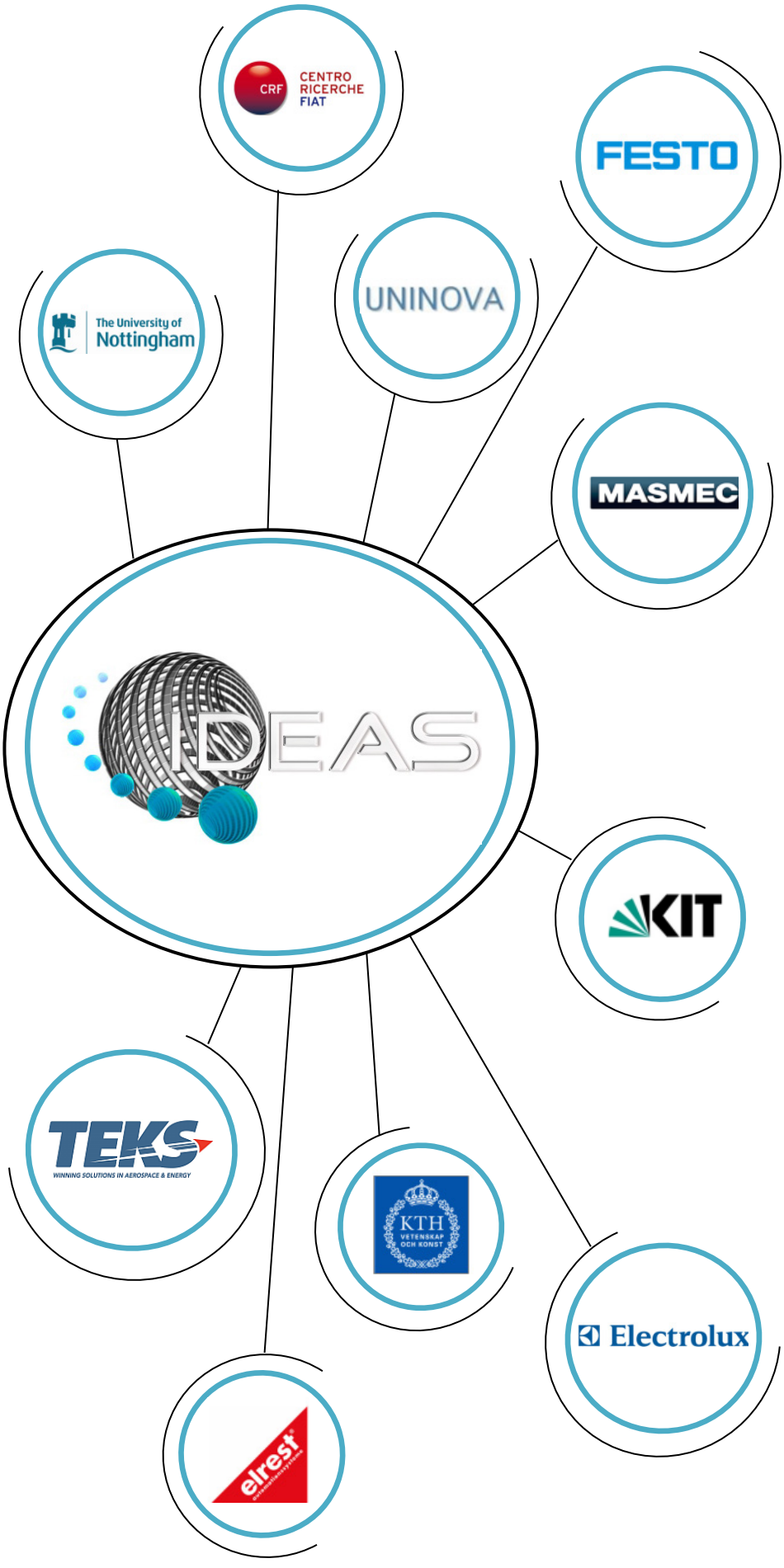
IDEAS Newsletter #2



Editorial

Dear Reader,

We are glad to present you the second issue of the IDEAS newsletter.

IDEAS is a European project funded under the scope of the Seventh Framework Programme (FP7).

In the first year our project has been able to successfully demonstrate the concept of pluggability (change the process unit configuration of the system) within the FESTO assembly system pre-demonstrator. The project implemented a multi-agent system in an existing and enclosed production environment with well-defined interfaces. This early success has now led to the development of two new assembly systems, one for automotive products at MASMEC (Italy) and the other for white goods at KTH (Sweden).

IDEAS has also been selected as an FP7 Success Story. For more information please check the website under http://ec.europa.eu/research/industrial_technologies/success-stories_en.html

Mauro Onori

Contact us

Prof. Mauro Onori, Project Coordinator
onori@iip.kth.se
Christoph Hanisch, Technical Coordinator
dha@de.festo.com

Content

More about the IDEAS Project

A large and growing proportion of European assembly activities are being outsourced to non-EU countries. The EU-funded IDEAS project has now developed a flexible approach to automated production to make assembly in-house more cost effective, particularly for new products and markets. It introduces an entirely new way of developing production systems based on highly automated modules which can be combined as required with no programming or expert knowledge required.

The evolvable assembly system consists of self-configuring, highly adaptive and process-oriented components which shift the technological focus from complex, flexible, multi-purpose systems to simpler, dedicated machine modules with embedded controllers that are maintained by a highly distributed control system. Communication between the modules establishes what functionality is required each time a module is added, activating the pre-programmed code accordingly.

IDEAS has now been applied within a medical testing/production system at FESTO. If the system requires DNA testing, such a module is added. If any other testing is suddenly demanded, only the needed modules are replaced. The time taken is only a few seconds and anyone is able to do it. Other systems are being built for high-variant products such as automotive subassemblies (Engine Control Units) and washing machine components.

The highly flexible and modular IDEAS production system enables small and medium-sized enterprises (SMEs) to invest in automation gradually and without any need for expert knowledge. SMEs can now keep production in-house and eliminate outsourcing. Their product designers will know, from the outset, which design aspects correspond to which production machine component.

This innovative technology will help improve the competitiveness of European SMEs. Companies will not have to train personnel to program and run automation equipment. Moreover, the modules are reusable, so SMEs can lease rather than having to purchase the equipment. The result is a dramatic reduction in costs when automating – allowing for more product variants, shorter time-to-market and the industrialisation of products which cannot be assembled manually.

IDEAS project is one of the eleven projects selected by the European Commission so far since FP6 for the special award of Success Story (figure 1). Please click on the URL for more information: http://ec.europa.eu/research/industrial_technologies/success-stories_en.html

Figure 1: Success stories on the EC website

IDEAS is co-financed by the European Commission DG Research under the 7th Framework Programme

Software Development Tools

The IDEAS project provides a set of decoupled software tools that target the multiple stages of a system. The tools were developed independently following an overarching IDEAS architecture, which provides a clear integration between tools without compromising on the specificities of each tool (figure 2). The MASCOT tool targets the physical system design and equipment module specification. This tool is built on existing state of the art description tools enhancing it with the mechatronic concepts. The tool provides the capability (Skills) of each equipment module to be present in a given system. This information is crucial for the creation of the Mechatronic agents which are able to control the equipment modules, and in turn the whole system. The Agent Configuration tool is responsible for processing this information and deploys the respective agents. This tool provides the ability to deploy in the system Resource Agents and Transport Agents, which are able to execute the defined skills. The Process Configuration tool provides the means to specify the product workflow which will enable the system to produce products. This is achieved to the creation of a Product Agent which contains a sequence of required skills for the system to execute. This tool can also check what skills are in the system and create Coalition Leader Agents which will be responsible for executing a given sequence of Skills (Composite Skills). In production system the agents follow the specified architecture to execute the product requirements that the multiple Product Agents provide. The System Visualization tool is used to monitor the operation of the system, the multiple products or equipment modules. This information can be used to verify the existence of bottle necks and trigger the system reconfiguration.

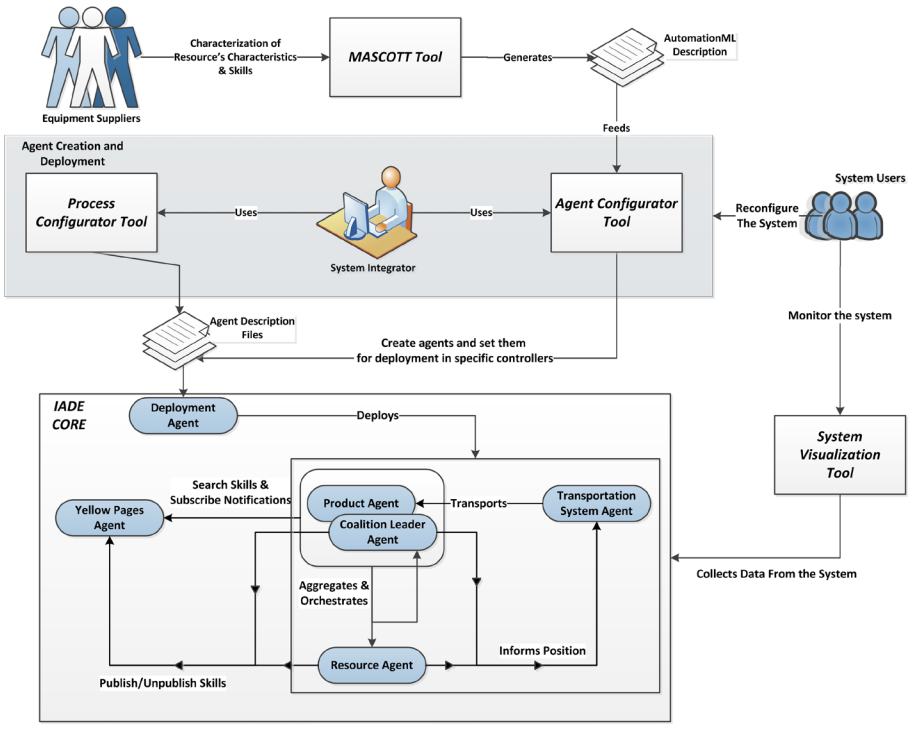


Figure 2: IDEAS software tools and their relations

IDEAS is co-financed by the European Commission DG Research under the 7th Framework Programme

SEVENTH FRAMEWORK PROGRAMME

Midterm Review

IDEAS has now passed its midterm review mark and has presented remarkable results in both real system demonstration and journal publications. The focus of the attention rotates around the November (in 2011) demonstration at the Festo premises in Esslingen, Germany. A small medical assembly system (figure 3) was officially demonstrated to be self-configurable and, to some extent, self-organising. The demonstration, shown for our project officer Jan Ramboer and the technical evaluator, Prof. Garcia, was completely successful. Modules could be removed and added to the running assembly system without any reprogramming effort. In order to achieve this milestone, a broad range of research results lay at the core of the demonstration: a new commercially available controller for multi-agent applications (Elrest), software (UNINOVA), modules with embedded control (MASMEC, Festo), program development languages (KTH, KIT, UNINOVA), simulation tools (TEKS), methodologies (UNOTT), and much more. This enormous effort was carried out by a relatively small project consortium, which brought the interest of journals and conferences. At present the work has been detailed in the Journal of Assembly Automation (Emerald Press) and will be covered in two special sessions at the upcoming CATS/CIRP 2012 and IEEE/IECON 2012 conferences.

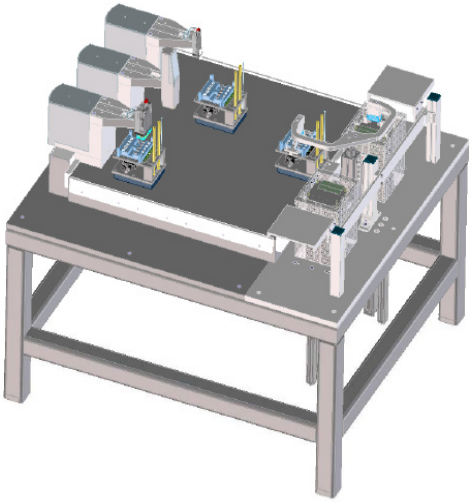


Figure 3: Design of the pre-demonstrator

Exhibition IT2012

Industrial Technologies 2012 (IT2012) offered an integrated coverage of nanoscience and nanotechnology, materials, and new production processes. The event programme highlighted the knowledge intensive products and processes driving European growth to 2020, for identifying solution to improve the framework conditions for innovation in Europe. The core of the IT2012 was a three day congress featuring plenaries, sessions and workshops with over 160 speakers.

Plenaries: three congress plenaries invited high profile international speakers from industry, government and research to discuss visions for European research and industry in 2020, how Europe can succeed in the face of global competition, and the form and impact of Horizon 2020.

Sessions: over 70 speakers across 18 sessions revealed the economic and technological impact of industrial technologies, with topics including low emission transportation, integrated systems, improving the environment, energy generation and storage, healthcare and construction. Sessions also built on the recommendations of the High Level Group on Key Enabling Technologies to promote practical solutions to improve the environment for industrial innovation in Europe.

Workshops: workshops and break-out sessions looked at individual topics in more detail, reflecting the work of individual project clusters or networks and building commitment and momentum for future activities.

The venue was the Concert Hall in Aarhus. The exhibition did take place 19-21 of June 2012. For the exhibition could be provided hardware by Festo and ELREST, posters about hardware as well as about software developed in the project and two PowerPoint presentations, which has been showed continuously. The IDEAS stand received several visitors each exhibition day.

IDEAS is co-financed by the European Commission DG Research under the 7th Framework Programme

SEVENTH FRAMEWORK PROGRAMME

Final Demonstrator by KTH and MASMEC

KTH: Under IDEAS scope a final demonstrator is under development at KTH lab which is composed of an ABB robot, a MASMEC robot and a Montrec conveyor as in the figure 4. Also three different grippers, a gripper exchange system and a bulk feeder will be added to the system. The target is to achieve a validation of a self-organizing system with distributed control architecture where a multiplicity of legacy equipment with different interfaces is abstracted as IDEAS mechatronic agents. Furthermore this demonstration will also include a manual station to demonstrate how the human and an automatic system can achieve collaborative work. The demonstrator is based on assembly sequences extrapolated from the domestic appliances manufacturing process.

MASMEC: The two principal activities that MASMEC brought forward in the last year have been focalized to the realisation of the final industrial demonstrator. The first one regards the design and implementation of the MASMEC library and the second one regards the realisation of a configuration tool for multi agent system (MASCOT, MASmec COnfiguration Tool).

MASMEC library permits of interfacing the MRA (Machine Resource Agents) of the IADE (IDEAS Agent Development Environment) with the hardware taking care about the logic and I/O management. The configuration tool is based on using the AutomationML editor (www.automationml.org) and software developed by MASMEC to read and write AutomationML files. The AutomationML editor, adapted to the management of a multi agent system, allowed facilitating the work of a system integrator in the configuration of a multi agent system. This thanks to a very simple and intuitive interface that uses widgets and windows similar to windows programs as well as drag and drop techniques. Another important aspect of this tool is the ability to see and describe to the system integrator all the aspects that characterise a system or device (mechanical, electrical, logical and 3D). All these aspects are glued and displayed on an XML files and then, using the MASCOT tool, all these information can be easily read and write.

These works together with the other IDEAS partner's tools will permit to realise an industrial demonstrator that will be used in a very simple way by an end user. About the final demonstrator, the hardware and process requirements have been written together with the other partners during these months and then it has been started all the electrical and the mechanical design activity. The major details of this demo have been discussed with the partners. The intention of this practical application is to show the IDEAS concepts about distributed control system, system adaptability and flexibility that this technology can guarantee in a generic automation process, but also the possibility to realise a simple configuration and an easy setup phase for an industrial system integrator (figure 5).

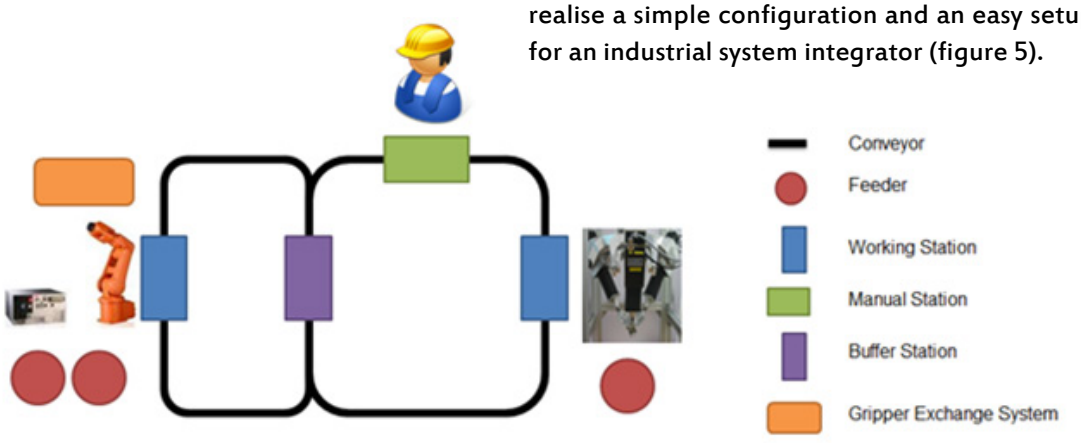
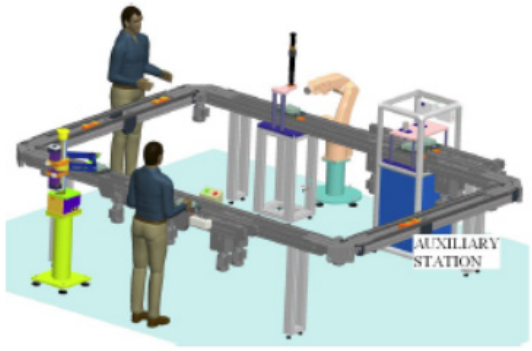


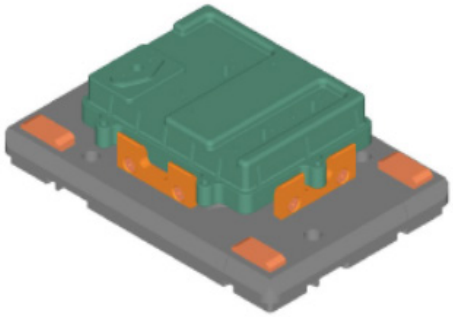
Figure 4: Final demonstrator at KTH

IDEAS is co-financed by the European Commission DG Research under the 7th Framework Programme

SEVENTH FRAMEWORK PROGRAMME



MASMEC industrial demonstrator



Pallet and CRF prototype model

Figure 5: Final demonstrator at MASMEC

The final demonstrator consists of following stations which replicate the assembly of an engine control unit from the automotive sector:

- Manual loading station: the operator loads the electronic unit with the already mounted, but not tightened, screws. After positioning the product on the pallet gives the start to the production.
- Assembling station: the KUKA robot picks the unit with one gripper and places it under a screwdriver to tighten all screws, after the robot places the control unit on the pallet.
- Leak test station: these stations perform leak tests directly on the pallet through a piston and a MASMEC leak test unit. Two stations are used to show the "plug and produce" philosophy.
- Auxiliary station: it has been decided that the auxiliary station is a station that will be provided by FESTO to make labelling operation on the products present in the pallet. The self-configuring concept will be showed moving the station in various parts of the plant during process running.
- Manual unloading station: this is a manual station. When the automatic unloading station is out of order the pallet arrives in this manual station and the operator unloads it. Red and green lights show the test results.
- Automatic unloading station: the MASMEC SCARA robot takes the finished piece and puts it in a good or scrap container.

Upcoming IDEAS Events

The Exploitation Workshop: an exploitation workshop will be held end of February/beginning March in the facilities of CRF in Orbassano, Italia. For more information please check our website.

Assembly Systems for a Sustainable Future: this workshop will be held on 10th December 2012 at the facilities of Festo AG & Co. KG in Esslingen, Germany. This workshop presents knowledge of existing European networks directing their respective effort to a shift in paradigm for production lines via decentralised control. The common denominator of this work is derived from advances in IT technology as well as in mechatronics. These will be the enablers for new ways of engineering, reducing change over and ramp up times significantly and that will help system integrators to solve their customers' problems with a new approach to the integration of control systems at all factory levels. The workshop is intended to bring together key players from industry and research to exchange their state of the art view and discuss the next steps in system development.

IDEAS is co-financed by the European Commission DG Research under the 7th Framework Programme

SEVENTH FRAMEWORK PROGRAMME

IDEAS Project Partners

Royal Institute of Technology (KTH)
www.kth.se

Festo AG & Co. KG
www.festo.com

Institute for the Development of New Technologies (UNINOVA)
www.uninova.pt

Electrolux Italia Spa.
www.electrolux.com

University of Nottingham,
www.nottingham.ac.uk

MASMEC SpA
www.masmec.org

Elrest Automationssysteme GmbH
www.elrest-gmbh.com

TEKS SaRL
www.teks.eu.com

Karlsruhe Institute of Technology (KIT)
www.kit.edu

Centro Ricerche FIAT S.C.p.A (CRF)
www.crf.it

IDEAS Project at a Glance

Project title:	Instantly Deployable Evolvable Assembly Systems
Contract type:	Small or medium-scale focused research project CP-FP 246083-2
Coordinator:	Prof. Mauro Onori, KTH
Project status:	Execution
Project funding:	IDEAS is funded by the EU 7th framework program, nanosciences, nano-technologies, materials and new production technologies (NMP_2009_3.2.2 adaptive control systems for responsive factories)
Project start:	01/04/2010
Project end:	31/03/2013
Duration:	36 months

Editors: Andreas Hofmann hofmann@kit.edu
Oezguer Firat firat@kit.edu

Karlsruhe Institute of Technology (KIT)
Institute for Applied Computer Science (IAI)
Herrmann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen, Germany

October 2012

IDEAS is co-financed by the European Commission DG Research under the 7th Framework Programme