

REPUBLIC OF SERBIA
MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGICAL DEVELOPMENT

3.1. Business plan
Task 4
Task name: Quality Management
Task description (up to 500 characters with spaces): Major importance will be assigned to implementing an efficient Quality Management which will track activities of the project on different levels. The Quality Assurance within the project will be shared between the Project Management (proper implementation and tracking of the overall project plan, compliance with the contractual obligations, consolidation of KPIs, efficient communication between partners and risk management), the Technical Management (assuring the quality of the technical activities and the technical plan, tracking the technical KPIs and the risks that might put at stake the technical achievements planned for the project) and the Business Management (business deliverables and their quality assurance, tracking of the KPIs geared to economic performance and management of business models. The Quality Management of the project will implement the continuous quality circle: <i>Plan-Do-Check-Act</i> . Special care will be dedicated to managing the interfaces between the different SPs and the roles assigned to safeguard that the full scope of activities will be covered as these interfaces are quality gates which are key to the success of project. A plan of interfaces between SPs will be set up as a prerequisite for Quality Management.
List of results: 4.1. Quality plan identifying quality gates, interfaces between SPs and the critical path 4.2. Periodic Quality Assurance Reports

Subproject title: System Analysis and Conceptualization
Ordinal number of subproject: 2
Month of beginning of subproject (in the interval from 1 to 36): 1
Month of completion of subproject (in the interval from 1 to 36): 6
List of researchers who participate in the project realisation: <ol style="list-style-type: none">1. Aleksandar RODIĆ, IMP, Serbia2. Petar PETROVIĆ, MF, UBG, Serbia3. Stevan STANKOVSKI, FTN, UNS, Serbia4. Xiangrong XU, AHUT, China5. Xinjun LIU, TU, Beijing, China6. Božica A. BOJOVIĆ, MF, UBG, Serbia7. Gordana OSTOJIĆ, FTN, UNS, Serbia8. Zhaodong LIANG, EFORT Co. LTD., China
Subproject description (up to 2000 characters with spaces):

We aim to create: a) SME-Suitable robotic technology, i.e., bimanual and/or dual-armed robotic system that b) assist in managing uncertainty by c) symbiotic Human-Robot-Interaction (HRI) and d) embedded cognition going beyond conventional flexibility (a programmable automation for manufacturing conceptually developed and turned into practice almost half a century ago, and then gradually perfected within the time, but without any substantial change) by e) semantic integration, and very important, f) optimally aligned with present state of the manufacturing industry in Serbia and China. Within this subproject conducted research activities will be focused to produce answers on listed generic research challenges, from (a) to (f), with a general aim to create well defined research and engineering requirements which will result in development and production of the collaborative bimanual or dual-arm robotic system which is truly collaborative, i.e., an industrial humanoid, which in the same time has a sufficient potential for ubiquitous use in Serbian and Chinese manufacturing industry sectors, in particular in manufacturing SMEs. Current knowledge is not sufficient to clearly answer this question. Therefore additional research is required and this research will be focused in two general domains: 1) System analysis of current state of manufacturing sectors in Serbia and China concerning extensive robotization of manufacturing processes (taking into consideration not only technological, but also economic and social aspects / consequences of this process!), and 2) Conceptualization of the new technological entity, an industrial humanoid, or more generally: the Next Generation Technology for Ubiquitous Collaborative Industrial Robotics – UbiCbot Technology as a specific brand created within this bilateral project. Research activities in both domains will be strictly constrained by the capabilities of the available resources in both countries, namely experimental (available laboratory equipment) and manufacturing resources.

Subproject objectives (up to 2000 characters with spaces):

The specific objectives of this subproject is to find a specific answers to the following list of a generic problems / scientific and research challenges, which all together create a set of building blocks for previously described UbiCbot technology:

- a) SME-Suitable robotic technology means that we have to create such a tailor-made robotic system which is technologically compatible with specific needs, culture and challenges of Serbian and Chinese Small and Medium sized Enterprises, operating in manufacturing sectors (food processing, metalworking (including automotive), office and household equipment, furniture and others) and in parallel, sufficiently inexpensive to be affordable for majority of Serbian and Chinese SMEs;
- b) Assist in managing uncertainties means that the developed robotic technology should be able to effectively work in highly unstructured and highly uncertain environment, that constantly changing, which implies a system that have inherent ability for adaptation by autonomous recognition, learning and even autonomous inference (decision making);
- c) Symbiotic human-robot mixed interaction means in this particular context ability of the robotic system to collaborate with human operator, shearing the same working task and the same working space, combining in a symbiotically manner advantages of both, biological and engineered system, that leads to a hybrid system which is capable to productively work in customized manufacturing environment;
- d) The embedded cognition going beyond conventional flexibility means highly

distributed cognition in robotic system populating working environment (reasoning embedded in equipment, based on explicit knowledge), including networking abilities for exchanging knowledge and experience (between human and robots, but also among robots) (IoT) and continuously improving working performances, converging gradually to manufacturing perfection (in fact, dogged learning, that combines learning from demonstration and mixed initiative control to enable lifelong learning for unknown tasks), i.e., cognition for robustness without explicit engineering;

e) Exploitation and enhancement of data/meaning along the IT-chain.

Task 1

Task name: **Identification and System analysis of the current state of manufacturing sectors in Serbia and China**

Task description (up to 500 characters with spaces):

Specific needs, culture and challenges of Serbian and Chinese SMEs, operating in manufacturing sectors in both countries concerning use of robotic technology is mostly unknown. We have just a fragmented and not systemized knowledge. The first task of the Subproject 2 should answer this question in engineering quantitative manner through conducting a dedicated system analysis, which include data collecting process, data mining process, and knowledge generalization. The result will be a system of technical requirements, closely tied with real needs of manufacturing SMEs in both countries concerning robotic technology and related factory automation (SME-Suitable robotic technology). These technical requirements will be an input for the second task of the Subproject 2.

List of results:

- 1.1. Report of the present state of SMEs needs in manufacturing sectors in Serbia and China concerning specific needs for robotic technology
- 1.2. Report on identification of laboratory and manufacturing capabilities in both countries – a level of technology readiness for development and production UbiCbot SME-suitable robotic technology
- 1.3. Specification of technical requirements for UbiCbot SME-suitable robotic technology

Task 2

Task name: **Conceptualization of the UbiCbot technology**

Task description (up to 500 characters with spaces):

Based on the results generated in the Task 1 of the Subproject 2, within the Task 2 of the Subproject 2 will be generated a conceptual framework of the UbiCbot technology, i.e., the industrial humanoid having two arms (bimanual and/or dual-armed) with collaborative ability in SME-specific industrial environment, in fact a new technological entity for building technologically productive and affordable automation in Serbian and Chinese manufacturing SMEs on a ubiquitous basis (pervasive and omnipresent), that will nonlinearly bust competitiveness of the SME companies in both countries, allowing

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them to enter Industry 4.0 technology domain and effectively use it on a regular basis, not as an exception (supporting transformation processes towards digital economy). In parallel, the UbiCbot technology will be created in a way that enable it to become a commercially recognizable Serbian-Chinese market brand (in global scale).

List of results:

- 2.1. Report on conceptual determinants of the UbiCbot SME-suitable robotic technology
- 2.2. Report on identification of the key building blocks of the UbiCbot technology
- 2.3. Specification of the selected, particularly important key deep diving research activities, as well as required development and production resources

Subproject title: **Research & Development of the UbiCbot Technology**

Ordinal number of subproject: **3**

Month of beginning of subproject (in the interval from 1 to 36): **6**

Month of completion of subproject (in the interval from 1 to 36): **30**

List of researchers who participate in the project realisation:

1. Prof. Petar PETROVIĆ, **MFB**,, Serbia
2. Prof. Aleksandar RODIĆ, **IMP**, Serbia (Project coordinator from Serbia)
3. Prof. Stevan STANKOVSKI, **FTN**, , Serbia
4. Prof. Xiangrong XU, **AHUT**, China (Project coordinator from China)
5. Prof. Xinjun LIU, **TSU**, Beijing, China
6. Yongqiang XIAO, **EFORT Co., LTD.**, Wuhu, China
7. All other reserchers from Serbia and China

Subproject description (up to 2000 characters with spaces):

The subproject SP3 is closely linked to the subproject SP2 and assumes generic research and development activities on ubiquitous collaborative robotics in order to establish specific theoretical background for the UbiCbot SME-suitable robotic technology, following requirements defined by the following formal inputs: 1)Report on conceptual determinants of the UbiCbot SME-suitable robotic technology, 2)Report on identification of the key building blocks of the UbiCbot technology, and 3) Specification of the selected, particularly important key deep diving research activities, as well as required development and production resources. This subproject will generate central theoretical and practical contribution for the overall project and should provide scientific and engineering answer to the key hypotheses and related challenges for building UbiCbot SME-suitable robotic technology, highly compatible with basic requirements of the Industry 4.0 concept of modern manufacturing technology. In particular, research and development activities will be guide with following challenges: a) creation of the tailor-made robotic system which is technologically compatible with specific needs, culture and challenges of Serbian and Chinese manufacturing SMEs, b) creation of the robotic technology able to work in highly unstructured and highly uncertain dynamical