PART 2: PROGRAMME PROJECT INFORMATION

2.1. Project No. 6

Title	***Processing of metal surfaces to lower friction and wear***	
Project leader's name, surname	Karlis Agris Gross	
Degree	PhD	
Institution	Riga Technical University	
Position	Assoc. Prof./ lead researcher	
Contacts	*Phone number*	+371 2020 8554
	E-mail	kgross@rtu.lv

2.2. Tasks and deliverables

(List all tasks and deliverables that were planned for reporting period, list responsible partner organizations, give status, e.g. delivered/not delivered)

Target: ***Develop a methodology and criteria for optimization of metallic material properties to improve the surface treatment and coating to reduce friction and wear of friction pairs including interaction with metal surfaces and ice.***

Time frame for the core tasks is given in Annexes 6-A.

Nr.	Tasks	Deliverable	Responsible partner	Status
1	Develop a method for measuring slip under laboratory conditions	Report (method) 31.12.2015.	K.A. Gross, Biomaterials research laboratory, RTU	In progress
2	Develop a method for determining the slip under real track conditions, in comparison with laboratory equipment	Report (method) 30.06.2017.	K.A. Gross, Biomaterials research laboratory, RTU	In beginning
3	Optimise metal surface for increased gliding on ice	Report 30.06.2017.	K.A. Gross, Biomaterials research laboratory, RTU	In progress
4	Determine the relationship of gliding between the metal surfaces and ice (report)	Report 30.09.2017.	K.A. Gross, Biomaterials research laboratory, RTU	In progress
5	A recommendation for a modification of metal surface to improve gliding in track conditions, application of the materia	Report 30.12.2017.	K.A. Gross, Biomaterials research laboratory, RTU	In beginning

In case of non-fulfillment provide justification and describe further steps planned to achieve set targets and results

The planned task of the Project 6 „ Processing of metal surfaces to lower friction and wear" were fully achieved in the reporting period from 01.11.2014 till 31.03.2015. The first phase of work has given valuable screening results that will be evaluated in more detail. This will allow more accurate assessment of sliding metal on ice.

2.3. Description of gained scientific results

(Describe scientific results achieved during reporting period, give their scientific importance)

The first phase of the project has been completed. A measuring device, equipped with a number of high-precision optical sensors, has been created and will provide precise information about the material sliding speed in different sections of the route. This is a very important starting point to optimize the metal surface and determine the effect of modification on the sliding ability of metal samples.

The first phase of the project involves the development of the climate simulator. In cooperation with the Faculty of Building and Civil Engineering at RTU, the Energy Performance of Buildings simulator microclimate camera will be modified to operate at low temperatures (as low as -10°C). Setting and maintaining a temperature is important because the ice temperature is highly influenced by gliding.

The conference Innovation 2014, on November 4, 2014, in London, provided non-traditional ways of thinking. The main point taken from the visit is to abandon the traditional way of thinking and to change the properties of the metal surface by quickly applying the coating. An alternative approach is to pay particular attention to the surface, thereby improving the sliding.

Tasks for Period 1	Main results
Develop testing apparatus (simulation of bobsled track) and software to detect movement of the sample at a certain angle	Laboratory track development
To verify how the sliding ability of the metallic surface responds to different treatment methods, an experimental apparatus or slip stand must be developed to measure metallic slip properties on different surfaces. This is the first phase of the project. The resulting apparatus consists of sloped planes (with different inclination angles, an adjustable U-shaped aluminium profile, and an iced surface). Four retro-reflective optical sensors will ensure a fixed distance for sliding of a metallic specimen from the top of the slope to the bottom of the slope. The four optical sensors will provide detailed information about the sliding process of the sample. The sensors will be placed at intervals (one on each end of the inclined plane and two between the end sensors) to provide information on average speed and acceleration of the inclined plane at three stages - at the beginning, the middle and the end. To collect and properly assess the signals generated by the optical sensors, a circuit consisting of a data collection module was developed. This module operates on a 24V DC signal, which powers the optical sensors and signal converter, and sends the signals to a computer. A data processing program, automatically converts the information from the sensors into examinable values of the sample speed. The slip stand actuators provide a time measurement with an accuracy of 0.01s.	

The data processing program will ensure a shorter calculation time period allowing a greater number of experimental runs, which will provide statistically reliable data. The slip stand assembly is designed so that the plane tilt, the size of the sample, and the applied force can be varied. The possibility to change all the above parameters provides great opportunities to simulate a variety of real life situations.

The operation slip stand has been tested using a metallic inclined plane (stainless steel base), which showed successful results as the test ran smoothly. In the next tests, the metallic base will be replaced with an ice tray.

2.4. Further research and practical exploitation of the results

(Describe further research activities that are planned, describe possibilities to practically exploit results)

The second phase of the project will be to compare the different surface test methods to find the best method for metal surface analysis. The chosen method will be fast, easy to use, have high accuracy, provide good quality topography and microstructure images. These results will then be used to analyse the metal surface and the impact of modifications on sliding. Meanwhile, work will continue on the first phase of the project, which concerns the development of a laboratory track and a low temperature simulator.

2nd phase tasks:

1. Characterize the metal surface and determine the best test methods (deliverable - scientific publication submitted for publication in a journal).
2. Modify the slip measuring equipment for use in the laboratory, and develop the climate simulator to work at appropriate temperatures (deliverables - anti-slip measuring device which is suitable for custom work in a cold chamber).
3. Modify the metal surface, to determine the slip dependence of the modifications (deliverables - complete report, submitted abstract, and participation in the European Materials Research Society conference).

Problems may arise due to the high number of parameters concerning metal gliding; this may affect the accuracy of the results. To improve the outcome, it is planned to stay in close contact with the bobsled and skeleton federation, ensuring the opinion of experts on the factors that have a greater impact on the metal.

2.5. Dissemination and outreach activities

(Describe activities that were performed during reporting period to disseminate project results)

The Innovate UK 2014 meeting in London, which occurred on November 4, 2014, gave new insight and ideas for metal modification techniques for improving sliding properties.

The abstract "Road safety barriers, the need and influence on road traffic accidents" (Ž Butans, KA Gross, A Gridnevs, E Karzubova) will be submitted to the international conference "Innovative Materials, Structures and Technologies", which will take place in Latvia from 30/09/2015 to 02/10/2015. Conference abstracts will be published as a full-length research paper in the journal open access "IOP Conference Series: Materials Science and Engineering (MSE)".

The project is part of the master's thesis: "Tribological property assessment method of surfaces made with a lower wear and material removal" (author - Jānis

Lungevičs, head - Prof. Jānis Rudzītis), which is expected to be completed in June 2016.

The research article on the characterization of metal surfaces by comparing analytical methods is the 2nd phase of the project which is planned to be published in the journal "Materials and Design" (impact factor 3.1) or the journal "Materials Characterization" (impact factor 1.9).

Project representatives participated in PPP IMATEH meetings (08/10/2014 and 26/05/2015) on the progress and implementation of the project.

Two meetings were held during the first stage of the project (02/10/2014 and 31/10/2014), where project staff and representatives of the profession attended. Project tasks and deliverables were discussed.

The IMATEH website (http://imateh.rtu.lv/) provides information on the activities of the project and current events.