Leveraging on new knowledge and latest advances in science & technology to allow large communities of EU textile machinery SMEs to innovate their products & keep EU leadership in added value textiles

Final Report Summary - NU-WAVE (Leveraging on new knowledge and latest advances in science and technology to allow large communities of EU textile machinery SMEs to innovate their products)

Executive summary:

Although Europe keeps the world-wide leadership in the textile market, Far East has become a major manufacturing area. This situation opened new perspectives in fast growing markets for the European manufacturers of textile machines, 95% of which are small and medium-sized entreprises (SME)s.
However, as today textile machines mainly consist of established electro-mechanical systems the advantages were only of short duration. An intensive effort of the manufacturers of textile machines in Asian countries in introducing the production of cheaper textile machines comparable in output but incomparable in price has started. As a result, Far-East has become the first applicant in the world as far as the number of patents on new machines and equipment for textile manufacturing is concerned, almost filling the gap with Europe.

Project Context and Objectives:

The Textile sector has an annual turnover of more than 200 billion Euros and employs some 2.5 million people in over 150,000 SMEs across the EU-27. Although Europe keeps the world-wide leadership in the market, Far East has become a major manufacturing area. This situation opened new perspectives in fast growing markets for the European manufacturers of textile machines, 95% of which are SMEs, representing an annual turnover of more than 12 billion Euros and providing jobs to some 100,000 employees. Germany and Italy as the main two producers of textile machines benefited most reaching respectively 3.8 and 2.7 billion Euro turnover. Furthermore new member states as the Czech Republic, pioneer of many of the innovations of the last century as air jet looms and automatic circular knitting technology had large opportunities. However, as today textile machines mainly consist of established electro-mechanical systems which are used to create a yarn or filament, interlacing them during weaving or knitting and transport the fabrics for further finishing, the advantages were only of short duration. An intensive effort of the manufacturers of textile machines in Asian countries in introducing the production of cheaper textile machines comparable in output but incomparable in price has started. As a result, Far-East has become the first applicant in the world as far as the number of patents on new machines and equipment for textile manufacturing is concerned, almost filling the gap with Europe. Patent and brand infringement is also a key issue due to the highly traditional technological approaches so far used in textile machines which are easily copied. This represents a major threat for European textile machinery SMEs, their competitiveness and knowledge base.

The only way forward for European manufactures of textile machines and producers of textiles and textile products is to establish once again the long tradition of symbiotic cooperation between the two sectors and to innovative products and product portfolio, searching for new sophisticated solutions in high added value markets. European firms have a high competitive advantage when developing new textile products and machines for their production. To solve the tasks connected with ensuring the textile production and the development of new applications, the traditional approach based on empiricism and experience is not sufficient, but a systematic and interdisciplinary approach is necessary that enable textile machinery SMEs to:

- make their machine more flexible, productive and efficient to move from mass production and cope with highly variable and functionalised textile products,
- reduce the huge quantities of energy and other resources required,
- improve the working conditions by reducing the noise and vibrations which represent threats for the workers and give an old-fashioned vision of the sector to the new generations.

To address this challenge in 2006 the MANUTEX initiative has been jointly launched by the European Technology Platform for Assuring the future of Manufacturing in Europe (Manufuture) and the European
Technology Platform for Assuring the Future of Manufacturing in Europe (Manufuture) and the European Technology Platform for the Future of Textiles (Textile ETP) in order to realise closer collaboration in pre-competitive research and development at European level between the Textile and related Machinery Industries. In this framework, the partners Euratex and ITA with the support of CEMATEX and in particular its National members ACIMIT and VDMA, both participating in the project NU-WAVE, have performed a preliminary analysis of the scientific and technological bottlenecks, in cooperation with 500 companies. This survey highlighted the need to replace complex kinematic devices (e.g. cams, alternating mechanisms) currently required to obtain distributed actuations starting from a central engine, to reduce high inertia of rotating bodies as well as high level of vibrations from high frequency oscillating masses, to decrease high friction of yarns and textile materials against metallic components as well as to introduce process simulation technologies and modularity concepts for cost-effective design and control of machines and drives.

In line with the Strategic Research Agenda of MANUTEX (see http://www.manufuture.org/documents/manutex-def1.pdf online), NU-WAVE has been conceived to support textile machinery SMEs in the design of a new generation of flexible and high-performance machines. Research objectives are clearly driven from the needs of the market end users: textile producers are looking for increased performances, modularity, resource efficiency and safety to compete in the global market.

The main objectives of the project can be summarized as:
To scientifically characterize and integrate advanced materials in the machine building, in particular:
- Composite materials;
- Smart materials;
- Ceramic materials.

To develop and integrate in textile machines novel mechatronics based design concepts, in particular:
- Modular design to organise a complex system (such as a textile machine) as a set of distinct functional components that can be developed independently and then plugged together as well as moved from one machine to another;
- High Power Density actuation devices able to replace the very complex power distribution kinematic devices driven by a powerful driving unit with several miniaturised (e.g. 20x20x100mm) actuators independently powered with an actuation frequency of at least 50 Hz;
- Distributed Control System in which the controller elements are not central in location but are distributed throughout the system with each component sub-system controlled by one or more controllers with sensors integrated in them;

To set a development methodology integrating different Virtual Prototyping Software (e.g. 3D Modeller, FEM Tool, CFD Tool) and web-tools, with guided functionalities able to support the non-expert user;

Project Results:

The Nu-Wave project is based on a structured approach to innovation, which is commonly adopted by industry in their development activities.
The methodology is assumed to pass through three phases:
1. Scenario Analysis;
2. Demonstrators Design: functional analysis, conceptual design;
3. Testing results and Dissemination: test campaign and dissemination actions

According to the PERT diagram and to the activities really performed, the Nu-Wave project itself can be conceptually divided into these three phases.

For a strong approach to industrial innovation, first of all a company shall set up a strategy and define the technology areas which are necessary to focus on. Once the overall scenario and the opportunities are completely known, the company can shift to the second phase of product development, which includes the prototyping activities, the validation phase, the final integration and test campaign. The last phase is not less important and includes all the activities aiming at exploiting the potential of the innovation: the IPR management, the evaluation tools (e.g. qualification under specific tests, norms, directives) and the dissemination activities.

It is important to underline that the innovation process shall not end as soon as the first prototype is produced, but it goes on with a sequence of further actions, aiming at consolidating the innovation, exploiting its potential and making the perception of the enhancements and innovation level easier to communicate.

The scenario analysis

Within the first phase, collection and organization of relevant technical and non-technical data have been performed, in order to get the whole picture of current scenario and allow the users (SME and SME-AGs) at getting easily results for future development.

The consortium developed new knowledge and performed a scenario analysis at different level, in order to acquire as many data as possible from which the research could start and on which the evolution could be based.

In particular, the activities performed can be summarized as:
- Patent analysis and hot patents collection;
- Collection of the newest patents from Far-East;
- Analysis of the scientific literature;
- Collection of datasheet of the newest textile machinery;
- Definition of the technical clusters of innovation.

The interpretation of data, the analysis of the scenario, of who is doing what, allowed the consortium in defining the main technological areas on which the worldwide research is currently pushing.

Thanks to that, the consortium has been able to focus the efforts in developing knowledge in the most actual arguments found, avoiding redundancy and increasing the research efficiency that showed high potential for textile industry.
Friction reduction and wear resistance;
Reduction of noise and vibrations;
Mechatronics;
Modularity of design;
Computer Aided Engineering (CAE);
Energy saving.

The huge quantity of interesting data and graphs suggested to structure all single analysis in a simple way, in order to make easier to the reader (potentially all Europeans associated SMEs) to consult the results and find new ideas or interesting topics:

Introduction. In order to introduce the reader to the topic, each chapter contains a brief description of the argument, including the important related critical aspects and the existing technological limits;

General analysis. Patents and scientific papers have been investigated for figuring out who in the world is leading the industrial and scientific research.

Detailed analysis. For each of the main field of investigation has been identified a certain number of recent and interesting areas, representing a sort of roadmap of future development: For this reason, the general analysis has been refined, with a focus on each of the most promising areas of improvement;

Textile industry. The last analysis wants to show who, coming from textile industry, is active on a certain topic and the opportunity related to a technology transfer.

Demonstrators design
The second phase started with a Technology Scouting activity, targeted at defining a portfolio of different possible innovative solutions, for each demonstrator and for each technological area identified in the previous phase.

This activity allowed the RTD performers and SMEs in identifying the most interesting concepts and the technology on which to invest and build a structured process of product development, avoiding cross roads already beaten by others and proved fruitless. For each demonstrator has been traced a development Roadmap, containing all possible alternatives for overcoming actual limitations and a workplan, for its production.

Nu-Wave demonstrators
Three Demonstrators have been developed within the project, as evidence of the new concepts, technologies and knowledge collected by the consortium:
1. Innovative parts for crochet machines: a crochet loom has been improved by modifying the actuation systems of the weft bars and the weft bars themselves. New concepts of mechatronics, innovative control algorithms, innovative coatings and light-weight materials have been the core of the demonstrator;
2. Wear resistance testing stand: the demonstrator is an important tool for Nu-Wave, since it has the aim of better evaluating wear resistance of machine parts subjected to yarn sliding. The demonstrator is completely shaped on yarn sliding and it can be used as first trial on some parts of demonstrator N°1.
Completely shaped on yarn sliding and it can be used as first trial on some parts of demonstrator N 1 (particular reference to the thread guide wear resistance increasing objective);

3. Yarn dyeing machine: development of new control sensors and algorithms for implementing the modularity of the plant and allowing fast adaptation and optimization of the dyeing process variables (temperature, salt concentration, and pH). This will increase the plant performances when managing rapid changes in the desired output and addressing high-quality customized production.

These industrial results reached within Nu-Wave were highly appreciated by technicians, researchers and journalists of the sector, as shown by the several expression of interest collected in ITMA fair - Barcelona 2011, by the Nu-Wave booth (H5-D116).

Crochet machine demonstrator

The RTD performers, together with COMEZ, realized one of the small-scale demonstrators displayed at ITMA 2011 in Nu-Wave booth. A twin demonstrator was displayed in COMEZ own booth (in Hall 3) for showing the Important improvements directly to their own customers.

The COMEZ demonstrator components, though tested and validated with a strict test campaign, still need improvements to fill the gap with market and be presented as potential commercial products integrated within a crochet loom.

In the actual types of knitting machines actuation systems, the cranck-shft mechanism is used, whose aim is to transform the rotary motion of the motor shaft into a rectilinear motion for the positioning of the weft bars.

The mechanism for controlling the bars is based on a crank directly connected to the motor shaft and a slider which pushes the weft bar onto a fulcrum.

The linear displacement of the weft bar depends on the angle between the cranck and the reference plain. Each motor step brings about a variable displacement according the sine of this angle.

The precision of the displacement must be within a range of +/- 0.01 mm.

With this kind of transmission, if a wide linear displacement (50 mm) is required while keeping the necessary precision, the displacement angular resolution must be very high (at least 16384 positions per revolution).

In addition, the algorithm for the positioning of the actuator requires a high calculation power since it has to be moved a load whose inertia related to the actuator shaft varies significantly (the same is a function of the sine of the angle).

At present, cranks of 3 lengths (14.5 mm - 20 mm - 30 mm) is used according to the amplitude of the linear displacement to be accomplished.

The displacements vary according to the machine gauge (needle per inch of needles per cm). The minimum gauge corresponds to a linear step of 1.25 mm.
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The weights of the bars are as follows:
- Patter bar weight = 1240 g Displacement = 30.6 mm;
- Ground bar weight = 3270 g Displacement = 10.2 mm.

The positioning must take place in 20 ms (1500 rpm).

The friction (first disjunction), according to measures taken on machines in operation, is comprised between 550 and 2000 g. The friction varies according the temperature since the lubricant cohesion increases at low temperatures.

All the movements of the textile mechanisms on COMEZ machines are currently based on the application of a brushless actuator connected to different types of mechanisms. The actuator is composed of a brushless motor to which - as continuation on the rear side - a converter based on digital technology (DSP) is attached.

Knitting Mechanism - Current Limitations
The Slider/Crank system offers the advantage to be simple, economical and reliable, however has significant limitations:
- Part of the force transferred is lost due to the increase of length of the crank;
- The precision of the linear position is reduced due to the transformation of the rotary movement into a linear movement;
- F2 is dissipated in heat over the axial sliding element (bearing brass) and only F1 actuates the bar, due to the split of the force F in two forces F1 and F2.

Consequently, keeping on using this type of system:
- The value of the actuators' torque is increased in order to offset the requests for wider linear displacements which presume longer cranks;
- The positioning angular resolution is increased in order to guarantee the precision of the linear positioning required;
- A sophisticated algorithm for the positioning is necessary in order to manage the various movements of the bars;
- A remarkable part of the energy is lost in friction and transformed in heat in the connecting bearing of the weft bar.

Weft Bar
Currently the bars are produced with UNI 7075 aluminum. Steel pins are attached to the bars which allow for the displacing along the longitudinal axle. The pins slide inside bearing brasses. The shape of the bars has been specially designed so as the spring shaft thread-guides fit properly.

The main problem connected with the weft bar is primarily referred to the amount of energy required to make it move back and forth during the working cycle: it strongly depends on the weft bar inertia, thus leading the actual research towards the identification of a novel design in terms of shape and material.
leading the actual research towards the identification of a novel design in terms of shape and material, primarily targeted on the minimization of the mass and of the energy lost by friction during the sliding movement of pins inside the bearing brasses.

The COMEZ demonstrator showed the feasibility of reducing of more than 50% the weight and up to 80% the energy consumption of the articulated crank-slider system necessary for a single weft bar, by modifying the design, the materials and integrating innovative surface treatments within lightweight carbon-fiber weft-bars and shafts, as well as wear resistant titanium coated guiding pins.

The brushless motor is based on new generation Digital Signal Processor, with high resolution positioning and High efficiency. The acoustic emissions are low and its operating modes allowed to replace all the mechanical devices involved in manufacturing processes on Crochet machines, Needle Looms and Warp Knitting Machines.

The connecting rod was made of Aluminum, the body has been re-designed using a polymeric material, reinforced with short carbon fibers, decreasing the overall weight of about 40%; the cylindrical couplings are still made of Aluminum, glued with the body.

The weft bar was entirely made of Aluminum: it has been redesigned and then produced using Epoxy with Carbon Fiber T700S-C-12000-50C, braided on a structure of balsa wood, an innovative process that enabled the high mechanical characteristics needed. The weight reduction is of more than 50%.

The pins of steel have been replaced with Titan pins; the surface of pins has been treated with flame spray, an innovative process that enabled the increase of surface hardness up to that of steel.

The performances of the innovations as a whole are surprisingly high. The stand was measured in VUTS facilities, with the aim of comparing the dynamic performance of the original and modified design. The new design, including the new driver, the composite weft bar, a composite connecting rod and an improved slideway, served to reduce the inertial mass and to save the power consumption of the weft bar drive.

The innovative features implemented by Nu-Wave will strongly affect the cost and then the appealing to customers of the new generation of knitting machine.

Energy saving. According to the preliminary tests performed during Nu-Wave project, the energy consumption of each actuation system could decrease up to 80%, thanks to the reduced friction, the decreased mass and the new electronic control. Being more than conservative, we could assume for an industrialized running machine a power consumption of 50% respect to the actual, 93.5 W instead of 187 W, per bar. A 20-bars machine will need around 1.9 kW, instead of 3.7 kW.

If we assume an average value for the cost of kWh of 0.07 to 0.10 Euros and that usually the machine is used 24 hours per day, the total savings given by each machine could vary from 95.76 Euros/month to 136.80 Euros/month, representing an important benefit for industry.

Floor-space reduction. According to the preliminary design of the new actuation system developed in Nu-Wave, the volume of a 20 bars machine has been significantly reduced. This is mainly due to the great
Wave, the volume of a 20-bars machine has been significantly reduced. This is mainly due to the great reduction of dimensions of the down-sized electrical motors (35-40% less than before, as power installed). The volume occupied by one current 20 bars knitting machine can be occupied by 1.2 new machines: this means that a floor-space currently hosting 10 machines can be revised to contain up to 12 machines, increasing its productivity of the 20%.

Mass reduction. The weight of the new actuation system of the knitting machine is 369 g, the 55% less than the previous version (821g). Each weft bar will bring a mass saving of 452g, this means a total reduction of more than 9 kg for a 20-bars machine. Including the weight reduction of further (conservative esteem) 50 kg related to motors downsizing, the total reduction is of around 60 Kg. Besides the already treated energy consumption reduction, this allows further cost saving, as shipment concerns. Starting from some latest statistics on air shipment price, as an example, the average cost for shipping a machine to China, can be reduced of around 113 Euros per machine shipped, that represents more than the 10% of the current mass-related shipment price (around 900 - 1000 Euros).

Low environmental impact. In order to assess the lowered environmental impact of the demonstrator, a comparison with the currently commercialized machine has been made, with important results: the carbon footprint calculated for a machine installed in the EU27 area showed a reduction of more than 1kg of CO2, per hour of functioning, with respect to the traditional machine.

Wear resistance testing stand
A further result of Nu-Wave is the small-scale test desk demonstrator developed by NAVETA and RTD performers, dedicated to wear resistance testing of textile machinery spare parts subjected to yarn friction. Different materials and shapes can be easily and rapidly tested, avoiding costs for long test runs and enabling the generation of optimized cost/lifetime plots.

On textile machines, damaging of machine parts from the abrasion of fibrous material occurs, i.e. scraping surface molecules from moving fibers. The greatest ones are radial force, relative velocity and the roughness of moving parts, the highest one is abrasion effect.

By abrasion, machine parts are deteriorated, and this can cause production failures - production decrease or product devaluation.

Service life of a part is defining the limiting state of the usage of a part. When assessing life service, mostly a dimension parameter of a part that must be kept is defined.

Part wear is examined at all machines where moving parts contact themselves. Experience is transferable also into the design of textile machines. From textile semi-products, yarn has the greatest abrasive effect. It moves along the surface of special parts and rubs at high speed and pressure on a part very often.

Textile production in the EU started to specialize in technical fabrics. When producing technical fabrics, very strong, coarse yarns are processed, which damage some parts very intensively. Yarns are made from polyester, Kevlar, glass etc., which are very aggressive materials. Abrasive effects of yarns differ remarkably: it depends on fiber length, bend rigidity, fiber roughness, lubrication etc. Climatic conditions have an influence during operation, i.e. air temperature and humidity. During textile production, fibrous
have an influence during operation, i.e. air temperature and humidity. During textile production, fibrous semi-products are kept under certain pressure. From the point of view of dimensioning mechanisms, ensuring machine input and service life of parts, it is necessary to determine forces.

The problem of wear (abrasion) resistance is worked out by choosing the basic material and part surface. The best parameters are achieved with ceramic parts. If ceramics cannot be used, abrasion resistance is usually settled by modifying the surface of metal parts. The abrasion resistance of steel parts is worked out by hardened steel (both carbon steel and stainless steel), chromizing, surface cementing, DLC surfacing (finishing), nitration etc.

Not only weaving machines are concerned. Problems occur already in preparatory rooms, in warping on creels (guides, lease and warping reeds, and namely tensioners), in sizing (sizing combs and frames), weft feeders, in finishing, but also in clothing (e.g. scissors for cutting Kevlar, trimming off false selvedges etc.).

An inspiration when choosing suitable materials for the production of stressed consumed parts may be found in car industry as well. There, they aim at high life service at minimum costs. Today usually special coatings on valves, sparkling plugs, bearing pistons etc. are used.

The yarn subsequently cuts a nut in the point of the largest stress which begins to damage the yarn surface. Yarn strength will decrease up to the stage when yarns tear during their processing. It is also disadvantageous from the economic point of view. Even a small erosion of yarn surface will evoke reclassifying the goods to lower quality level because when dyeing a cloth, colour difference on the abraded yarn will occur.

Damaging parts by yarn abrasion also impacts on the economics of the operation. Besides the price of a new part, it is also the loss of operation time for the exchange of parts. At weaving machines, with some parts, there is a problem that the exchange time of a worn out part is optimal in the time where a new warp is being drawn-in. It concerns reed, heddles and drop wires e.g. It is advantageous if the life service of those parts is given in multiples of the processing time of a warp.

At reeds, mainly edging portions are damaged due to higher yarn tension by warp shortening. Therefore, either exchanges for new reeds are carried out or NAVETA offers special surface hardening of edging reed dents, which is financially costly. Another solution consists in delivering reeds with exchangeable edging sections. During this solution, considerably less warp threads are drawn-in. The reed centre is used multiple times. Up to now, however, it is difficult to set the safe number of surface modified edging reed dents or the length of the exchange section more precise.

At heddles, exchange is carried out on the weaving machine as a whole because it is not possible to differ the starting and the advanced erosions of their surface precisely. After an exchange it is necessary to draw-in the warp as a whole again.

The principle of accelerated course of wear is used to suggest a test methodology and equipment, which would enable to compare the wear / abrasion resistance of the chosen consumed parts of textile machines by provably comparable kind of yarn loading under reversible movement, by max. accelerated course
by provably comparable kind of yarn leading under reversible movement, by max. accelerated course.

The desk simulates the wear on consumables of knitting machines, during millions working cycle, in few hours. A yarn is moved by a pulley and tensioned, with a defined value, by an actuator. The consumable metal part is mounted on an oscillating support, which speed can be varied, to better simulate the real working environment.

The test can last few minutes up to 12 hours; in this period the instrument records all relevant parameters of the test, in order to find relation between the working load/cycle with the results of microscope analysis on the consumable tested.

The major figures of the demonstrator:

- It shortens needed time and facilitates evaluation in comparison to operational tests;
- It helps in finding an optimum execution version of a textile machine wearing part;
- Help in looking for compromises of price and quality;
- Help in developing new materials and surface treatments of wear parts in textile machines;
- A possibility of comparative measurements;
- Also a possibility of optimizing yarn finish in relation to acting of wearing parts.

Modular dyeing demonstrator

In the last years the state of the art of dyeing control system has not changed so much. This demonstrates that innovation in this sector is strongly needed.

A process for the dyeing of a fibrous article makes use of one or more dyes and other chemicals that are adjusted in real time as a function of selected monitored parameters of the dyeing bath. The process includes immersing the fibrous article in a heated aqueous bath with a predetermined pH according to the nature of both the fiber and the dye. Salt is also added to the dyeing bath to promote the aggregation of dye molecules which thus become less soluble in the bath while their affinity for the fiber is increased.

Most dye houses use standard dyeing procedures for a particular dyeing system. Since there can be variations from one lot of fabric to another and there can be some errors in the dyeing variables, the standard dyeing procedures may lead to mismatched and unlevelled dye lots.

These dyed goods may then have to be re-dyed to get the desired result, and this leads to loss in time and resources. It is therefore the desire of dye houses to get the desired shade with good levelness of the fabric in the first process. Many researchers have been focusing their efforts to overcome these problems.

The innovative Yarn Dyeing Machine technology is going to be based on the use of the Variable Optical Path Spectrometer (VOPS) as monitoring system for the bath exhaustion, temperature and density of the dyeing bath. Those parameters are not the only ones that have to be monitored for obtaining the best dyeing results: salt concentration and pH are also crucial. As matter of fact, the bath exhaustion depends on these parameters as well.

The monitoring system has thus been conceived with the following equipment connected to a PC with a user-friendly interface:
The developed system has the ability to collect real-time spectral measure of the bath with a high degree of accuracy in order to provide dye colour information along with conductivity, pH and turbidity parameters.

The system showed sometimes some minor problems during its functioning. This was justified as the system is still a prototype and needs a further work for final industrialization.

In any case the intense testing campaign showed that the innovative technology introduced with this system is really of help for the dyeing companies. It showed to be strong enough for working in a very harsh environment such a dyeing industry. The end-user companies involved in this evaluation phase gave all their support and demonstrated to be confident in the obtained results.

After the necessary industrialization phase, DYE-BATH MACHINE will be ready for being installed and integrated in each industrial plant, being able to allow the on-line monitoring of the dyeing bath. Besides this, DYE-BATH MACHINE will be able to help the dyeing operator to perform a corrective action to the bath if needed.

All this innovative functionalities were demonstrated thanks to the performed tests during the last months of the project. All partners were involved in these trials, in order to let the whole Consortium finally understand the real potential of the developed prototype.

The 'Green Label' tool
One of the Nu-Wave objectives is to develop a new generation of textile machines characterized by a reduced environmental impact, a smart exploitation of resources and energy and an improved life cycle sustainability.

In collaboration with RTD performers, ACIMIT has created a working group whose purpose was to identify the objective parameters to evaluate the characteristics of eco-sustainability of textile processes. The final output is a 'Green Label' applicable on the textile machineries of the companies participating to the initiative, as a reference for carbon footprint.

Four main steps necessary to realize the “Green Label” have been concluded by the working group:
1. Technical-commercial survey, data collection/evaluation;
2. Identification of a set of indicators to be inserted in the label;
3. Identification of two front-runners (ACIMIT members) in order to perform pilot projects;
4. Creation of a tool that generates the Green Label - Green Label Realization.

All the steps have seen out successfully: in particular two companies members of ACIMIT, Flainox and Jaeggi Mecacostitile Srl, have been identified by the working team as front runners.
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Calendar of meetings have been held between D'Appolonia, ACIMIT and company people in charge for this action, to assess correct parameters for the analysis, to evaluate and correct recovered data, to elaborate the results and to implement comments and observations emerged during the meetings.

The final output for these companies has been the evaluation of carbon footprint of a plant or a machine, representative of their product portfolio, through a tool, available and now usable by Nu-Wave SME-AGs members able to realize the Green Label with just few passages.

The tool is an instrument that has in its memory the set of indicators selected for the type of machinery (in textile area) and, on the basis of data entered, it is able to calculate the primary footprint of the machine or plant subject of analysis.

The tool is articulated in five sections:

- Company info: in this section general information about the company and its compliance with specific environmental standards are requested and certificate and certification agency logos can be uploaded. In addition, the name and logo of national textile machinery, which the company is affiliated can be inserted;
- Machine data: some information about the machine / plant object to the energetic labelling are requested as, for example, commercial name, process description, materials processed, location country;
- Process parameters: here various technical data (e.g. installed power, water consumption, other), useful also for the CFP calculation, are requested;
- Other information: in this section other general information are requested (obligatory PPE, previous CFP values of previous years, if available);
- Result: display of label generated by the computer system. A Green Label Reference Code for the upload is also provided, this will be useful to modify the Green Label generated in a fast way.

The greenhouse gases emissions assessment method is the CML 2001 - Version Nov. 09, Global Warming Potential (GWP 100 years), developed by Institute of Environmental Sciences of Leiden University.

The CML is an impact assessment method to measure the environmental impacts in LCA. The CML 2001 baseline method elaborates the problem-oriented approach; the CML Guide provides a list of impact assessment categories grouped into:

- Obligatory impact categories (category indicators used in most LCAs, among them Global Warming Potential);
- Additional impact categories (operational indicators exist, but are not often included in LCA studies);
- Other impact categories (no operational indicators available, therefore impossible to include quantitatively in LCA).

GWP is measured in kg CO2 equivalent: each greenhouse emission is normalized according its dangerousness compared with CO2 one.

The carbon footprint (CFP) is the measure of the impact that whatever type of activities has on the environment and in particular on climate change. The CFP is in fact directly related to the amount of
The carbon footprint represents the amount of all produced greenhouse gases and it is measured in tonnes (or kg) of carbon dioxide equivalent for a given time interval (usually either one year or the entire subject life) or for a mass unit of the product. The concept name of the carbon footprint originates from ecological footprint discussion. The carbon footprint is a subset of the ecological footprint and of the more comprehensive Life Cycle Assessment (LCA), which is used to calculate it.

An individual's, process', product's, nation's, or organization's carbon footprint can be measured by undertaking a greenhouse gas (GHG) emissions assessment: the aim of this esteem is to give an objective parameter that evaluates the impact of a certain activity and on which one can set up a sustainable strategy to reduce it, e.g. by technological developments, better process and product management, changed Green Public or Private Procurement (GPP), carbon capture, consumption strategies, and others.

The mitigation of carbon footprints through the development of alternative projects, developing greener management solutions, represents one way of reducing a carbon footprint and is often known as Carbon offsetting. Moreover, the assessment of CPF and the efforts to reduce it often bring industry to an overall optimization of the whole production/distribution chain with important economic savings and improvement in logistics.

Various experiences over the globe have been addressed in order to evaluate carbon footprint in different cases, according to British Public Available Specification, PAS 2050, elaborated on behalf of DEFRA (Department for Environment, Food and Rural Affairs) and ISO standard 14064:2006.

ISO standard is subdivided in three parts:
- ISO 14064-1 "Greenhouse gases - Part 1: Specification for the quantification, monitoring and reporting of organization emissions and removals";
- ISO 14064-2 "Greenhouse gases - Part 2: Specification for the quantification, monitoring and reporting of project emissions and removals";

The carbon footprint of a product is made up of the sum of two parts, the Primary Footprint and the Secondary Footprint.

The Primary Footprint is a measure of the direct emissions of CO2 from the burning of fossil fuels, including internal energy consumption and transportation (values easily controllable), during its normal functioning.

The Secondary Footprint is a measure of the indirect CO2 emissions caused by the product, associated with their manufacture and eventual breakdown. The aim of the labeling is to use the Primary Footprint as a parameter of eco-friendliness of the machines. Its calculation does not need the involvement of suppliers' or other third parties', being exclusively based on machine technical data. Moreover, the Primary
Suppliers or other third parties, being exclusively based on machine technical data. Moreover, the Primary Footprint can be also used as a means of communication, being directly linked to consumption and thus interesting in the eyes of the customer both from an economic and environmental point of view.

In the reference industrial sectors, for the project purpose, the labeling is referred only to the primary carbon footprint.

The Green Label met a very large consensus of associated SMEs and was officially presented in ITMA fair 2011, in Barcelona. More than 60 Green Labels were exposed in the booths of textile machinery producers, each one addressing the carbon footprint of a specific machine. More than 30 SME producers decided to join the initiative and the Green Label became a 'leit motiv' of the fair.

ACIMIT organized a press conference dedicated to this initiative and the Green Label was presented to specialized press; following is a non-comprehensive list of articles on the label:

The knowledge repository

NU-WAVE project strongly involves the combination of different experiences, backgrounds and capabilities in order to develop a vision and the technologies for future added value textiles. In order to improve the knowledge and enhance the exchange of information among the partners, a knowledge platform has been improved.

The goal of the knowledge platform is to offer an easy and more efficient way to catalogue and organize all the information generated and collected during the project. A suitable way to achieve this goal is a software tool which can upload and store any kind of document with a classification system based on a keyword indexing. This software allows the partners to reach any content of interest and implement an efficient knowledge repository database.

In order to be easily reached and cross-platform, avoiding as much as possible any problem of compatibility, the software is being developed as a component of the website. The knowledge repository database is developed with Adobe Flash technology which, according to the data provided by the manufacturer, reaches almost the 99% of the PCs connected to internet.

The software is completely integrated in the website.

The knowledge repository is a database which stores and organizes different kind of documents with the help of previously defined keywords. In order to have a more homogeneous insertion of all the documents at this stage the user is not allowed to modify the keyword structure, although he can advise the system administrator if anything important is missing or it is wrong.

The software is organized in three main parts:
- The graphical interface for uploading and searching the contents;
  The communication system between the interface and the database;
The communication system between the interface and the database;

To have a widely accessible tool the interface has been developed in Adobe Flex. Adobe Flex is a software development kit (SDK) released by Adobe Systems for the development and deployment of cross-platform rich Internet applications based on the Adobe Flash platform. Flex applications can be written using Adobe Flash Builder or by using the freely available Flex compiler from Adobe.

The communication system guarantees the interaction of the webpage with the database. The communication system for the repository tool is implemented in PHP which is a widely used, general-purpose scripting language that was originally designed for web development to produce dynamic web pages. For this purpose, PHP code can be embedded into the webpage source document and interpreted by a web server with a PHP processor module, which generates the web page document.

The database is stored using MySQL. MySQL is a relational database management system that runs as a server providing multi-user access to a number of databases.

The upload interface is structured in two main parts: the first part is constituted by the basic data of the document. This part is further divided into three sections, the first contains common information such as Title, Author, Short Description, Long Description and the path of the file to be uploaded, the second section contains the keywords for the indexing system, the third section contains a policy access section. The part on the right is a tree structure where all the keywords are organized in a way such that the user can explode, view and select the more appropriate ones.

A similar structure is provided to explore the keywords in the searching phase. This structure joins a more traditional module that implements the searching functions. The latter module is similar to the upload interface.

Although the tree structure implemented for the keywords needs more efforts in an initial phase, it seemed an idea that can help the user to find interesting documents or ideas related to the field of its search. It is moreover a valuable method to clearly organize all the contents.

This platform is shared out in two different sections, characterized by different access policy. The public section contains the basic information about project, partnership and public documents for dissemination activities; in the private section, with access restricted to the Nu-Wave Partners, it is possible to collect documents, share the results and keep partners updated on the project progress.

The partners periodically update the website content with relevant documents, papers and presentation in order to highlight the actions done and the new outcoming ideas.

The access to the private section of the website is possible by logging in with proper user ID and password provided by the Coordinator during the Project. Full access is also granted to the European Commission Officers, if necessary.

Each Partner, after the first log in, is enabled to manage its profile (profile menu) and, subsequently, to...
Each Partner, after the first log in, is enabled to manage its profile (profile menu) and subsequently, to modify the password for granting safe access. With the private access it is possible to share private documents, to upload and download deliverables and material useful for the other parties and to access the different tools developed within the project.

The Private Access policy has been structured in two different levels. Consortium members and selected people belonging to each Nu-Wave Partner are able to access the whole website content, without any restriction except for the web-mastering tools. Innovation Champions and other SME-AGs members can access only the Nu-Wave technical content published. By this level of users, it is not possible to access to Administrative, Contractual or any other kind of Management documents or content. The account will be registered only after the necessary request from the pertinent SME-AG that will collect the request from each interested member.

Potential Impact:
Europe's textile and clothing industry as well as its textile machinery sector are leaders in their respective markets. The Textile and Clothing sector has an annual turnover of more than 200 billion Euros and employs some 2.5 million people in over 150,000 companies across the EU-27. The European textile machinery industry has an annual turnover of more than 12 billion Euros and provides jobs to some 100,000 employees. The EU is the world's biggest exporter of textiles and textiles machinery which are manufactured by a vast majority of SMEs. This leadership was built on a long tradition of symbiotic cooperation between the two sectors. Recent global market trends force both sectors in Europe to intensify their innovation activities to defend their leadership positions. In fact, apart from growing patent activities and counterfeiting of machines, China is becoming an important player in textile machine manufacturing. According to the China Textile Machinery Association, in first half of 2006 some 741 Chinese textile machinery manufacturers accomplished an export value of about 565 million USD, targeting increase of up to 40.84% with respect to 2005. This effect decreased European shares significantly as the overall 2006 export sum up to 1.5 billion, half of the 2.7 billion Euro turnover generated by ACIMIT members, to mention a concrete example. In such a scenario, the close collaboration in the field of research and technological development at European level obtained through the NU-WAVE initiative promises a clear win-win situation for the competitiveness of the SMEs of both sectors, largely represented by the participating SMEs. In fact Euratex, having as members all the main European National Textile Associations, represents the entire population of EU-27 textile SMEs as ACIMIT represents one of the main textile machinery production countries in Europe.

The NU-Wave Project developed the necessary Scientific and Technical knowledge to efficiently address key issues and opportunities for a sustainable and high added value textile production through novel, operator friendly and resource efficient machines and equipment.

The potential impact of the NU-WAVE results on the SMEs represented in the proposal is indeed significant and will deliver benefits spanning increased knowledge and value in products, improved quality and productivity, essentially heightened productivity. The commitment and conviction of the SME AGs in disseminating the results of this project among its SME members and ensuring the uptake of the NU-WAVE Collaborative platform, will have a clear strategic and competitive impact for the SMEs:
Enabling a shift towards a knowledge-based design approach in new machine development, it is worth highlighting that the Manutex roadmapping exercise and the drawing up exercise of this proposal has already increased the knowledge base of the SMEs represented in this project via in-depth discussions on the project objectives. The work programme, as well as potential benefits of the project, will provide collaborative opportunities for SME’s and research organisations with different degrees of expertise and will thus serve to increase the know-how and technological skills of these SMEs. Already the SME AGs that form part of this consortium have been very active in mobilising interest for this project among their members and key SMEs from each have contributed invaluable input to the authors of this proposal in terms of information on the sector, their needs and expectations in terms of machine and new applications, as well as making sure that the project and workplan, even from a conceptual stage is in line with the medium term development routes of the textile machine and broader textile markets and sector realities;

In terms of improving the competitiveness of European SMEs involved both in the manufacturing of added value textiles and production of advanced machines, the widespread uptake of the Collaborative platform will provide them with a cost effective, practical and easy to use means of ensuring that their engineers have structured and systemic access to all the potential information that they could require about the equipment and machinery that they have to develop or upgrade. Ready and immediate access to technical information will lead to more knowledgeable professionals who will: save on time for trials and errors approaches while being more innovative. This will undoubtedly lead to more satisfied textile end-users, which will foment good industrial relations and sustainability, which will in turn lead to profitability and higher added value post sale services in a win-win relationship to increase competitiveness against low quality imports.

The visibility of the latest technological achievements in a number of areas and sectors and the appropriate management techniques on an easily accessible platform, together with the trans-nationality of services offered, will naturally allow an SME driven exchange of knowledge/goods/technology in a broad European context.

Quantified benefits for the SME AGs

The services associated with the NU-WAVE Collaborative Platform deployed through SME AGs portals have a significant impact on all production stages along the textile filiere and will therefore enable the broad EU Textile Sector to increase its competitiveness and improve its position in the global market. According to preliminary estimates by Euratex and ACIMIT within the framework of the MANUTEX initiative, an initial target market for the web tools resulting as project outcome, namely the Collaborative Platform, comprises 500 SMEs in the enlarged Europe, with a turnover of over 5 billion Euros. The SME AGs involved claim that the successful execution of the NU-Wave project will lead to a total economic impact in the medium term to be in the region of 25 million Euros/annum estimating that each of these SMEs invests up to 0,5% of their turnover to daily use the NU-Wave web tools as part of their innovation strategy. Considering the typical relationship between cost for web service development and additional investment for service deployment (roughly 35% including management and infrastructure integration) as well as economy of scale occurring after service start-up, it is forecasted that a price will be between 2500 and 10000 Euro in the medium term per SME, depending on their size. These assumptions are also based on latest predictions that web services demand will grow from 21 billion USD in 2007 to 184 billion USD in the next decade, only for US. A return of 125 million Euros is predicted within 5 years of termination of the project, giving a return on investment ratio of 1:42 over that 5-year period (the investment considered is less than 3 million Euros).
The expected outcome demonstrates a clear economic impact for the SME-AGs and the sectors concerned. The overall expected impact fully justify the investment in the project by the European Commission and SME AGs, demonstrating the sustainability of a business model in which SME AGs run Web services based on the NU-WAVE outcome and maintain the Web-portal, while SMEs subscribe to the service to profit from more effective 'New Product Development' and continuous improvement approaches.

Quantified benefits for the participating SMEs
The direct economic benefits of the project originate from the exploitation of the new machines and equipment concepts enabled by the knowledge and methods that will be developed in the framework of NU-WAVE. The participating SMEs (COMEZ, GIUSSANI, NAVETA and INVENT) will have a time advantage in their role of participants into the project, driving the research work towards their specific needs and features.

Invent, Germany, Composite components producer: Enlargement of products portfolio. Invent is already active in several sectors that are currently exploiting the composites, first of all railways, aeronautics and defence. The possibility of entering a new market, potentially characterized by high demand is crucial for INVENT future industrial and commercial progresses.

Every machine has a minimum of 8 to a maximum of 20 bars mounted and COMEZ expect to sell 70 to 80 machines per year, this mean a production boost for INVENT of 1000 to 1400 composite high value parts per year.

Comez, Italy, Machine producer: Bringing innovation to the market. Comez will launch on the market a very revolutionary machine that will induce several savings to customers. This will potentially bring to the increase of COMEZ market share, in the worldwide scenario of knitting machine and will represent a clear added value with respect to traditional machines of competitors, especially from Far east and China. The trademark of COMEZ will also gain in prestige, being synonymous of technology enhancements. A single machine can cost between 50.000 to 90.000 Euros, the expected increase of machines sold, for the first years, is of +10%, this mean a turnover of 5,4M Euros in the short term, related to Nu-Wave sales.

NAVETA, Czech Rep., Innovative testing desk: Innovative testing. Thanks to the developed technology, Naveta could be directly involved in textile machinery development projects, as support to production and testing of consumable components. Nu-Wave represented for NAVETA a very good opportunity to develop the basic knowledge needed to create the wear resistance testing desk.

The next step is a complete run of tests with the new desk, and an evidence of its importance for textile machinery development: the 'test the tester' experience will be useful to fine tuning the demonstrator and make it, as well as COMEZ demonstrator, suitable for the market. The revenues of selling this new stand or the subcontracted future wear resistance testing activities from market players will increase the overall turnover of an expected 12% in two years.
Nu-Wave represented an enormous potential for innovation, since GIUSSANI developed an innovative real-time monitoring system for Dyeing machines. Main benefits are mostly connected with the possibility to effectively set up a modular and fast-reconfigurable dyeing process, optimizing process performances as well as materials consumption through real-time monitoring of process parameters. The environmental impact of the machine will be also decreased, thanks to the decreasing of exhausted water pollution. GIUSSANI will be able to sell integrated dyeing systems, increasing the firm's appeal thanks to improved environmental sustainability and efficiency of the machines. Real-time monitoring system can be also sold as standalone device to customers in the textile dyeing sector, to be integrated into existing machines without the need of huge investments: this will represent for GIUSSANI a new niche in this market. GIUSSANI expects an increase of turnover of about 10% in 3 years.

European dimension and social objectives
The Nu-Wave project has brought to the market the innovations developed by the consortium, already appreciated by the experts of the sectors. The project showed that a possible great step forward on textile machinery is possible and Europe is today still the leader of the sector.

The objectives of Nu-Wave could only be addressed at a European level rather than at national/regional/private level because of the geographical dispersion within EU of the technological expertise and know-how needed to achieve the project objectives. Italy, Germany and Czech Republic have a long textile and textile machinery tradition and only those countries, together, could really give a boost to the innovation. The intended transnational approach will allow companies from different European Countries to exchange information about novel technologies and best practices. The impact of this transnational project was therefore expected to be greater and more cost-effective than the sum of smaller national projects. The Nu-Wave project has been an opportunity for the SME proposers to go on with their trans-national and complementary cooperation among themselves and the European RTD performers, guaranteeing an effective approach to problem solving and having therefore a greater impact than national projects. Through the partnership established in this project, 4 European SMEs had the opportunity to work together which otherwise would not have been possible due to their geographical split. The project contributed to EU policies concerning the European Research Area as it supported a supply chain oriented consortium of SMEs active in the field of textiles and textile machinery to respond to the pressures for continuous innovation and technological adaptations to stay competitive in the global market, providing a scientific base for future norms and standards which prevents imports of goods from low cost labour countries.

The leading role of Europe has been further on supported by Nu-Wave results and demonstrators and, as evidence of that, a list of the expected new patents possibly arising from the project is here reported:
- Machine components - design and production method;
- Carbon fiber braiding;
- Surface treatment/coating on metals.
- Actuation system - design and production method;
- Control algorithm.
- Knitting machine - design and production method;
Application of the new concepts to other machines.
Application of the new concepts to other machines.

Put all together, this will define a new gap with emerging countries, especially with Far East and China.

The new opportunities for skilled workers, both in electronics and textile, coming from the machine market entering is completely in line with the European policy of ‘Green jobs: Europe’s environmental and economic future’.

The great saving in costs and the reduction energy consumption will also contribute in stopping the need for re-locating textile production outside Europe.

Steps to bring about the impact
Several improvements have been induced by Nu-Wave activities, from an increased sustainability of the textile processes to a positive societal effect, to an economic boost of European industry.

All those are expected to reach higher and higher targets according to the proposed future scheme for implementation, organized in following levels:
- Short-term level: the future development actions should be completed by one end-user, so that they will immediately experience the potential of Nu-Wave innovative machinery and give to the market an evidence by direct measurements on the field;
- Medium-term level: at the beginning, Nu-Wave demonstrators and tools will be industrialized and/or optimized to be adopted by the main target textile sector, and this would bring to the extension of the benefits potentially to the whole textile machinery sector;
- Long-term level: Nu-Wave is based on an innovation methodology that is potentially applicable to build a complete new generation of machines, thus there is the possibility of releasing dedicated optimization for other textile sectors with slight efforts. In the medium/long term objective, Nu-Wave enhancements, tools and methodology could be proposed for all textile machinery fields, from spinning to finishing.

The partners foresee that a time to market of about 12 months will be needed in order to further develop the technology from the level of a product-like prototype, to the full industrial scale. Industrialisation activities as well as production capacities building will be needed in order to be able to bring the intended product to the market.

The primary commercial exploitation routes for the output of Nu-Wave will be the fashion textile sector, but the scope is to enlarge the possible range of application, towards the high tech textile sector. Thanks to the strong commitment of partners and their capability to directly address customers in Europe and worldwide, results can in fact directly be implemented into products/services. The process for addressing the market has been organised during the project in four future phases:

I. During the first phase, the consortium will perform a deep market investigation and survey. This activity has the scope of collecting all relevant updated information to be eventually integrated in the achieved technical enhancement. In this phase will be evaluated the needs and requests from the main target sector and from other potential industrial environment. In particular technical and safety directives will be taken into account;
II. Second step, the consortium will further develop the Nu-Wave demonstrators into industrial machines
II. Second step, the consortium will further develop the Nu-Wave demonstrators into industrial machines ready to be fully exploitable. As stated in the Nu-Wave, the partners have the capability of carrying out such additional development that will mainly consist in the optimisation of the modules and in performing the industrialisation.

III. In parallel with the second phase, a first industrial version of the machine will be used by selected end users, in their production facilities works. This will build up a consistent and large record of successful application of the system and also generate the first revenues from the use of the machines. During this phase the IPR holders will be update the original business plan and the Economic Impact Assessment, including market analysis and sales forecast.

IV. The final aim is to start the commercialisation of the system within two years (possibly earlier) after the end of the Nu-Wave project. As a deep experience on the field is needed to push the new system on the market, partners will provide training and demonstration to potential users in the reference market.

List of Websites:
http://www.nu-wave.eu

Related documents

Last update: 17 June 2013
Record number: 58283