20 years of ITEA

How ITEA projects changed today's society with their innovations

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This article shares, among many others, a set of unique innovations pushed by 20 ITEA projects during the last 20 years showing how ITEA projects are extending the State-of-the-Art in different directions. The first set will be shared in this magazine. In the next magazine, you will be able to read about the others.

"When we are in love, we are always 20 and when we are 20, we are always in love."

- Pierre Dac

For ITEA I would say, indeed we were, and we intend to stay in love, with innovation and impact on the market, for many years.

"When you are 20 the future erases the past when hope is shining"

- Georges Brasens

For ITEA I would say our past remains in our memory through the evolution of the State-of-the-Art, but we are already working on the next shining steps.

Distributed simulation

Modelisar designed an open interface standard FMI (Functional Mock-up Interface) to conveniently exchange models from different simulation environments, including the Modelica and non-Modelica tools of the MODELISAR partners. Usage of a model in another environment can be performed either by model coupling, i.e., no integrators are embedded in the model, or by co-simulation in various levels. The first target was to improve the exchange of simulation models between suppliers and OEMs. This approach allows dynamic modelling of different software systems to be used together for software and hardware-in-the-loop simulation. As a result, different disciplines can now work on their models with their own modelling approach and tools while the FMI offers standardised application programming interfaces (APIs) into the software world. Effectively, the FMI offers a sort of plug&play approach for components in the simulation framework.

Smart product development

High-tech manufacturing industries are globalising through multiple projects that involve the collaboration of multiple sites and multiple companies, supplying each other with specific services in engineering and manufacturing. To survive in this very competitive environment, European industry should combine high-tech solutions with fast, robust and low-cost product development and operationally excellent manufacturing. **IDEaliSM** addressed this challenge by creating a flexible and service-oriented framework for multidisciplinary design optimisation (MDO) that integrates people, process and technology. This platform includes an Engineering Language Workbench (a set of domain-specific and high-level modelling languages, ontologies and data standards) and a methodology for service-oriented development processes. Airbus Defence and Space improved its processes for early aircraft design by including multidisciplinary design optimisation as well as more extensive automation. Fokker Elmo demonstrated how the developed technology could design a wire harness in 10 days - instead of several months- at the equivalent level of the detailed design and production preparation phases. Employing the same technologies, DRÄXLMAIER demonstrated an automotive cockpit wire harness design within 3 weeks, integrating mechanical, electrical and electronic components inside the installation space provided.

Energy optimisation

Energy consumption optimisation has been explored in **Nemo&coded, Imponet and DiCoMa** through an RT infrastructure for smart grids and in **Geodes** through consumption optimisation at terminal and system level.

The **Nemo&coded, Imponet** and **DiCoMa** projects started to use open source Big Data technologies early for processing large amounts of data coming from the smart meter deployments that were being initiated, developing the concept of Meter Data Management (MDM) to comply with regulations. Among the technical challenges were new demands for efficient management and sustainable energy, which require the development of intelligent networks (Smart Grids) whereby the information flow is integrated into a real-time platform for operation and monitoring of the network. They developed energy monitoring and the evolution of consumption patterns as a key performance indicator for energy-management systems. A key innovation lies in the service-oriented architecture (SOA) ready to carry out distributed monitoring, diagnostics and control so that service suppliers can provide accurate forecasts of energy costs and potential savings. It resulted in:

- A distributed infrastructure enabling dynamic energy efficiency services for low-voltage

electrical distribution
- Global architecture and SOA models for dynamic control, monitoring and diagnostic of electrical distribution devices
- A communication paradigm – publish/subscribe SOA – and a novel implementation of semantic SOA
- Enhancement of current Web Service technologies
- Development of a real-time acquisition platform for collecting energy data
- Extension of the classical SOA on an Extreme Transaction and Processing Platform
- A real-time platform by means of a high-performance Data Distribution Service middleware and developing algorithms to more accurately predict energy consumption

Low-power technologies and energy-efficient protocols have been developed in **GEODES** to improve product power consumption. It responds to consumer awareness of the need to focus on energy use for environmental reasons and device autonomy to use less energy despite embedded devices implementing many functions. GEODES demonstrated that energy consumption optimisation can't be solved only at the terminal level but that the networked system optimisation generates another level of opportunities. GEODES delivered many innovations like:
- A transparent network which can be easily deployed through plug&play for end-user applications. It is a reliable, secure and easy-to-manage network that allows the measurement of energy consumption as well as interpretation and communication of this
- New stand-by mechanisms to reduce energy consumption
- Transmit power control, where correct power levels need to be assigned to nodes in such a way that total power consumption is minimised but the whole network stays connected
- Power-aware protocols and applications
- Power-aware components at operating-system level – new schedulers, new file system algorithms for data storage, new graphics drivers, quality of service (QoS) managers and power-monitoring facilities
- New MAC algorithms, new routing algorithms, dynamic power transmission and dynamic node power adaptation to transmission rate
- Middleware for QoS handling and node interoperability
- SystemC simulator for power estimation

These innovations resulted in:
- Almost doubling of the autonomy of video surveillance applications
- A 100% extension in Wireless Sensor Network (WSN) lifetime, depending on size, structure and latency
- Up to 11% reduction of total energy consumption for TV set-top boxes - in a 10 million product market, this would save some 62 GW of power a year

Smart Buildings & Collaborative City Co-Design

The problem in buildings today is that automation disciplines are still separated into independent control systems, e.g. for lighting control, HVAC (heating, ventilation and air-conditioning), safety and security. The trend towards smart commercial buildings demands the integration of building automation systems.

BaaS developed a novel semantic IoT service framework for commercial buildings along with a reference architecture and corresponding software platform as a basis for current and future commercial building automation and management technologies. The publicly available BaaS Reference Architecture provides common concepts and guidance for the development of concrete BaaS platforms. The BaaS Information Model facilitates the semantic modelling of devices, functions and data and thus provides a blueprint for the specification and generation of BaaS services. The establishment of a BaaS system follows a service lifecycle model that covers the six phases: Design, Development, Engineering, Commissioning, Operation and Optimisation. The BaaS platform provides tools and methodologies that support the first four phases of the service lifecycle while the BaaS runtime provides the capabilities needed to operate a system of BaaS services. A technical management system monitors the services and ensures their proper operation.

The enhancement of city planning by co-design requires simple access to different sources of information, the visualisation of relevant information for decision-making, the simulation of different scenarios, stakeholder communication support and static and dynamic data. **C^{3}PO** achieved tackling the urban design challenges through a cloud collaborative and semantic platform for city co-design.
In developing what is essentially an open and generic intermediary, the C^{3}PO project followed the three key functions of participative urban planning:
- City data access, acquisition, transformation, analysis, management and integration;
- Applications development support and dissemination;
- Enabling user (stakeholder) involvement, participation and city co-design.

This process ensured that the interaction between existing applications was focused through a unique multi-dimensional repository covering the different types of information in city co-design, like GIS, BIM, electricity grids and traffic. This resulted in unique partial solutions of city co-design, incorporating simulation tools, open API, 3D modelling and visualisation, gaming tools, etc.

The C^{3}PO platform takes two forms: cloud-based data storage (owned by NETAS) and local data storage (MAPGETS, owned by FCG City Portal). Among the key innovations are multi-ontology usage via one platform that breaks down the vertical silos and enables the faster development of applications, process management for the large-scale participation of multiple stakeholders and visualisation (3D, Augmented Reality and Virtual Reality).

Security

Different aspects of security have been impacted by ITEA projects such as:
- Hybrid attack detection and countermeasure impact analysis with **ADAX**
- The SEPA protocols with **EPAS**

ADAX innovates mainly at 2 levels. The first innovation is a hybrid detection technique

in which behaviour-based and signature-based detection are combined. The former is a probabilistic approach that helps to identify new attacks (0-day attacks) while the latter is a deterministic approach that is largely applied to known attacks. Combining both techniques helps improve detection rates, lower false-alarm rates and shorten the detection time, saving both time and costs for customers and security service providers in the detection phase, resulting in improved detection of new complex attacks (detection rate of 98.7% and false alarm rate <1%). A second level of innovation is the simulation of the countermeasure impact associated with the ROI concept so as to avoid using a proverbial sledgehammer to crack a nut and pay the consequence for continuity of operation. The result is an acceleration of the detection-to-remediation loop resulting from the development of enhanced decision-support tools along with a network simulation tool to enable attack and countermeasure impact to be assessed before implementation on a real IT infrastructure. A new metric, 'Return-On-Response-Investment' (RORI), was set up to calculate the 'cost-benefit' of the different countermeasures that can be implemented to remediate a specific attack.

European actors worked together to ensure the successful creation of the Single Euro Payments Area. SEPA allows payments in euros to be made and received between and within countries under the same conditions anywhere in the area. This will ensure that consumers, businesses and public administrations will be able to make cashless payments from their domestic accounts to anywhere within SEPA. Such harmonisation required issuers, acquirers, card schemes and operators to adapt to new principles known as the SEPA card framework. Overall, **EPAS** has delivered a series of specifications that enabled a smooth migration from yesterday's non-interoperable and proprietary solutions with dedicated interfaces to an open environment based on interoperable hardware and software components from different manufacturers. Their innovations were around three major elements involved in point-of-interaction transactions:

1. A terminal management system involving data transfer, including encryption, and maintenance; this ensures easier payment systems administration and suitable security
2. A retailer protocol covering administrative, payment-services and device-services exchanges; it ensures a separation between sales and payment functions, removes dependencies between payment services and products, and offers a common protocol for all types of architectures and environments
3. An acceptor-acquirer protocol covering authorisation, completion, rejection, reconciliation, diagnostic and specific service exchanges; this offers a single common solution for multiple acquirers, removes local and regional constraints and embeds security

Healthcare

SoRTS solved the challenge of availability of coupled real-time feedback of the imaging and therapy systems during interventions. Essentially, the problem was that the movement of a tumour in the abdomen under the effect of respiration, for example, risked damaging surrounding tissue, whereas the only imaging modality, MRI, that can visualise the tumour well, traditionally has image creation times of minutes. However, the image-based feedback has to be available within a fraction of a second. SoRTS came up with a solution to this problem in the shape of the MR-linac system.

The key world-leading innovations centre around:

- A Real-time Therapeutic Procedure Supervisor providing the required architecture for adaptive real-time operation
- Heterogeneous real-time motion correction including visualisation chains dedicated to image-guided therapies running on a distributed heterogeneous RT High Performance Computing architecture
- A Magnetic Resonance Imaging system suitable for low latency real-time feedback during image guided interventions. Image capture to treatment system adaptation in 300ms
- RT interfaces with therapy systems, like brachytherapy, linear accelerator (Linac) and high-intensity focused ultrasound
- Parallel real-time reconstruction

BENEFIT developed software analysis and imaging methods and tools that present quantified information, personalise patient models and offer treatment alternatives before and during minimally invasive surgery procedures. The technologies developed in BENEFIT were demonstrated in several use cases, e.g. on heart valves, involved 4D MRI based blood-flow quantification across heart valves and personalised computer modelling that accurately predicts device-host interaction for heart valve replacement. Another use case concerned the quantification of flow in aneurysms to enable better assessment of therapy success, shorter time to intervention and the integration of brain anatomy and function information with improved biomarkers. Another example of their use cases concerned liver tumours which provided the focus for the development of an accurate overlay of contrast-enhanced pre-operative to non-contrast-enhanced intra-operative images, resulting in better guidance during ablation. A new way to calibrate endoscopes and surgical displays in real-time was developed so that the perceived colours will be the same irrespective of which endoscope and display are used.

In this magazine, we are only able to share a small selection of successful ITEA projects and show how they have changed today's society with their innovations. In the next magazine, we will present another selection. Browse our ITEA Impact Stream for more incredible impact stories on https://itea3.org/impact-stream.html.

You now also have the chance to become part of one of these life-changing projects: join the ITEA PO Days 2018 on 4-5 September in Stockholm and submit your project proposal in ITEA 3 Call 5, opening 4 September. More information on: https://itea3.org/podays2018/index.html