mixer. The implementation was very difficult because there was very little place to install but together with the technicians of TONNES they fixed it.

  IUV, they have actively contributed to the market analysis and developing the plan for use and dissemination of knowledge. The papermakers and researcher were impressed by the branch knowledge gathered in rather a short time. An very robust computational fluid dynamics study with much more details than expected and based on actual rheological data measured by MV.

- PAPRINSA, they have actively contributed to translate the findings of the modelling of TONNES, GORICANE and OUDEGEM towards their own situation and find the critical place in the stock preparation namely the screening in relation to the stickies levels;

  JURESA, they have actively contributed to discuss the wet-end instability with UCM and MV. Special interest is their in the process monitoring aspect by means of the FBRM; focus wet-end. They perform control experiments on machine level by changes of additive dosages and white water dilution (with high risks); the machine was on-line FBRM monitored, adjusted and controlled.

The RTD communication with the SMEs during this period has been assisted by one representative in each country responsible for contacting the different SMEs, as follow:

Prof. Dr. A. Blanco (UCM) was responsible for the Spanish partners;
Mr. L. Joore M.Sc. (MV) was responsible for the Dutch and Belgian partners;
Dr. D. Stumm (PTS) was responsible for the German and Slovenian partners.

Plan for using and disseminating knowledge (PUDK)

The SHAKER project considers that there is an **obligation to use and disseminate the results** of the project with the aim **to spend public money effectively** and, at the same time, **to increase** future **competitiveness of the SMEs** involved in the project. **Knowledge arising from the work** carried out under the SHAKER project **is the joint property of the SME** contractors according with the rules of the EU. The CA has included the agreement among them on the allocation and the terms of exercising the ownership of the knowledge.

The **project web-page** was an efficient way to disseminate the existence and objectives of SHAKER project during the whole period (supported by the EU Commission) to the EU Scientific Community and Industrial Sector. The SHAKER web-page also has facilitated the rapid and efficient exchange of information with a potential interest for all project partners. Advantage of the facilities provided by MV servers has been taken for maintenance of this web-page during this period.

The concept version of the plan for using and disseminating knowledge has been accomplished as deliverable D8.

Plan for using and disseminating knowledge is also included in the work programme as well as in the management. As summary the deliverables accomplished during the project in relation with PUDK are:

Concept version of the Plan for using and disseminating knowledge, deliverable D8;.
Webpage, deliverable D16;
Final version of the Plan for using and disseminating knowledge (PUDK), deliverable D20;
A Shaker brochure and poster for poster sessions during seminars;

Furthermore, onsite training actions have been undertaken by UCM, IUV and INVEN.

During the project, it has been also disseminated scientific and technical results through different actions, being important examples, the following ones:

One seminar Vapa (NL) has been presented by MV with support of INVEN;
Some PhD students were performing some research in the university laboratory as well in the mills; Some work will be published later on;
Some PhD students were participating the last SCM meeting in Madrid to get some experience in the managerial aspects of EU R&D projects.
Project feed back on workshop of the Dutch and Belgian water platform by OUDEGEM;
Poster presentation by D. Stumm during the PTS paper symposium on September 2008.
Newspaper and Newsletter of MV and PTS several times; see PUDK;
Promotion foreseen for technologie kring seminar on November 4 + 5 2008 in Beekbergen (NL) by MV, INVEN and IUV.