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Project Acronym: DEMOULTRAGRIP

Project Full Name: Implementation of high-grip designing tools

PERIODIC REPORT 1
PUBLISHABLE SUMMARY

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Publishable Summary

Summary description of project context and objectives

Currently, sole manufacturers design their models to be anti-slip using basic design criteria, often relying on their intuition and previous experience. The problem resides in the lack of design tools that can be used in the conception of footwear, Because of this situation, ULTRAGRIP project (FP7-SME-2010-1.262413) developed guidelines and specific software which can be used as design tools for soles and floorings to optimise their performance in relation to slipping. Two of the main results from ULTRAGRIP project are a slip behaviour predicting software (mathematical model), and guidelines for recommendations on improving products slip resistance.

ULTRAGRIP Consortium has the need to carry out demonstration activities in order to ensure that the ULTRAGRIP tools are ready and suitable for exploitation and commercialisation. As a consequence of this situation, the objective of this DEMOULTRAGRIP project is to bridge the gap between the precompetitive tools of ULTRAGRIP and a new version of these tools which can be commercialised.

According to this objective, new commercial tools will be put into market. With DEMO-ULTRAGRIP project the footwear SMEs involved will obtain a competitive advantage based on the use of the new design tools to develop high slip resistance products, accelerating the designing-prototyping operation, reducing prototyping and production costs, improving the anti-slip product properties, and reducing time-to-market. All these aspects will imply the increase of market share and the increase of designers' qualification.

Description of work performed and main results

DEMOULTRAGRIP project work is developed in different work packages as shown in the following diagramme:

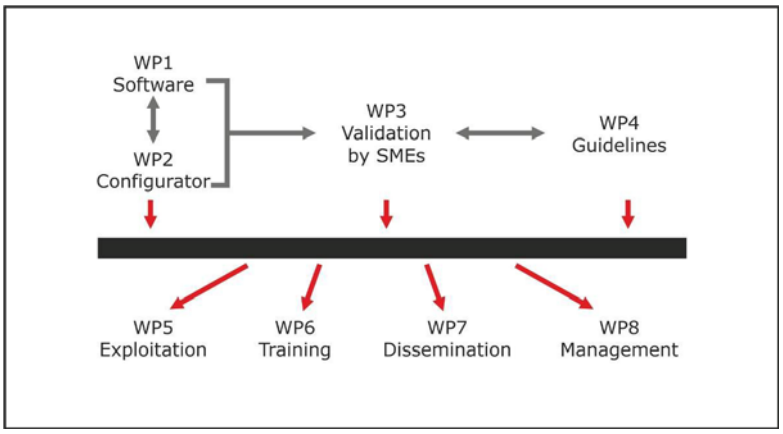

Figure 1 : Technical Work Breakdown WP Structure

Said work packages follow the logical phases of the implementation of the project, and each one includes specific tasks. Interdependency among WPs is shown in following figure:

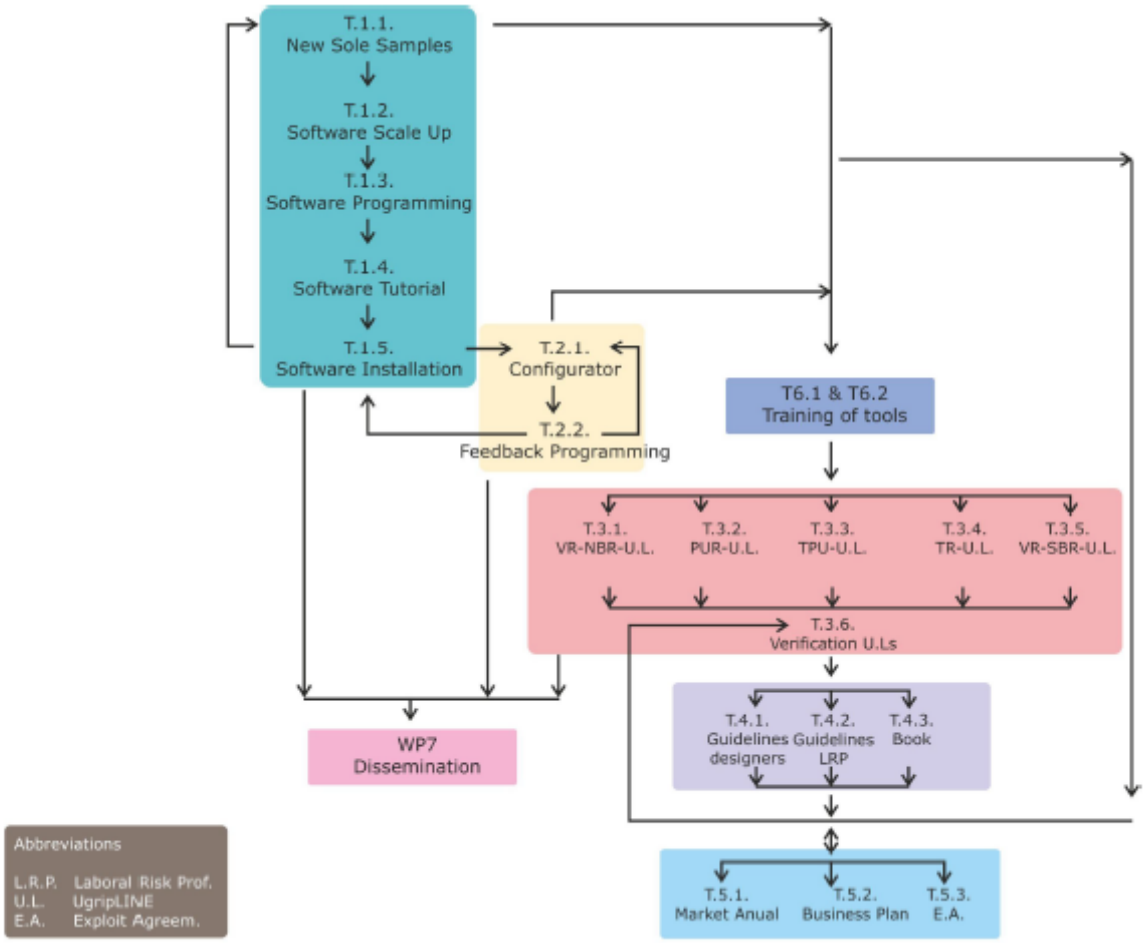

Figure 2 : Activities work flow.

A description of the work performed since the beginning of the project and main results achieved during the first reporting period (M9) are detailed below:

PROTOTYPE VERSION FOR MATHEMATICAL MODELS USED FOR CoF PREDICTION

As it was foreseen in the work plan, all project partners related to the footwear sector have contributed to the sample collection task – coordinated by INCDTP – providing samples of sole units or sole materials for the scale-up of ULTRAGRIP CoF prediction mathematical models.

Needless to say that the more soles are subjected to study, the better the prediction power of the mathematical models. Furthermore, with the addition of the new sole-footwear materials (VR-NBR, VR-SBR, PUR, TR and TPU) the predictive models will cover 85% of materials for footwear soles.

In total, 593 samples of different materials were collected and around one third of said samples were selected for the execution of the first phase of the mathematical modelling trials. Consequently, 195 samples were characterised and subject to testing.

Slip tests have been performed by INESCOP in accordance with the standard UNE EN-ISO 13287:2012, so as to recalculate the new polynomial functions and thus improve the CoF prediction.

Figure 3 : Images of experimental phase
Figure 3.1 : Slip testing
Figure 3.2 : Detail of a sole sample being tested

The mathematical models obtained from the experimental trials are the basis for the Coefficient of Friction Prediction Software developed in the project. The more accurate the prediction, the better the results obtained when using these tools for the design of shoe soles.

In accordance with EN-ISO 13287 standard, the CoF uncertainty value should be 10%. In this sense, although low values have been obtained as a result of the trials carried out, the mathematical model will be recalculated and optimised during the second period of the project so as to further improve the prediction power of the tool (aiming at a maximum uncertainty value of 15%).

In total, data from 274 slip tests (in accordance with UNE EN- ISO13287:2012 standard) have been used for the mathematical modelling. Furthermore, all samples collected were subject to a comprehensive characterization (polymeric nature, hardness, cleat height and contact surface) and tested (in accordance with the different test modes: flat slip, heel slip and forepart slip).

PROTOTYPE VERSION FOR CoF PREDICTIVE SOFTWARE

INESCOP is developing the mathematical models using a software tool, already used in ULTRAGRIP project. The tool instances are adapted to the modelling needs for the estimation of the CoF. Using this tool, the coefficients linked to each model parameter will be recalculated in the polynomial functions, as well as the scope of action of each polynomial according to the input parameters.

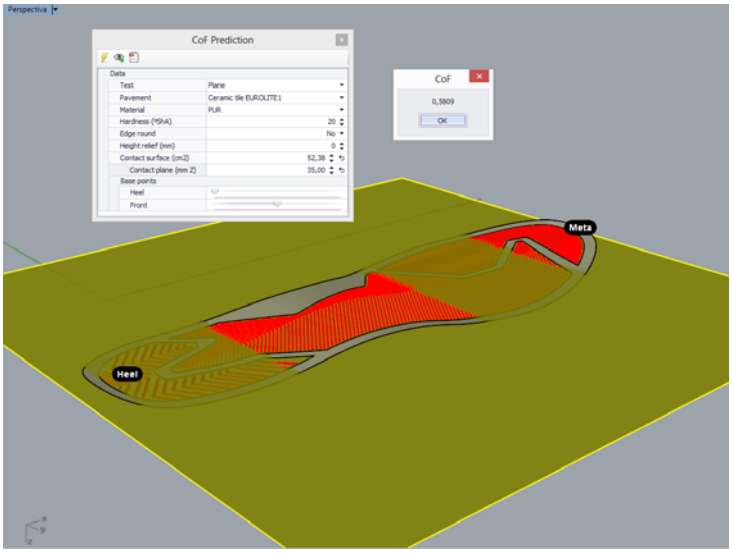

Figure 4 : Flat slip COF (The user can run the CoF calculation tool and the contact area with the ground surface will be automatically calculated).

Main conclusions drawn from the development of the CoF predictive software can be summarized by saying that this tool performs parameterization of mathematical CoF prediction models developed in this project, allowing the dynamic interaction with the user for the calculation of CoF. This software provides the user with the tools necessary to design a sole tread pattern and set some input parameters that will allow defining the area of contact with the ground surface and calculating the corresponding CoF, for each type of slip tests in accordance with applicable standards. Furthermore, the system makes it possible to dynamically modify the tread surface of the sole and thus, proceed to automatically re-calculate the CoF of the designed model.

The main objective is to provide a tool that covers a wider range of possible shoe sole designs. Therefore, the system makes it possible to dynamically modify the tread surface of the sole and thus, automatically re-calculate the CoF of the designed models.

The CoF predicted results from the simulation of slip tests will be reported in a pdf document that will include information on applicable standards or any other data that may be considered useful for the manufacturer, in particular regarding technical specifications derived from the CoF calculation software.

The software application that allows predicting the Coefficient of Friction (CoF) is built in INESCOP's sole design software (Icad3DP). In particular, it is available within the tool for sole parametric design.

In M12 with the beta version and the samples gathered during the first period, the initial pre-validation will begin as well as the comparison between experimental&CAD data.

PROTOTYPE VERSION OF CONFIGURATORS WITH CoF PREDICTOR

The sole designing configurator in DEMOULTRAGRIP project will allow the assessment of changes in the soles' coefficient of friction, in a qualitative way, when a given change is made in their tread pattern design or in their material. Three different versions of this configurator are being developed in Work Package 2: a web site platform with free on-line access, a table design device, and a configurator version for PC tablet.

It has always been considered that these tools are planned to be used by people who do not have the necessary skills and knowledge to manage them. Therefore, creating a version of configurators as easy and simple as possible has been a development priority.

The functionalities available in the current version of the configurator are: a database and entering data, 2D user interface, 3D modeling, 2D textures and cleat patterns, Materials creation, Materials lists and tags, Model parts soles configuration.

During the first 9 months of the project, efforts were focused on analyzing the importance of the sole in the design of the whole shoe. In this sense, 3D technologies were used to provide a high level of detail and accuracy to the designed sole. The selection of the most suitable techniques for the design of the tread pattern, its geometry and the integration of the cleats involved greater dedication and effort. The calculation of the contact area and CoF is considered in the prototype version and will be functional in the beta version of the software.

Figure 5 : Screenshot of sole design with the configurator prototype version

ULTRAGRIP LINE

The four footwear SMEs in the Consortium will design their soles with anti-slip properties using the software tools developed in the project, and manufacture prototypes of non-slip soles-footwear models (ULTRAGRIP-LINE sole-footwear models) of different sole polymeric nature and different intended uses.

GUIDELINES WITH COMMERCIAL APPLICATIONS

Project partners are working on bridging the gap between the recommendations and guidelines obtained as a result of ULTRAGRIP project, to obtain several commercial versions of these guidelines addressed to different types of final users. In particular, they are addressed to footwear-sole designers, businessmen and risk prevention responsible persons.

EXPLOITATION

As regards exploitation, a market study for DEMOULTRAGRIP products was prepared by a specialised company, with the cooperation of all project partners. In addition, a patent an novelty search and a plan of knowledge transfer were developed in view of the specific exploitation agreement among partners, so as to anticipate the path to successful commercialization of project results.

The above-mentioned Market Analysis was made in order to maintain relevant and timely information for the business plans and detect any shift on the market or industry trends. This document, also includes a strategic conclusion for every business case.

DISSEMINATION

All Consortium members have participated in project dissemination and contributed to the preparation of dissemination materials.

With the objective of facilitating the take-up of results showing their added value not only to the SMEs directly participating to the project but also to other European companies which can be interested to them, the following dissemination activities were performed during the period:

- Creation of DEMOULTRAGRIP website (www.demoultragrip.eu). In order to attract a wide range of public to the web, most of its contents are public. Project partners have access to confidential information in the private area.
- Social media (available in Web): A YouTube channel, Google plus page, Facebook page and a Wikipedia page have been created for improved dissemination.
- Preparation of dissemination materials: posters and brochures (available in Web and Facebook)
- Dissemination of project objectives and activities by project partners to their respective customers and in fairs and exhibitions.

Expected final results and potential impacts

The expected final results for the project are listed below:

- "CoF predicting-CAD software", with mathematical models for the quantitative prediction of the sole friction coeficient (CoF). It has been incorporated as a new function into a 3D CAD sole design.
- "Design configurators of soles": new software tool to design soles and to predict their slipping behaviour in a qualitative way. This configurator will be addressed to the general public with not necessarily a high skill level in 3D CAD software. At present, they are in prototype version, in M13 (October 2014) it will be made available in beta version for validation.
- "Computer tools assessment": new soles-footwear model with optimum grip behaviour (ULTRAGRIP LINE) by using both types of computer tools: CoF predicting-CAD software and on-line configurator. At present the prototype version is available, in M13, (October 2014) the web and tablet applications will be made available online in beta version for free validation by general public. The table design is in the same state of development and will be validated by RUIZ ALEJOS.

- “Five ULTRAGRIP LINE sole-footwear models developed of different sole polymeric nature and different types of uses: high, medium and low requirement levels corresponding to professional use, leisure use and home-comfort use, manufactured with the most frequently used sole polymeric materials in the footwear sector (VR-NBR, VR-SBR, PUR, TR and TPU). Their design will start in M13 (October 2014) with the software validation.
- "Guidelines with commercial applications": especially addressed to three different kind of end users: sole-footwear designers, businessmen and risk prevention professionals. The guidelines are being drafted.
- “Book about slip resistance footwear” with a compilation of all know-how regarding slipping and all new knowledge from ULTRAGRIP and DEMOULTRAGRIP results. This book will constitute a master document regarding grip in footwear sector. At present, effort is focused on Know-how compilation and selection of contents.
- “Exploitation-Business plan” with a detailed economic analysis for the commercialization of the new products will be developed. The data from the market analysis will be essential to elaborate this business plan: the expected market volume, which additional quantity the final users are willing to pay for the new products that have similar characteristics than others, market segment profile, the impact of the added value of the products (good grip behaviour) in the projection of a better company public image, etc. In the first period of the project, a patent search, market analysis and filling of patents document were prepared.

Main impact will be related to the European SMEs working in the footwear industry due to the fact that the global market competition demands extreme flexibility and speed in production to meet the high customization needs of customers. The members of the consortium are characterized by the adoption and promotion of strategies to enhance their products and reach new niche market segments. This project will have a significant effect on the ability of SMEs to remain competitive and enhance their presence in the global market.

Footwear SMEs in the consortium are aware of the need to differentiate their products from those imported from low wage countries by means of the addition of slip resistance attributes that such imported products do not feature. The innovation aspect is related to the enhanced anti-slip properties of professional footwear applied to other types of footwear, such as sports shoes, leisure, casual, etc. Moreover, the footwear industry demands integrated design and production process innovation in order to reduce the *time-to-market* and the production costs, and to increase product diversification in conjunction with small batch production, and high fashion content as well as product quality.

Performance **economic indicators** of the impact on participating footwear SMEs (RUIZALEJOS, BASEPRO, KOPITARNA and INCDTP) are:

- *Reduction in time* for *prototyping*: 12 days instead of 55 days.
- *Reduction in prototyping costs*: This will mean an indicator of 33% or 67%. More drastic scenario has been considered (67%).
- *Reduction in production costs*:
- *Product quality*: the design tools developed will imply a final increase in anti-slipping performance of products.
- Overall *time-to-market*: 57 days instead of 100 days.
- *Market share*: Higher level of satisfaction for consumers.
- *New skills*: a knock-on effect over young people and designers.

Innovation impacts of DEMOULTRAGRIP are explained about the commercial tools available after the development of the project are directly applied in the footwear sector. The guidelines are intended to help designers obtain prototypes faster and in a more effective way, and to help the suitable selection of the footwear in different use environments.

Furthermore, the project will also provide other potential social impacts, such as:

- Adoption of new sole design criteria to obtain products with higher level and *durability of grip properties*.
- Adoption of new sole design criteria to obtain *bespoke products* for different applications.
- Adoption of new *sole design criteria* to obtain PPEs (Personal Protective Equipment, such as safety footwear) with a higher level risk protection regarding slipping properties.
- Adoption of new sole design *criteria* for a better *selection of safety footwear* in the different professional environments, which require different levels of risk protection, always regarding slipping properties.
- Development of *new sole-shoe models with better grip performance* (ULTRAGRIP LINE, comprised by four different sole-footwear models).
- Increased number of orders, due to a *higher level of satisfaction of consumers* and shorter time to market.
- *Better production flexibility*, since the developed design tools do not imply style design limitations.
- Better differentiation of *European products* from those imported from low wage countries by means of the addition of the slip resistance attribute that such imported products do not incorporate.
- Possibility to maintain *production in the country of origin*, without the need of delocalization.
- Ability to put into market new *software tools* for improving the grip performance of footwear.
- To give sole *design options* to all workers-profiles in the footwear sector (high and low skill levels in 3D CAD software).
- To promote the *introduction of young people* in this manufacturing sector, as they are attracted by the presence of new technologies and tools.

At present, there is a growing interest in the application of requirements from Expert Technical Committees, which support the performance of final products, such as CEN/TC 309 “Footwear”, the European Standardisation Committee for Footwear products. In the case of footwear, technical specifications recommended in Technical Reports are considered, in particular, Technical Report ISO/TR 20880:2007 (Footwear. Performance requirements for components for footwear. Outsoles), which deals with the determination of slip resistance for different types of footwear: sports, children’s, casual, women’s or men’s town footwear, fashion, cold environments and home wear. Said requirements are used as a reference for footwear providers and manufacturers.
Furthermore, experts are now working on the development of standards that determine the minimum requirements applicable to children’s footwear. Within this context, the working group on “Children’s Footwear Safety” – promoted by INESCOP – is considering the addition of anti-slip properties to this type of footwear, due to the fact that this is directly related to the safety of children as they allow for the prevention of falls due to slipping (http://pequelia.es/98436/nuevo-grupo-de-trabajo-para-la-seguridad-del-calzado-infantil/; http://www.diarioinformacion.com/elda/2014/04/11/inescop-promueve-desarrollo-normas-seguridad/1490179.html).