Artificial Intelligence and soft touch solutions for robotics in automotive SMEs

Project title			Artificial Intelligence and soft touch solutions for robotics in automotive SMEs
Project related to the previous concept			
PC No	6	PC title	Robot for grinding/trimming/cutting operations, surface and edge finishing of complex thin layer composite components (Company 1)
	7		Robots for packaging and assembly – easy programmable (Company 2)
	9		Automation of previous operations and later (Company 3)

Kind of project	Area of industrial modernisation covered by the project
[to be decided] Research and development project / Investment project	Robotics & Artificial Intelligence in production processes

Project consortium			
Project leader (company name)	[to be decided]	**Cluster**	
Project partner	COMPANY 1 (Polish SME)	**Cluster**	SAAM
Project partner	COMPANY 2 (Polish SME)	**Cluster**	SAAM
Project partner	COMPANY 3 (Spanish SME)	**Cluster**	CEAGA
Project partner	Some potential technology suppliers identified in Poland and Spain: providing soft touch solutions, quick learning artificial intelligence, etc.	**Cluster**	SAAM, CIAC, CEAGA
Note: Looking for another partner from France/Serbia/Bulgaria to join the project. It could be a SME or a supplier.			

Main issues covered in the project	
Scope	The main aim of the project is to develop a robot workstation that can serve for chaotic picking, cutting, trimming, grinding, drilling operations for small series parts. In general, the companies involved in the project will try to set up a demonstrator appropriate to each specific process. However, the common interest lays in the development of a solution in soft touch operations and quick machine learning by applying new image recognition technologies. The robot has to take into account the specific features of the part that is processed, as such the robot must be able to: • Pick the part (possible chaotic picking) • Identify the part • Select the appropriate soft touch mode • Select the appropriate tool to be used for processing the part • Provide quality control of the processed part • Place the part aside for next production or logistic actions Available image recognition solutions on the market allow to set up learning processes by way of gathering data of over 1.000 images. However, these solutions are not appropriate for small series production or in situations where the parts to be processed have different features.
Building blocks of the solution	1. The robot (Fanuc, Mitsubishi-Electric, Universal Robots): a. Stand-alone robot b. Cartesian robot c. Cobot

	2. Interface (holder for soft touch) between the robot and the gripper 3. Tools: a. Tools fixed on the robot by an operator b. Tools fixed on the robot by the robot (tools selected by the robot) c. Verification of the tool's quality by an operator d. Verification of the tool's quality by the robot 4. Picking and placing activities: a. Picking and placing done by the operator b. Picking and placing done by the robot c. Predefined picking vs. chaotic picking 5. Visual control tools (SICK, CIN Advanced Systems BFA, FESTO, Fanuc, Mitsubishi Electrics, Future Processing): a. Camera b. Laser c. Light 6. Additional infrastructure: a. Racks b. Manipulators c. Transport and logistics 7. Specific issues: a. Problem of particle/dust from grinding b. Problem of residues/waste fractions after cutting
Financial aspects	Cost of final solution per robot station depending on the kind of production process: 600.000 euro – 3.000.000 euro
Staff and competences	• Staff to be trained in industry 4.0 issues to understand the automation process • Staff to be informed about the idea behind the project and consequences for the staff in terms of employment, responsibilities, new competencies to be acquired • Staff to be trained in the final solution
Risk analysis	• Set-up risk ○ High setup cost for each variant of parts ○ No possibility to flexible programme the robot for each operation ○ Every "x" parts the tool must be replaced manually (problem with tool quality control) • Process risk and maintenance issues: ○ Lack of process stability and repeatability for short series processing (lack of feedback methods) ○ Increase of scrap (lower quality performance than in case of work done by an operator) ○ Low resistance for dusts and other particles, intensive maintenance of the robot (dust, etc.) ○ Unstable interaction between robot and parts (pick and place technologies, chaotic picking) • Financial risk ○ High costs of new technologies (quick learning technologies by way of image recognition) ○ High costs of overall investment (taking into account environmental issues) • Scrap ○ Parts' surface/material too sensitive for processing by robots ○ Force of robot not flexibly adjustable to different parts to be processed

Main activities covered in the project	
Pre-project analysis Defining the financial feasibility and the conditions in the company	Steps: 1. Description of the current process in the company 2. Description of the framework conditions, costs and risks related to the current process 3. Analysis of the organisational and financial conditions that define the basic parameters for change 4. Preparation of the financial feasibility report including recommendations concerning: a. Financial aspects b. Technical parameters concerning productivity, quality, flexibility 5. Including the key-information in the project proposal
Pre-project agreement	Steps: 1. Defining the role and responsibilities of the actors in the project (automotive companies, technology suppliers, integrators, research institutions, branch experts) 2. Defining the intellectual property rights issues for the project partners in the consortium 3. Defining the tasks and the budget for each partner in the project 4. Final decision: R&D project or investment project

Project activities	
1. Defining the technology challenges	Steps: 1. Defining the interface for soft touch connected to the gripping tool (drilling, trimming, cutting, grinding operations tailored to the specific surface of the object to be processed) 2. Defining the tool for visual quality control including quick learning and chaotic picking features 3. Defining the process of identifying and setting the appropriate "soft touch" and pressure of the tool on the object's surface Main questions: 1. How to secure the same pressure during the processing of the part in a repeatable way? 2. How to apply 3D vision in quick shape definition for identifying the part and selecting the process? 3. How to secure the part is in the same position before and after the processing operation? 4. How and when the robot knows that the process is performed well and the quality is reached? Solution requirements: 1. User-friendly 2. Intuitive learning 3. Easy programmable 4. Flexible grip technology
2. Defining the scenarios for the robot workstation	Steps: 1. Optional: identification of the technology suppliers (in case these are not part of the consortium) 2. Optional: identification of the integrator (in case he is not part of the consortium) 3. Preparation of the robot workstation scenarios based on different configurations of modules: a. Robot modules b. Soft touch modules c. Vision control modules d. Image recognition technologies 4. Selection of the robot workstation that will be tested as a demonstrator
3. Preparation of the demonstrator	Steps: 1. Building of the demonstrator workstation in the selected companies 2. Selection of the modules by the technology suppliers 3. Preparing the configuration of the selected modules on the demonstrator workstation
4. Implementation of research and development activities on the demonstrator	Steps: 1. Analysis of the picking, handling and placing module 2. Analysis of the soft touch module for the specific processes (cutting, trimming, grinding…) 3. Analysis of quick learning process by image capturing and image recognition technologies 4. Analysis of quality aspects 5. Analysis of productivity aspects 6. Analysis of the scrap and dust capture process 7. Information feedback to technology suppliers 8. Optimisation of the technologies and process solutions
5. Preparation of the technical documentation of the robot workstation and training of employees	Steps: 1. Preparation of the final configuration of the robot workstations 2. Preparation of the technical documentation of the robot workstations and instructions for the operators 3. Training of the employees 4. Round-up meeting of the consortium members, lessons learned, recommendations for the future

Expected results of the project
A robot cell including a robot for grinding/trimming/cutting and chaotic picking/placing operations that is easy programmable by the own employees with acceptable pay-back time taking into account the fact that the robot would be involved in small-series projects.