



Publishable summary

1.1 Summary Description of the Project Objectives

This project stems from **the innovative idea** to transfer the technologies of bi-manual laparoscopic surgery to the endoluminal surgical approach, thus further reducing the operative trauma and enhancing the therapeutic outcome of minimally invasive surgical procedures. This transfer of technologies is enabled by the incorporation of mature and advanced micro-nano-bio technologies and ICT.

The ultimate goal of ARAKNES is to integrate the advantages of traditional open surgery, laparoscopic surgery (MIS), and robotic surgery into a deeply innovative system for bi-manual, ambulatory, tethered, visible scarless surgery.

In traditional **open surgery**, physical and rigid links exist between the surgeon and the patient's organs. The instruments are hand-held and operated under direct binocular vision.

With the introduction of **laparoscopic techniques**, the direct physical links between the surgeon and the patient's organs are represented by the trocars, which are used for the insertion of different instruments, energised dissection devices and staplers - all having a remote end-effector and proximal actuation i.e., the surgeon's hand.

Surgical tele-operated robots, such as the Da Vinci system¹, are considered an important on-going evolution in minimally invasive surgery because whilst the main features of surgical execution are retained, the actuation of bi-manual tools is remote from the patient and is performed by the surgeon operating from a console.

Finally, in **flexible interventional endoscopy**, the rigid link between the surgeon and the organs becomes progressively weaker as the mechanical constraints are transferred from outside the body (e.g. the hand held device, the instruments inside the trocar, etc.) to lumen of an internal hollow organ.

The system that we are proposing advances the current endoscopic surgical procedures by adding the bi-manual tele-operation equivalent to that of laparoscopic surgical robots.

¹ <http://www.intuitivesurgical.com/>

1.2 Description of the Work Performed in the Fourth Year (plus six Project extension months) and Main Achievements

Based on the original hybrid approach, with a double access through the oesophagus and through the abdomen in a single platform, two platforms have been devised and developed: the **research platform**, preserving the original ARAKNES spirit of an army of modular robots, and **the clinical platform**, based on a bimanual robot (SPRINT) with umbilical access coupled with the external manipulator (Dionis).

The two approaches are sketched in the picture below (Figure 1).

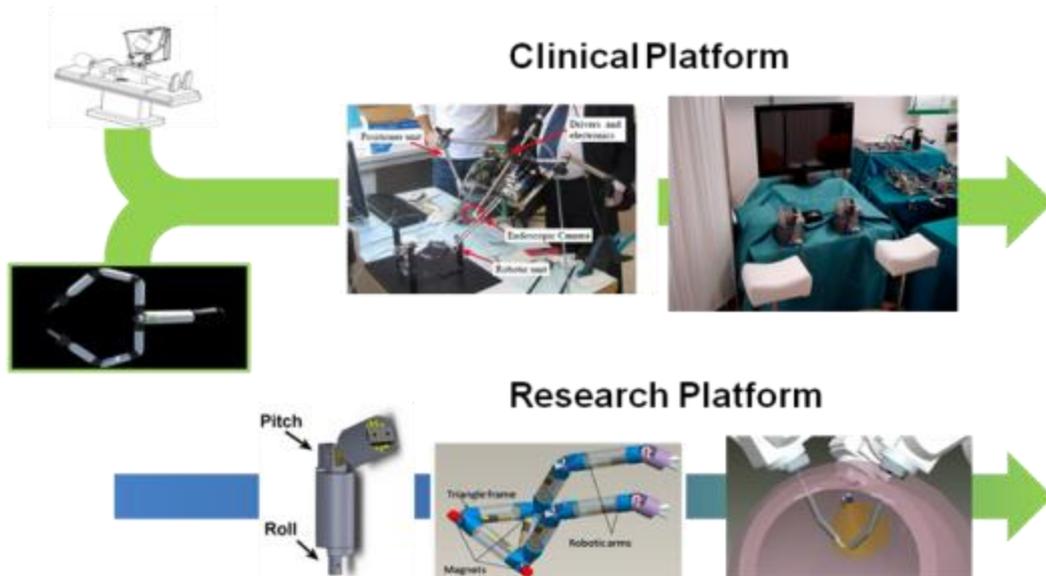


Figure 1: Clinical and research platforms overview.

This strategy for the Project guaranteed the achievement of tangible results combined with a parallel activity of development of very advanced solutions, thus generating exploitable results, clinical interest and scientific knowledge.

The main results obtained by ARAKNES in the last Project year, and more specifically in the last 6 months of extension, can be summarised as follows:

- The final integrated ARAKNES clinical platform (SPRINT+Dionis) has been assembled and validated in *in vitro* and *in vivo* conditions during animal laboratories (under the ARAKNES medical responsibility in Tuebingen) and by organizing simulation/training test sessions in Pisa with many medical doctors (medical doctors with and without robotic experience have been involved in the test sessions).
- The final integrated research ARAKNES platform has been assembled and validated both during animal laboratories and exploiting dedicated test benches designed and realized in the research lab.
- Exploitation efforts have been dedicated to the market analysis of the ARAKNES platform and derivative devices.

The final features of the overall system have been illustrated in the deliverables submitted before the end of the Project and in the current annual report. However, in this published summary the Consortium would like to highlight the important efforts of integration and validation performed in the last months. Some pictures of the main achievements are illustrated in Figure 2.

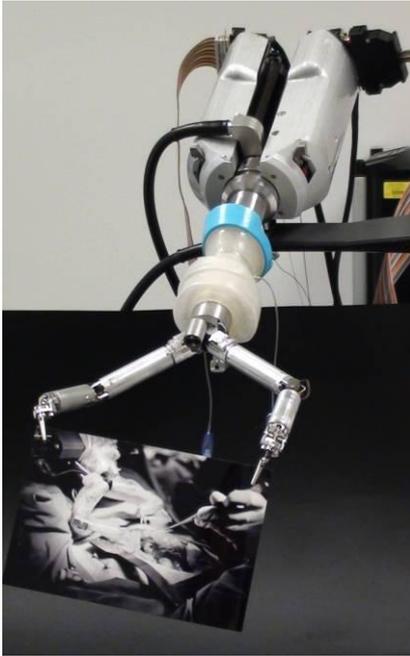


Figure 2: Main achievements of the last 6 months.

1.3 Description of the Main Results of the Fourth Year plus six Project extension months

Based on the project Gantt, updates, details and results about the only 5 active Work Packages have been reported here. Moreover, in the last period of the project, the dissemination phase is fundamental in order to share the ARAKNES results and Consortium experiences with the scientific community. For demonstrating the intense activity of ARAKNES, final figures of this last Project months are reported here:

- Number of published paper with ARAKNES acknowledgments: 15 journal papers and 37 conference papers
- Number of patents: 30
- Number of derivative devices: 4
- Number of lectures on ARAKNES:32
- Number of delivered project brochures: 250

1.4 Expected Impact

The expected impact of ARAKNES is summarized below:

A. Substantial improvement on various aspects of smart systems integration: higher product quality and reliability, increased miniaturisation, integration and functionality, lower costs, reduced power consumption, higher speed requirements and/or shorter time-to market.

B. Transformation of industrial production by adding intelligence to process control and the manufacturing shop floor, and by improving logistics and distribution - thereby increasing productivity.

C. Increased market share for European companies across different industrial sectors by delivering systems with new functional capabilities and improved quality within a competitive timeframe.

All the outcomes of ARAKNES relevantly address one or more of the aspects illustrated in the above three points.

A relevant set of results is related to derivative devices that can be commercialized at the end of the project. These potential products, that can be components of the overall ARAKNES system adapted for different use still related to diagnosis and therapy, can be grouped in the following categories:

- Innovative surgical instruments
- Novel endoluminal vision systems
- Adaptation of Micro- and Nano- devices to a surgical scenario
- Innovative Human Machine Interface
- Array of Robots
- Teleoperation Techniques
- Novel surgical procedures
- Novel procedures/equipment for Computer Aided Surgery

A Board devoted to the Project Exploitation and involving members from Academia and Industry has continuously monitored the field and corrective measurements for maintaining the project competitiveness in the R&D international scenario have been taken time by time.

Following the Project strategy, a deep and careful investigation of possible exploitation of the obtained results has been performed. The ARAKNES consortium has decided to focus its efforts on dealing with business cases for the whole robotic platform and 4 most promising derivative devices (see deliverable D11.8 for details). Thus, the business cases are the following.

- the ARAKNES SPRINT robotic platform;

- Camera (mono and stereo) with magnetic levitation for abdominal surgery;
- Optical system for Endoscopy based on Raman spectroscopy;
- Ischemia electrochemical sensor.

1.5 Promoting Material, Contacts, Web-Site

The project website has been activated within one month from the beginning of the project and it is the following: <http://www.araknes.org/>.

From the downloading area, it is possible for all users to download the public project presentation, the project brochure and the project Logo for an easier dissemination.

The project coordinator of ARAKNES is Prof. Paolo Dario (paolo.dario@sssup.it). The e-mail address for asking more information is info@araknes.org.