SystemX
INSTITUT DE RECHERCHE TECHNOLOGIQUE

2013
ACTIVITY
REPORT

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Editorial

Pascal Cléré
Chairman, SystemX

> I'm pleased to present you the first activity report of SystemX Technological Research Institute (IRT) which covers all the activities conducted under the auspices of the institute during 2013.

The year that has gone by, since the signature of the agreement with the French Research Agency (ANR, *Agence Nationale de la Recherche*) at the end of October 2012, and the official launch of SystemX in February 2013 has enabled us to lay the foundation of the technological research institute, to implant ourselves in the industrial and academic ecosystem, and to bring together talented men and women ready to invest themselves in the new innovation dynamic.

The year 2013 has been punctuated with leading-light events that have enabled us to achieve the targets we had set ourselves. We started the year with our official launch, at the end of last February, in our offices at Nano-INNOV. More than 350 people attended this event, including officials such as Louis Gallois, General Commissioner of Investment, Bruno Sportisse, Technology Transfer Advisor of the Ministry of Higher Education and Scientific Research and Jean-Paul Planchou, Vice-President of The Île-de-France Regional Council. In June, we took part to the Systematic PARIS-REGION Convention, which enabled us to interact with the industrial ecosystem within which we exist. On October 10, the eight IRTs throughout France jointly organized the first IRTs Forum, in Rennes: it was a unique opportunity to do a "Tour de France" review of the IRTs and bring to light, the excellence in technological innovation in the key industries and businesses covered by these new organizations. In the middle of November, SystemX co-chaired the ICT (Information and Communication Technology) Paris-Saclay Forum in association with Digiteo and Digicosme (Laboratory of Excellence); the academic community got together for a day to take part in a variety of workshops and conferences addressing the scientific stakes pointed-up by the digital revolution. At the beginning of December, SystemX joined forces with the Complex Systems Design & Management Conference (CSD&M 2013), which gathered together nearly 250 people - academics, experts and executives - from all over the world, to discuss the industrial and social challenges with which businesses are confronted. Lastly, on December 12, there was the first meeting of the Scientific and Technological Council, chaired by Yves Caseau, during which the management of SystemX presented the institute's technological roadmap laying out the lines of strategic research that will define the forthcoming scientific orientations to follow. Because accelerating innovation is a priority for France, and because research and development are essential for the country's forward progress, the government has decided to invest alongside industrial players and regional authorities, so as to increase the nation's growth potential. This is why, after this startup year for our projects, SystemX will be placing importance in 2014 on taking-on some major challenges, which are, firstly, to collect the initial results of the R&D work, to complete our robust scientific seating and, lastly, to establish an economic model that is appropriate for our partners. I would like to thank our founders, partners and teams for involving themselves within the institute throughout 2013. And I know that I can count of the support of every one to drive SystemX forward to meet the challenges awaiting it.

2013 highlights

Interview with Eric Perrin-Pelletier
CEO, SystemX

What were the key highlights of 2013?

SystemX was officially launched in 2013 and this year was its first fiscal accounting period. The organization of the governance bodies has been completed within the Scientific Cooperation Foundation, the Board of Directors and the Scientific and Technological Council, and within the operational division, with the management team and the Program Orientation Committees.

What are the particularities of the SystemX model?

SystemX is a unique environment for the co-location of industrial and academic expertise for conducting research projects targeting industrial challenges. SystemX's operating model has been developed in accordance with the principles written into the Partnership Agreement signed by each of SystemX's partners. This agreement includes an intellectual property charter that lays out a common framework for everyone, augmented for each research project launch by a Special Collaboration Contract that sets out the stakes being targeted and the commitment of each partner in the project.

SystemX positions itself as an accelerator towards digital transformation. Centered on digital systems engineering, the research projects within SystemX address the challenges that industrial companies and corporations are encountering in the design, modeling, simulation and experimentation for future products and services, which will increasingly have to integrate digital technologies. Technological progress and the need to integrate these technologies involves taking account of a new paradigm, through a "systems" approach - and even a "systems of systems" approach. The key fields of expertise defined within each technological roadmap of SystemX are: architectures and models, critical software, data and decision, and usage. They structure our actions and our skills, and are applied within the technological challenges assigned to

the plans for the "New Industrial France", which are: advanced manufacturing, automatically-piloted vehicle, embedded software and systems, cybersecurity, cloud computing, and big data.

The real estate facilities have been provided at the main site in Palaiseau, on the Saclay plateau, as well as at a secondary site in Paris, for which a strategic partnership has been concluded with the LINCS consortium (**Laboratory of Information, Networking and Communication Sciences**) for better cost management.

What are SystemX's ambitions?

The ambitions of SystemX have been defined and structured around the following objectives:

- enhance mastery of the basic digital technologies;
- develop and experiment with the new concepts for products, services and systems, through the assembly and integration of technological components, and capitalize on results and practices;
- contribute to the development of the skills necessary, through suitable engineering training, and by opening-up the resources of SystemX to students;
- support and accompany the growth of SMEs in the industries and businesses concerned;
- bring closer players in public and industrial research, and accumulate a critical mass of co-located technical expertise and resources;
- develop the profile and attractiveness of the Île-de-France Region.

Key figures

<table>
<tr><td>

10

R&D
PROJECTS

</td><td>

€32M

INCLUDING
AN INDUSTRIAL
FINANCING OF €16M

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43

INDUSTRIAL
PARTNERS

</td><td>

14

ACADEMIC
PARTNERS

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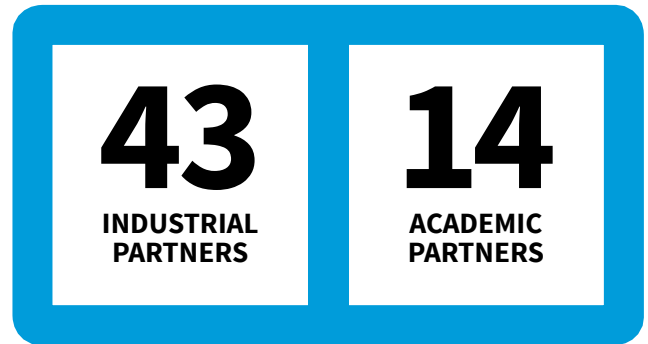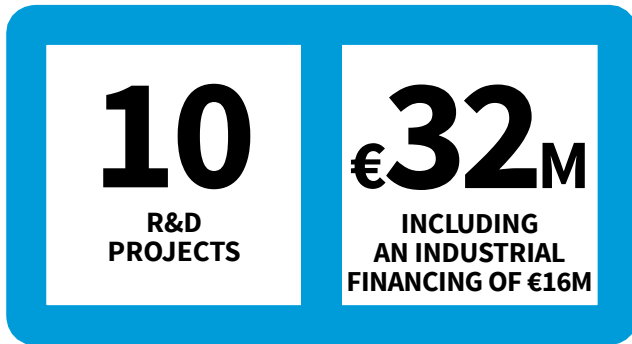
● Staff

Overall staff: 171 people

80
people made available
full or part-time
including

26
PhD students (fixed-
term contracts)

8
special hirings

15
research engineers
and researchers
(permanent staff)

111
people per year
over 3 years

50
part-time
researchers
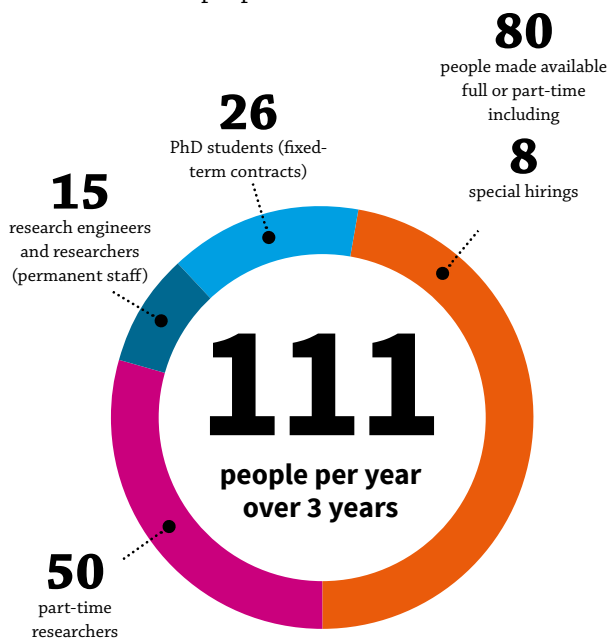
●● - Permanent staff
● - People made available by industrial partners
● - People made available by academic partners

● Theses

Université Paris 8

Université Paris-Sud

Université de Versailles Saint-Quentin-en-Yvelines (UVSQ)

Université Pierre et Marie Curie (UPMC)

IFSTTAR

Supméca

ESTACA

ENSTA ParisTech

LNE

Inria

Supélec

Ecole Centrale Paris (ECP)

CEA

Institut Mines-Télécom (IMT)

26
SystemX's
PhD students
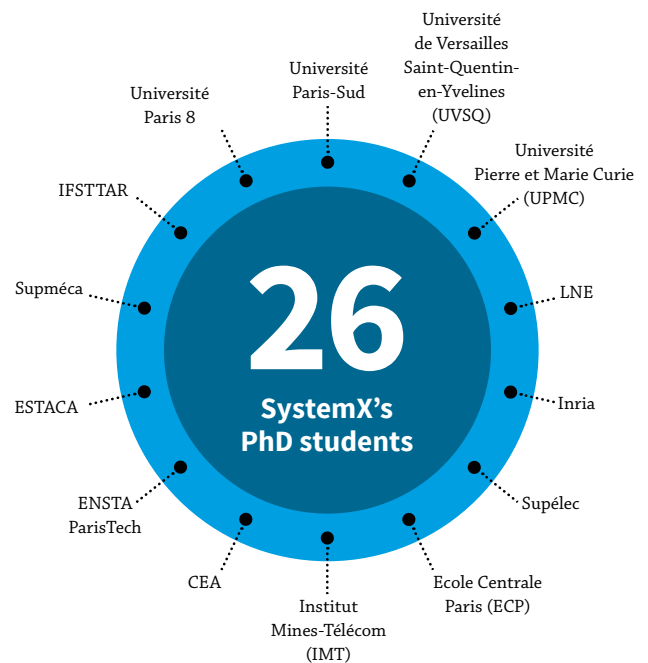
Research activities

Key fields of expertise dedicated to designing the systems of the future
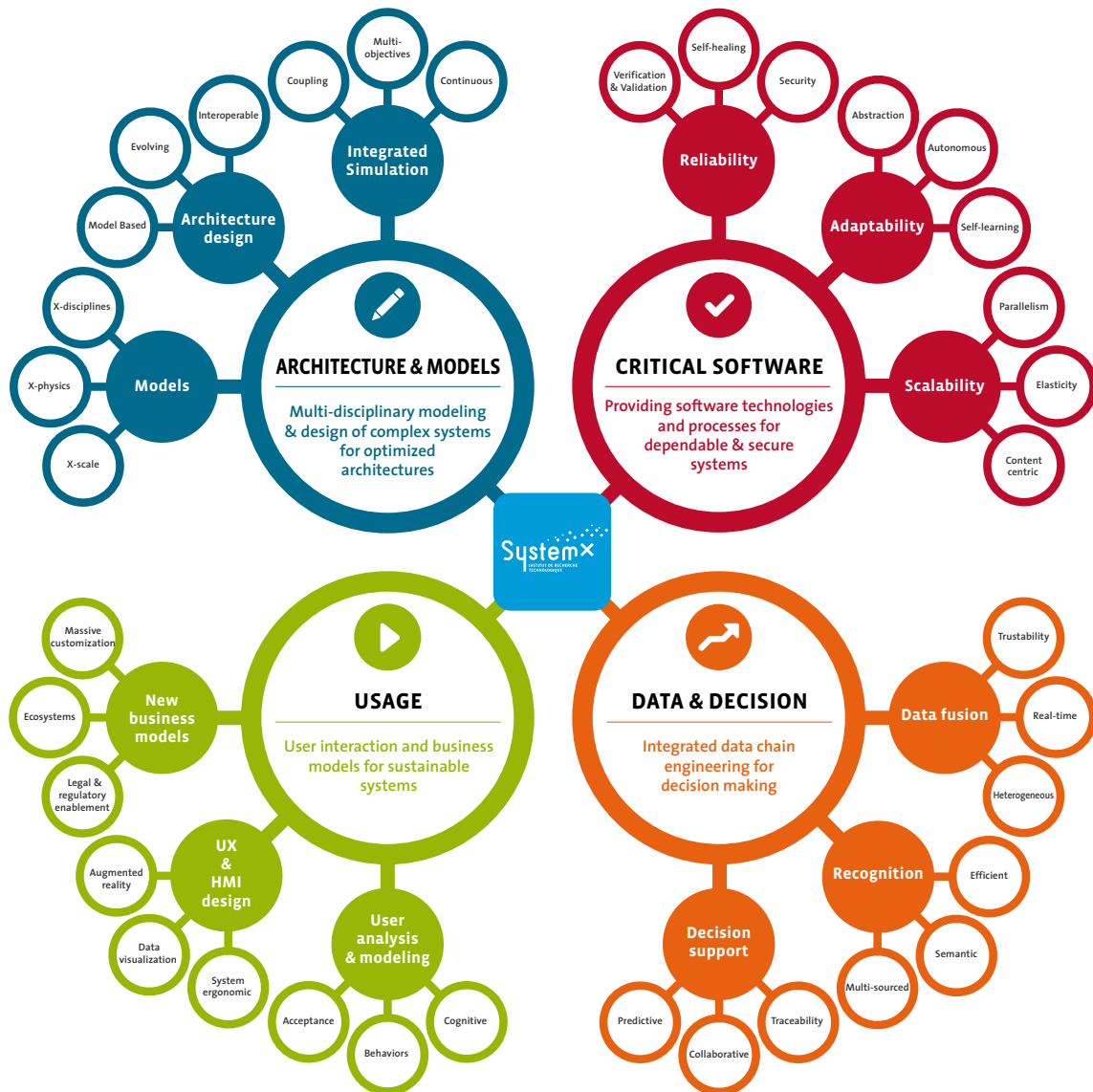
The increasing complexity of products and systems, which are becoming ever-more interconnected and rapidly renewed, means that they have to be modeled, simulated and designed using new architectures, new models, new algorithms, and new languages. The designing of these products and systems requires increasingly shorter cycles, simultaneous deployment of a large number of specialists, plus access to extremely-varied domains of knowledge - both scientific and technological, and sociological and economic - as well as more and more computing power, and the successful adoption of methods and organizations of a new type. The competitiveness of our economy and industrial base in the 21st century is dependent of making breakthroughs in digital engineering and then disseminating this newly-developed expertise in every economic sector.

Technologies and Tools program: stakes and prospects

Paul Labrogère
Technologies and Tools program Director, SystemX

The aim of the Technologies and Tools program is to create a technological reference center in the areas of **embedded systems**, **cloud computing**, **design and simulation tools** and **high-performance computing**, calling on the best expertise in science and applied mathematics so that we develop **tools for assistance with decision-taking** for designing complex systems.

We are seeing a major change in paradigm within the digital design engineering that underpins the transition from products to systems. The industrial partners of our research institute design and develop complex digital systems that adapt to organizations that are unknown in advance and that, over time, need to accommodate extensions and cope with defects in operation (failures or shutdowns). They are researching on technological answers to these challenges.

The components of these systems (hardware, software, networks and data) have to become more adaptable, more independent and resilient, and have to integrate intrinsic enhancements in capabilities and performances.

For example, increasing the number of processing unit within a cloud, or within an embedded system also increases the probability that a component or set of components will suffer an outage. This raises many questions during research, so that we can take advantage of new capabilities and better performances and yet always guarantee the required level of reliability:

- How do you integrate this uncertainty within software?
- What defense mechanisms and what certification techniques do we need to adopt?
- Security also has to be taken into account when designing systems, to as to prevent or limit the impact of acts of ill will.

2013 projects

During 2013, the Technologies and Tools program launched five projects:

- the **ROM** (Model Reduction and Multiphysics Optimization) project, to improve digital simulation models, properly manage their precision, and to better integrate them into the process of digital design;
- the **SIM** (Engineering and Multi-disciplinary Simulation) project, to implement interaction and decision-taking on the basis of models between different professions and fields of knowledge, and thereby consolidate an optimal architecture;
- the **ELA** (Automobile Electronics and Software) project, to design software architectures capable of introduction of driving assistance systems, safety systems and entertainment systems, and to suitably adapt and control the design process;
- the **FSF** (Safe and Reliable Embedded Systems) project, to harden the reliability and security of systems operation based on multi-core processors, and to adapt design processes to achieve reduced development efforts;
- the **APA** (Parallel Algorithmics) project, to develop new mathematical methods and efficient, robust and scalable algorithms for digital simulation needs.

Projects under construction

About embedded Systems

Several projects are in preparation to heighten the robustness and safety of the embedded systems:

- One project to enable the dissemination of technology and consolidate the base of SMEs in France, in the domain of safety and reliability, will nurture the maturing of one component based on the **AltaRica** language, and produce a reference implementation.
- Another project addressing the securing of **ITS** (**Intelligent Transport Systems**) involves several partners from the motor industry, and the work accomplished could reinforce the work done on the ELA project.

About Design and Simulation Tools

- Several opportunities for projects focused on design and simulation tools are under examination, with close attention to multi-physical modeling and co-simulation with the "**Modelica**" standard. In particular, the creation of libraries of digital models is under study, as is the strengthening of aspects linked to Modelica within the Scilab tool.
- Also within a logic of permitting the dissemination of technology to consolidate the base of SMEs in France, the extension of the ROM project could support the democratization of probabilistic approaches in the management of uncertainties.

About Cloud Computing and Networks

The program anticipates the startup of the Networks Architecture and Cloud Computing projects in the first quarter of 2014. One of the stakes is to focus on secure Cloud Computing architectures and on robust and resilient clouds.

> **Testimony** scilab enterprises
>
> *"Scilab Enterprises is working on two complementary axes within SystemX institute. On the one hand, we provide technical support and maintenance to SystemX research people who are using our open source numerical computation software called Scilab. On the other hand, we are working with the simulation module Xcos. Thanks to this transversal approach, we are able to work with the SytemX research teams and partners to address a critical challenge: keep Scilab as the reference numerical computation software."*
>
> **Claude Gomez, Chief Executive Officer, Scilab Enterprises**

Model Reduction and Multiphysics Optimization (ROM) project

Partners

- **Airbus Group (formerly EADS)**
- **Cenaero**
- **Distene**
- **ESI Group**
- **Renault**
- **Safran Group**
- **Inria**
- **Supélec**
- **Supméca**
- **Université Versailles Saint-Quentin-en-Yvelines (UVSQ)**

● Objectives

> The aim of this three-year project is to:

- provide a set of scientific and technological tools allowing the designing of complex multiphysics systems. These tools will address the implementation of multiphysics and multiple-scale models, the techniques of exploration of the design space, and optimization techniques;
- develop tools allowing the evaluation of the quality of models developed and results of simulations (model verification and validation aspect);
- deploy an integration and demonstration platform integrating both the scientific and technological tools developed within this project and software tools (free or proprietary) allowing the production of industrial test scenarios from the aerospace and automobile sectors. We need to validate the impact of the developed tools and to integrate them into the software suites already widely used by manufacturers.

● Challenges

The project is mainly structured in accordance with three scientific lines:

1/Systematic exploration of all the influential parameters to best optimize a large-scale system

A systematic and automatic exploration of the design space is necessary to identify the important parameters, understand how the specifications interact with each other, and identify promising regions for the design space. Much progress still remains to be made, particularly in the following domains: construction of complex simulation models (notably multiple-scale); robust model reduction methods; optimization algorithms (statistical methods; evolutionary algorithms; multi-objective optimization; optimization under probabilistic constraints; …); efficient techniques for exploration of design spaces (planning of digital experiments with several objectives; adaptive planning); precision of response surfaces; and methodologies to ensure high quality and prediction capabilities for models.

2/Taking account of digital quality and management of uncertainties to guarantee and validate the results

The verification and validation of developed simulation models requires special tooling that is absolutely essential to take advantage of simulation tools and make real use of them for design work. One particularly important stake is, in the downstream phase of design work, to take into account the uncertainties in simulations, in order to guarantee robust digital designs.

3/Effective analysis of the information generated to provide effective assistance with decision-taking

The development of mathematical and technological tools ensures consistency in the various levels of modeling, and enables optimal decision-taking through precise and interactive analysis of the results obtained. In addition, the results garnered through performances analyses have to be synthetized in order to offer an assistance with decision-taking, highlighting the hindrances, the degrees of interaction between elementary performances and global performances, so as to reach satisfactory compromises between the specifications and the design criteria. The risk associated with decisions has to be quantified, so that the margins can be managed in a rational manner, basing oneself - for example - on the concepts from the RBDD (Reliability-Based Design Optimization) domain.

● Targeted markets

The ROM project aims at improving the processes for the designing of complex systems, so as to reduce costs (to be halved) and lead times (to be divided by four).

This project addresses complex systems that require very long computing times and a very big design space. It addresses the automobile and aerospace markets.

One stake of the ROM project is to find technical solutions that optimize the integration of digital simulation and that enhance the management of simulation models within design processes, and to improve their quality. Another stake is to enhance digital simulation models, properly manage their precision, and better integrate them into the digital design process.

Engineering and Multi-disciplinary Simulation (SIM) project

Partners

- ▶ **Airbus Defence & Space (formely EADS Astrium)**
- ▶ **Airbus Group (formely EADS)**
- ▶ **Esterel Technologies**
- ▶ **Renault**
- ▶ **Ecole Centrale Paris (ECP)**
- ▶ **ENSTA ParisTech**
- ▶ **Supélec**
- ▶ **Supméca**

● Challenges

> One particularly important stake for industry is to:

- accumulate a large number of interoperable, multi-system, multi-physical and multiple-scale behavioral models;
- build hierarchies of models that allow one to represent the physical behavior of a system (a vehicle, or a subsystem of a vehicle);
- ensure collaboration between the system designer/integrator and the subsystem suppler, in an integrated framework, with sharing of models.

For instance, it is necessary to be able to build a functional and behavioral architecture for a hybrid vehicle with a low environmental impact, based on interoperable, multi-physical and multiple-scale models, within a multi-enterprise environment (with the ability to integrate models produced by partners/subcontractors), with a guaranteed level of quality (for representativeness in relation to true life).

The deployment of tools at "systems architecture" level based on behavioral models of different types is a key requirement, and is still today a choke point for subsequently effectively dealing with the performance analyses and multi-disciplinary optimizations necessary when designing systems.

The SIM project addresses the vehicle architecture level and also focuses on the engineering of model production (including the concept of simulation designer), including the collaborative aspects tied-in with the "extended enterprise".

● Targeted markets

- Engineering methods and tools market, and the usage of such methods and tools within an industrial context (automobile, aeronautics and other sectors).
- Consultancy market for new engineering methods.

Automotive Electronics and Software (ELA) project

Partners

- **Continental**
- **Intempora**
- **Open Wide**
- **PSA Peugeot Citroën**
- **Renault**
- **Valeo**
- **CEA**
- **ESTACA**
- **Institut Mines-Télécom (IMT)**
- **Université Paris-Sud**

> The ELA project aims at providing operational solutions allowing one to respond to the new technological and economic challenges in the automobile industry, notably with regard to network-connected vehicles and driving assistance systems. The objective of the partners, therefore, is to build and share a modular environment for design and validation centered on models, to invert the testing pyramid (deploy the virtual model and reduce the testing and validations of complete vehicles), and to optimize QCD (Quality, Cost and Deadline).

● Challenges

Three technological challenges have to be overcome, to succeed in this:

- proper management of the impacts of multi-core software architectures and virtualization on the design engineering for automobile software systems and electronics, so as to develop tools and methods for the development of multi-core applications. For example, to use virtualization to be able to combine several operating systems such as AUTOSTAR and GENIVI in a single platform. It will also be necessary to work on the "integration-readiness" of embedded intensive image processing algorithms for driving assistance systems;
- properly manage heterogeneous network technologies and ensure digital security by preventing malicious attacks on embedded systems;
- integrate these two aforementioned technological components into a complete process, and into the system design tool chain, incorporating validation and integration.

A demonstrator (software and/or system bench and/or vehicle) will be produced to implement and showcase the developed components within a number of usage scenarios.

➡ Testimony

"Open Wide Ingénierie is deploying open source software in the area of embedded systems. We differentiate ourselves with the experience and knowledge gained through key technological components of present and future embedded systems.
Our involvement within SystemX allows us first to create close contacts with customers and second to access technological innovations. This enables us to anticipate needs and to provide relevant answers to customer requests".

Olivier VINE, Director, Open Wide Ingénierie
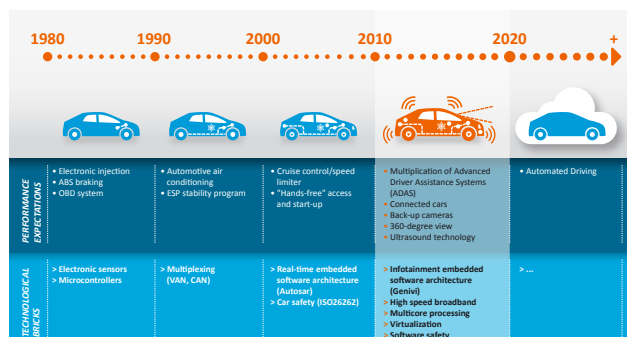
Towards the autonomous and connected car

● Targeted markets

The project addresses the two principal French manufacturers, Renault and PSA Peugeot Citroën, as well as the equipment manufacturers Valeo and Continental. The work conducted within the project targets cars that will be manufactured as from 2018. The solutions offered are primarily for network-connected cars, for which new embedded information technology architectures will be necessary.

Safe and Reliable Embedded Systems (FSF) project

Partners

- **Alstom Transport**
- **APSYS**
- **Esterel Technologies**
- **Krono-Safe**
- **Scaleo Chip**
- **Trusted Labs**
- **CEA**
- **Inria**
- **Institut Mines-Télécom (IMT)**
- **Université Paris-Sud**

● Challenges

> The FSF project is based on a railway usage scenario. The associated industrial context can be summarized as follows:

- The embedded systems of railways are communicating systems of which the level of security of operation has to be specified and demonstrated to be compliant; this is because, with the revision of the Cenelec EN50128-2011 standard, all the components of software-based systems must have a defined and proven degree of security of operation, ranging from SIL0 to SIL4. Consequently, the requirements for the design and validation cycles are augmented, with a resulting rise in development costs.
- Moreover, progress in the performance and functional enrichment of railway information and control systems requires increasingly-powerful execution platforms: it has become vital to use the capabilities of multi-core processors, to have sufficient resources when operating security has to be defined and demonstrated.
- The realities of the rail transport market are such that the production volumes, in comparison with the development costs, do not make it financially feasible to develop special execution platforms for each rail system. Therefore, one platform (with its development roadmap) will be used for all signaling applications.

● Targets

- Organize operational hardware and software resources so that the execution platform attains the performance, security-of-operation, availability and safety goals for a given system.
- Specify the necessary services, and characterize the available resources between the execution platform and the software subsystems, to ensure that there is independence between the design cycles of the two parties.

● Testimony

"Considering the work done within SystemX, It is an opportunity for us to position ourselves in cutting-edge software platforms and to partner with key stakeholders in the area of embedded and critical systems. We will then be able to validate our proper technological choices and guarantee a perfect match between the products development and market expectations notably for railway. Moreover, with the academic and industrial research people working on one same location, SystemX is a catalyst and therefore facilitates the emergence of new technological solutions. Human and material resources are pooled for a greater efficiency to boost innovation and accelerate industrialization".

Didier ROUX, Chairman, Krono-Safe

- Integrate a continuous validation process into the software design workflow, taking account of the characteristics of the execution platform configured for the system being developed.

● Targeted markets

The FSF project seeks to encourage the emergence of an industry around execution platforms for railway systems, both for inter-city lines and urban transport lines. As explained previously, the production volumes in comparison with the development costs mean that it is necessary to opt for greater generic design within these systems, and to achieve broader integration of COTS (Components Off The Shelf), for both hardware and software. COTS software products are typically real-time operating systems or middleware components. The COTS hardware components studied within the scope of the project are essentially system-on-a-chip commodities for critical embedded systems, that incorporate multi-core processors.

The project is also focusing on the tooling for system and software development, analysis and validation. The interfacing of tools and their integration into an industrial design process compatible with CENELEC rail standards is being evaluated. To give one example, the coupling of the formal security-of-operation analysis tools and the system specification tools provides added value for both product ranges. Another example lies in the specialization of the execution platform.

Parallel Algorithmics (APA) project

Partners

▶ **ESI Group**   ▶ **Ecole Centrale Paris (ECP)**

● **Challenges**

> The challenge today is to to be able to take best advantage of massively-parallel machines with more than 200,000 cores and/or distributed over separate geographical sites (cloud computing).They incorporate interconnection technologies with per-core bandwidth limitation and more latency. To make best usage of these new parallel architectures, software components have to increase their degree of parallelism. Conventional algorithms are poorly suited to such a large number of cores, because most of them require regular and frequent synchronizations. So, asynchronous algorithms now seem to be an attractive alternative.

Therefore, the project aims to analyze and develop new asynchronous algorithms that have experienced little development work and application until today. This is mainly because the existing asynchronous algorithms are less efficient than conventional algorithms in a situation in which communications are not the main constraint. With the emergence of systems with more than 200,000 cores, or that are distributed over multiple sites, asynchronous algorithms are now becoming beneficial, because they eliminate the need for regular and frequent synchronizations. However, this is dependent on being able to develop new asynchronous algorithms that are robust and well-performing.

The research work will give rise to scalable algorithms that allow the use of a very large number of cores, and that lend themselves well to distributed architectures (cloud computing).

● **Targeted markets**

Notably applicated to computations requiring high number-crunching power fluid dynamics, electromagnetism, high-speed dynamics, and computing (for car crashes, for example). The scalability of resolvers is currently particularly limited (not more than a few hundred cores). To increase the processing speeds for complex computations, the speed of results rendering, the number of computations possible and the precision of calculations, the upgrade to parallelization of thousands of cores would be significant advantage for industry. The work in this field will also allow advantage to be taken of new IT hardware architectures that have already been announced, for which important technological leaps forward remain to be made. Better use of the available technologies would also make these infrastructures available at acceptable prices for industrial customers, that are compatible with their budget constraints.

Digital simulation has been on the rise for many years, and is now reaching a watershed point as regards its usages, its generalized uptake and even the way it is employed.

Systems of Systems program: stakes and prospects

François Stephan,
Systems of Systems program Director, SystemX

The "Systems of Systems" program address several stakes that manufacturers have to cater to. Environmental issues have pointed-up several important domains for which a systems of systems approach is necessary, including transport systems, energy management, water management, urban planning, safety, and with others besides. Optimization of resources usage is becoming a key argument in all markets: whoever can prove that their product or system achieves, it will have a crucial advantage. Big French companies and corporations are now investing heavily in systems of systems engineering, with the quest of accomplishing the optimization goal.

A system of system consists of subsystems that fulfill all or some of the following attributes: the components are heterogeneous, have a relative autonomy, are distributed location-wise, are interconnected and/or in interaction, can be social and economic factors and, in some cases, can be natural elements.

The Systems of Systems program addresses the concepts of integration, interoperability and, above all, capacity augmentation and scalability, as regards the following three themes: **multimodal transport**, **energy management** and **safety and multimedia**.

2013 projects

During 2013, the Systems of Systems program launched four projects:

- the **MIC** (Modeling - Interoperability - Communication) project and the **LRA** (Localization - Augmented Reality) project, concerning the theme of **multimodal transport**, respectively for the design of a decision-taking assistance system for the optimization and supervision of a multimodal transport system taking onboard the new economic models, and for the development of new driver/vehicle interfaces based on augmented reality and localization systems, with breakthroughs in cost, performance and security of operation;

- the **IMM** (Multimedia Multilingual Integration) project, targeting the theme of **safety and multimedia**, seeking to design an open platform for test research, development and certification for the analysis of unstructured multimedia multilingual content;

- the **SIP** (PLM Interoperability & Standards) project, to provide means of testing the interoperability processes specific to the various phases and domains of PLM (product Product Lifecycle Management), and to develop generic frameworks and approaches that support multiple-sector and inter-organizational intercommunications.

Projects under construction

Further projects are also slated for launch in 2014:

1/About Multimodal Transport

- The extension of the Modeling - Interoperability - Communication (MIC) project, with many new stakes and usage scenarios, and associated technological challenges.

2/About Energy Management

- The Smart City Energy (SCE) project, for which preparation started in 2013.
- A project dealing with intelligent management of electrical power networks (smart grids), which will notably involve one or several network operators.

3/About Safety and Multimedia

- The Interoperability and Cybersecurity Evaluation (EIC) project, for the development and deployment of an experimental and human environment dedicated to research, assistance with development (SMEs) and qualification of innovative pre-competitive solutions in the field of cybersecurity.
- A project especially focused on image and video processing.

Modeling - Interoperability - Communication (MIC) project

Partners

- **Alstom Transport**
- **Renault**
- **CEA**
- **IFSTTAR**
- **Inria**
- **Université Pierre et Marie Curie**

> The MIC project aims to:

- develop technologies that improve multimodal travel, principally in urban areas, firstly by optimizing the means of transport (capacity, performance, and energy consumption) and, secondly, by providing supervision within transport systems, allowing optimal operational running within the day-to-day reality of needs and unpredictable factors;
- demonstrate the usability of the technological components developed, through demonstrators representative of real-life usage scenarios, and evaluate the associated economic models;
- extend the capabilities of the system development environments, to effectively implement a "systems of systems" dimension compliant with security-of-operation requirements;
- specify the open systems of systems architecture with regard to an attractive number of project models for the various players in transport systems;
- facilitate the analysis of alternatives, from both a "business" and "technical" angle, by constructing a modeling framework interlinked with these two aspects, allowing the description of different "structured" scenarios, and enabling their verification and comparison.

CAPACITY MAXIMIZING · ENERGY SAVING · TIMETABLE ACCURACY · REROUTING
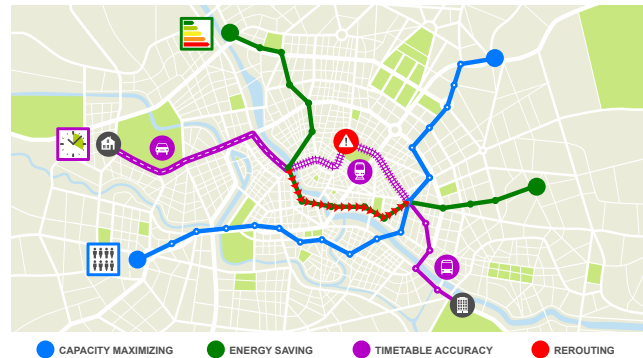
Challenges to address in a multimodal transportation network

● Challenges

The description of the targets above highlights the innovative nature of the project: its main ambition is to demonstrate the associated concepts and to validate them in the laboratory to attain a Technology Readiness Level (TRL) of 3 to 4, depending on the components concerned.

● Targeted markets

The MIC project has a "product concepts" goal allowing one to demonstrate both the feasibility and identification of economic models. It mainly addresses collective services, targeting the sizing, positioning and regulation of mobility systems, to increase their efficiency.

The project aims at covering two levels of usage:

- optimization and operation of a multimodal transport system;
- optimization and operation of a unitary transport system (a metro line, a tramway line, a bus route, fleets of shared and self-service vehicles, etc.).

The principal players are:

- the operational organization center of transport systems within the zone;
- transport operators handling the operational running of each means of transport.

Localization - Augmented Reality (LRA) project

Partners

- **Alstom Transport**
- **CEA**
- **M3 Systems**
- **OKTAL**
- **Renault**
- **SafeRiver**
- **Sysnav**
- **Valeo**

> The purpose of this project is to analyze and develop technologies and services for information processing and visualization for the automobile and rail sectors:

- study new interactions and interfaces between the driver (or rail system) and the vehicle, notably based on augmented reality technology;
- study location systems procuring a cost/performance/security breakthrough.

Challenges

- Invent, experiment with and simulate future driver/smart vehicle relations, particularly exploring the possibilities of autonomous vehicles (automobile case).
- Contextualize relevant virtual information items within the driving scene.
- Identify and combine location systems achieving a financial breakthrough while preserving security of operation.

At present, existing vehicles (rail and road) have no or little augmented reality capability. The project's goal is to provide information that is not directly accessible to the driver or to the rail system, with a location need achieving a breakthrough (in terms of cost or security).

Location for guidance is currently mostly resolved in outdoor environments with GPS or, in the case of rail systems, with environment-sensitive sensors. However, new systems for driving assistance, such as augmented reality for navigation assistance (insertion of virtual data synchronized with the environment) demand a more-exact degree of location, and with greater speed than GPS can provide.

Testimony

"M3 Systems is partnering with SystemX to work within LRA collaborative project involving many complementary players and end users in the area of positioning and localization technologies. This project is a great opportunity for us to address the railway market and to position ourselves to meet future industrial needs. More generally, our involvement within SystemX creates a competitive advantage to launch new products".

Marc Pollina, Chairman, M3 Systems

Thus, the project examines:

- information processing and merging;
- rendering via display technologies at the driver position, for road vehicles and rail systems. In both cases, an appropriate degree of security of operation has to be achieved (the road vehicle driver will need to be reassured that he/she can delegate driving to a non-human system);
- human factors, to ensure effectiveness of interaction.

Targeted markets

The project targets the automobile and railway markets, and the applications are:

- exact and sure location;
- relaying of railway trackside signaling to the driver's cab;
- supervising road vehicle driving;
- road vehicle HMI (human-machine interaction) supervision;
- HMI content/visual grammar;
- rendering technologies.

Multimedia Multilingual Integration (IMM) project

Partners

- Bertin Technologies
- Capgemini
- EXALEAD
- Ministère de la Défense
- OVH.com
- Systran
- Temis
- Vecsys
- Vocapia Research
- CEA
- Inria
- LNE
- Université Pierre et Marie Curie

● Challenges

> The IMM project comes within a context of an increase in the data produced and disseminated in the world, with the volume doubling every year. The project has to fill a need for the development of tools to help a monitoring user extract knowledge from an unstructured data stream (mainly text and audio), that is useful at a given time for producing a report or taking a decision.

● Objectives

1/Monitoring application platform and prototype

The prime objective is the deployment of a testing, development and evaluation platform for components and applications dedicated for the analysis of multimedia and multilingual content provided by the partners (information extraction, speech transcription, translation, information searching, and graph analysis).

2/Adaptation for a new language - particularly a little-used language

To be able to deploy and evaluate the complete chain of processing operations, the various components of the platform must be able to process data in different languages (obligatorily French, English and Arabic and, optionally, Russian, Chinese and Persian).

3/Ability to overcome noise and adaptation of the processing system to the style of the document

The goal is to study the process of constitution of resources from corpus, to adapt a system to a particular style. This is a keystone element of the project that will ensure the robustness of the templates to noise and style variations. The system needs to be able to adapt the processing operations to the properties and salient characteristics of the documents analyzed.

4/Advanced information extraction

Improved quality of analysis of individual documents and extraction of basic semantic information, such as named entities, has to benefit higher level functions such as the extraction of facts from documents with diverse content, and navigation within information search results.

● Targeted markets

The studies to be undertaken will notably address upscaling, support for multiple information items within the links and nodes of the network, support for its dynamic aspect, and the development of visualization tools suitable for large-scale networks. The domains of usage targeted are contingency management, cybersecurity and strategic monitoring.
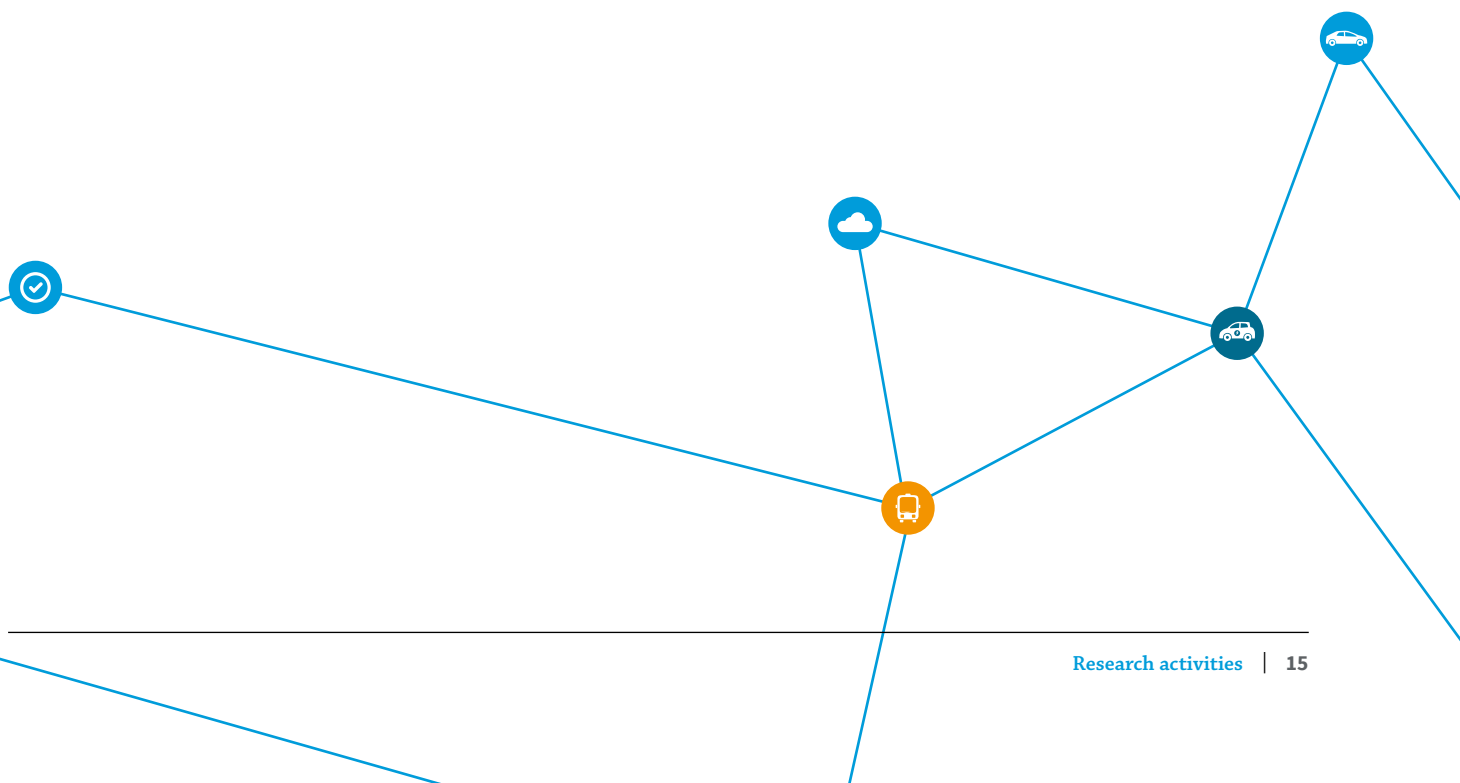
PLM Interoperability & Standards (SIP) project

Partners

- **Airbus Group (ex-EADS)**
- **Boost Conseil**
- **Datakit**
- **OVH.com**
- **SOFYNE**
- **Université Paris 8**

> Manufacturing industries (aeronautics, automotive, railway, etc.) increasingly depend on "models" (computerized representations that can be handled by IT systems) as opposed to the "document approach", which is based on a machine-readable representation of what can be presented in paper-based form. This is true throughout the life cycle, from the preliminary study and design stages to after-sales support.

● Challenges

The results of the PLM Interoperability & Standard (SIP) project - and notably the **testbed** for the evaluation of standards and their implementation - have to integrate into the standardization landscape, so as to provide an understanding of the industrial stakes attached to the standards, and so as to steer the development of these standards as a function of implementation targets, with the required degree of maturity. Therefore, the SIP project has to be a driving force for the accumulation of a community around its platform.
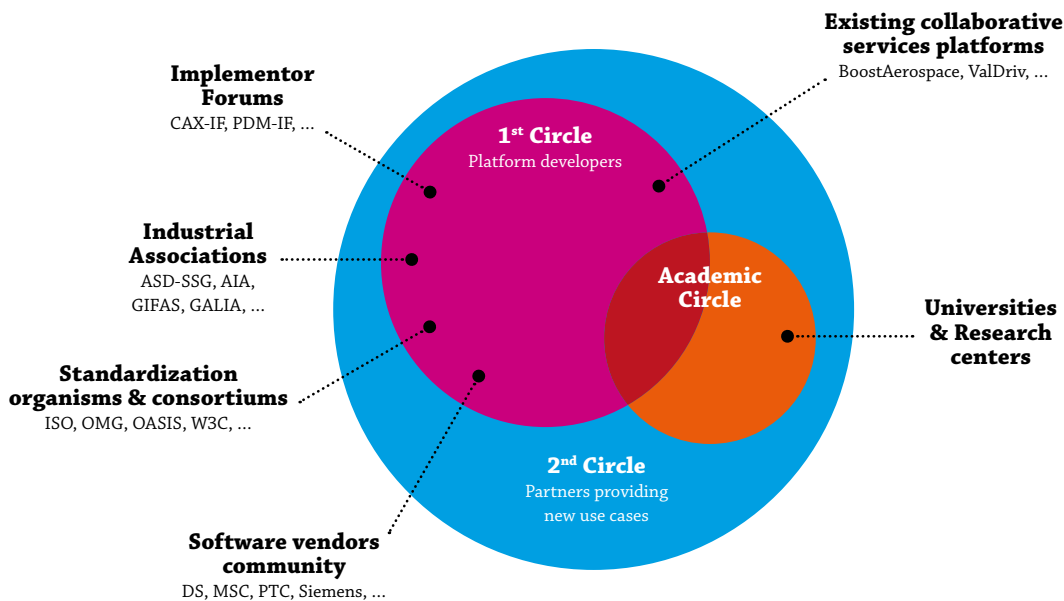
An initial circle of partners is necessary to establish the architecture of the testbed and validate it on the first industrial cases. A second circle of broader partnership then has to be formed quickly, so as to feed the first version of the platform with new cases and, in particular, to implement a desired transversal extension, both for cases within a particular industry and for cases covering multiple industries. The university circle is composed of universities and laboratories interested in the subject. Some are members of the first circle, while others are being regularly consulted and informed by the universities of the first circle.

This means that the testbed has to both feed and be fed by:

- manufacturers wanting to test the usability of a standard within their business processes;
- software companies wanting to test the implementation of a standard within their system on cases of industrial usage, or wanting to know how to implement a standard;
- academics, for testing new methods and systems of interoperability, drawing on industrial study cases provided within the platform;
- industry bodies and standardization organizations working on the same types of standard as the cases covered within the platform;
- the other existing PLM collaborative platforms.

PLM ecosystem:

Strategy for competitiveness and growth

Training program: stakes and prospects

Gaëlle Berthomieu,
Training and SMEs Relations programs Manager, SystemX

SystemX's training program is intended, firstly, to support systems digital engineering training by further education and research institutions, in accordance with the needs of industrial companies and corporations, and in association with the research projects underway at SystemX and, secondly, to contribute to the development of the lines of expertise necessary for training engineering adapted for students.

Thus the methodology of deployment of a **systems engineering expertise, professions and training observatory** has been confirmed. Based on the skills study consolidated by the Systematic PARIS-REGION, in 2006, and the French Systems Engineering Association (AFIS, *Association Française d'Ingénierie Systèmes*) in 2011, this observatory will list all needs in terms of training on this subject.
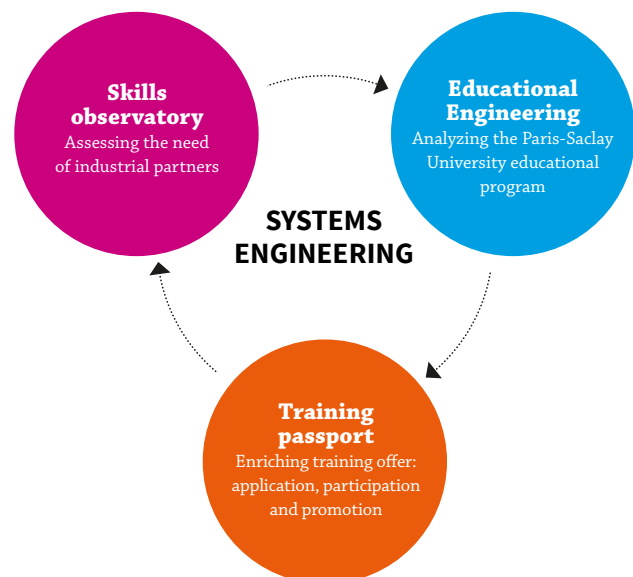
The observatory will be based on the following:

- A survey to assess the needs of SystemX's partner enterprises regarding system engineering lines of expertise;
- An analysis of the Paris-Saclay University training offering with regard to the aforesaid lines of expertise;
- A comparison of expressed needs with the offering, and selection of lines for improvement.

This study is cross-referencing needs expressed by firms within the ecosystem and the training offering within the perimeter of the future Paris-Saclay University in 2014. This will complete the existing range of training.

With regard to the **educational engineering**, which falls within the scope of the organization work for the Paris-Saclay Campus, SystemX is collaborating with the future Paris-Saclay University on the compilation of a catalog of training courses for SystemX doctoral students. A "**training passport**" will be extended and specialized for the various SystemX populations, particularly research engineers and partners coming to work on the institute's research projects. This passport will be a certification of quality to be promoted within the career history of the person concerned.

With regard to the training of doctoral students, SystemX has continued its involvement in the ICT doctoral school and a collaboration with the interfaces graduate school is under study.

SystemX's Training program

Skills observatory
Assessing the need of industrial partners

Educational Engineering
Analyzing the Paris-Saclay University educational program

SYSTEMS ENGINEERING

Training passport
Enriching training offer: application, participation and promotion

SystemX

SystemX has also developed a comprehensive range of training courses which involves either the intake of individual trainees into our R&D projects, or the induction of trainees into so-called CRÉE (Enterprises/Students Research Cooperation) projects. These courses are end-of-studies projects for students, and last 5 to 6 months. They provide a unique working environment because of the close proximity to SystemX research teams, an operational management conducted by reference technical experts of the research institute, close contact with multiple industrial partners or academic laboratories, and access to shared facilities. A CRÉE project accommodates 4 or 5 trainees, and gives them practical experience in forms of expertise in a variety of fields applied to an industrial scenario. Each student has a precise objective keyed on a specific training subject, and provides the "system" team with particular skills (systems, software, simulation, information technology, marketing, etc.).

This CRÉE program accommodates 20 to 25 trainees working on themes such as cloud computing, intensive computation, driving simulation and modeling, and simulation and optimization of digital models, focusing on the following subjects:

- reduction and optimization of simulation models, with the production of a human/machine interface (HMI);
- production of a demonstrator of a Web service with digital optimization;
- specification of the reference future architecture for private clouds;
- specification and implementation of an intermediate-sized intensive computation platform;
- implementation of a car driving simulator, for evaluating the use of driving assistance.

● Perspectives

In 2014, a Training Orientation Committee (COF) will be founded to support all this work, and will draft a mapping of an offering of training courses contributing to accumulating the fields of expertise sought by companies, disseminating and providing training modules that could seed SystemX's R&D projects, and disseminating and creating additional training modules, where appropriate, subsequent to the study of skills requested by companies. The committee will also have a role of relaying information about new training courses that become available in the ecosystem. It will be staffed by a representative from each of the academic partners wanting to be involved, notably the director responsible for training within the Paris Saclay Campus Foundation.

System×

INSTITUT DE RECHERCHE
TECHNOLOGIQUE

2014 and after...

2013 2015

PHASE 1

Establish a critical mass of skills in digital systems engineering.

Deploy technological reference platforms for accelerating technology transfer.

Work on acquiring European and international recognition.

2015 2019

PHASE 2

Act as an European player in systems, and systems of systems engineering, supporting the involvement of SMEs in Europe.

Extend the usage of technological platforms with Europe platforms to support SMEs development and businesses structuring.

Become an expert in systems engineering (methods, technologies, tools and standardization).

2020 >>>>

PHASE 3

Be an international reference center in systems digital engineering.

Maintain the industrial financial commitment regarding projects and assigned staff.

Operate technological reference platforms for accelerating the technological transfer and consolidating business expertise.

Visibility and promotion

Located within the Paris-Saclay University's campus, and thanks to the Systematic PARIS-REGION ecosystem and know-how, SystemX's vision is to become a reference center in Systems Engineering. In colocating research teams and supporting inter-disciplinarity between high-tech market segments, SystemX will enhance its efficiency and attractiveness.

In a general manner, SystemX will promote the construction of a support mechanism for Open Source technological components produced by French laboratories and used by the research institute's industrial partners. SystemX will lend support to initiatives targeting the attainment of excellence in connection with its lines of research, notably those of the Paris-Saclay Center for Data Science and TerraLab pertaining to massive and heterogeneous data processing.

Its relationship with the other French IRTs will allow to consolidate the promotion of the co-located cooperation model, and to underpin the first European-level initiatives.

From the communications viewpoint, SystemX has established a strategy in close correlation with the institute's global objectives. All communications operations undertaken by SystemX are designed to promote the institute's image, to give it a profile, and to put across the values it enshrines, both internally and externally, covering all possible targets.

SystemX has concluded close **partnerships** with players in the businesses and industries concerned: the **CESAMES** association, which runs two international scientific conferences in the field of complex systems, and of which SystemX is a member of the organization committees; the **TERATEC** campus, which federates big industrial companies involved in simulation and high-performance computing; and the French Systems Engineering Association (AFIS, *Association Française d'Ingénierie Systèmes*), which supports the dissemination of best practices in systems engineering, and is the French chapter of INCOSE.

With regard to external communication, the aim is to promote SystemX and inform every audience (partners, institutional targets, and press relations) about the progress the research organization is making with its projects. In 2013, SystemX organized, steered and took part in a good number of events, conferences and seminars.

Internal communication is also an essential stake for SystemX, because one of the institute's goals is to federate people and ensure the cohesion around a single culture of teams brought together from various backgrounds.

Looking forward to the prospects for 2014, the communications strategy will underpin the research institute's positioning in the systems engineering field, in respect of research operations and the associated roadmap, training operations, and internal and social communications actions.

2013 News

2013 Events

December 4-6	CSD&M2013
November 19	South Paris Engineers Forum
November 13	ICT Paris-Saclay Forum 2013
October 10	1st IRTs technological research institutes Forum
September 19	Technopolice 2013
June 25 and 26	Teratec Forum
June 17	Systematic PARIS-REGION Convention
February 21	SystemX official launch

2013 Press Releases

December 13, 2013	The three major players in Information and Communications Technology of the Saclay campus (Digiteo, DigiCosme, SystemX) organize the ICT Paris-Saclay Forum 2013
October 15, 2013	SystemX launches the Automobile Electronics and Software (ELA) project
October 4, 2013	SystemX present in Rennes alongside big names in French innovation, at the first IRT technological research institutes national forum
September 26, 2013	SystemX acquires its Scientific and Technological Council
September 26, 2013	SystemX's Scientific and Technological Council elects its Chairperson, Yves Caseau
September 12, 2013	New project: Modeling - Interoperability - Communication
July 22, 2013	SystemX places French research at the heart of Big Data
June 27, 2013	SystemX launches the Model Reduction and Multiphysics Optimization project
May 30, 2013	New project launched within SystemX: Engineering and Multi-disciplinary Simulation
May 15, 2013	SystemX announces the launch of the technological research institute's first project
April 30, 2013	Stay connected with SystemX on the Web!
April 25, 2013	SystemX is hiring!
April 4, 2013	LINCS, the international laboratory for the networks and services of the future, welcomes SystemX as one of its partners
February 22, 2013	SystemX, an asset for the ecosystem
January 30, 2013	Official launch
December 6, 2012	Make digital simulation applications available in the *cloud*
November 13, 2012	Operational startup
November 13, 2012	Board of Directors

Governance

Board of Directors

Name	Position	Entity
Pascal CLERE	Chairman	Alstom
Antoine PETIT	Treasurer	Inria
Jean-Luc BEYLAT	Member	Systematic PARIS-REGION
Pierre GOHAR	Member	Campus Paris-Saclay
Gérard MEMMI	Member	Institut Mines-Télécom (IMT)
Eric MONCHALIN	Member	Bull
Joël MONNIER	Member	Kalray
Alban SCHMUTZ	Member	OVH.com
Jean-François SENCERIN	Member	Renault
Dominique VERNAY	Member	Campus Paris-Saclay
Atilla YAZMAN	Member	Sherpa Engineering
Yves CASEAU	Permanent guest	Scientific and Technological Council, SystemX
Maryse DARNAUDGUILHEM	Permanent guest	Académie de Versailles
Flore LAFARGUE	Permanent guest	DIRECCTE
To be named	Permanent guest	CRIF

Scientific and Technological Council

Yves CASEAU	Chairman, Scientific and Technological Council
François BOURDONCLE	Co-Founder and Chairman of the company Exalead
Henri CALANDRA	Expert in digital methods for the geosciences and high-performance computing (Senior Advisor, Depth Imaging and High Performance Computing) within the TOTAL Group
Patrick GODFREY	Professor of Systems Engineering at Bristol University
Marta Zofia KWIATKOWSKA	Professor of Information Technology at Oxford University
Rudy LAUWEREINS	Vice President of IMEC Academy
Michel MORVAN	Chairman and Co-Founder of The COSMO Company
Agnès PAILLARD	Director of Research and Technology within the EADS Group
François PIERROT	Director of Research and Robotics at the Laboratory of Information Technology, Robotics and Microelectronics (LIRMM) of Montpelier
Tom RODDEN	Professor of Interactive Systems at the Mixed Reality Laboratory (MRL) of Nottingham University
Frédérique SEGOND	Director of the Research and Development Center of the Viseo Group
Bruno SUDRET	Professor of the Institute of Structural Engineering (ETH) in Zürich

"Technologies and Tools" program Orientation Committee

Name	Position	Entity
Laurent ANNE	Sales and Marketing Director	Distene
Eric BANTEGNIE	Chairman and Chief Executive Officer	Esterel Technologies
Gérard CRISTAU	Senior Expert	Thales Research & Technology
Philippe DAGUE	Director of LRI (Laboratory for Computer Science)	Université Paris-Sud
Mathieu DAKOWSKI	Head of Methologies and Development Tools Department	Safran Group
Eric DUCEAU	Scientific Director	Airbus Group Innovations
Roberto DI COSMO	Director of IRILL (research and innovation initiative dedicated to open source)	Université Paris Diderot
Gilles FLEURY	Director of Research	Supélec
Claude GOMEZ	Chief Executive Officer	Scilab Enterprises
Olivier GUETTA	Lead Expert, Embedded Software Technologies	Renault
Thierry HOUDOIN	Head of Strategy	Orange Labs
Jean-Pierre PANZIERA	Engineering Director	Bull
Pascal POISSON	R&D Program Director	Alstom Transport
Jean-Noël PATILLON	Scientific Director	CEA LIST
Nunzio SANTORO	Director of Innovation and Development	Institut Mines-Télécom
Yves SOREL	Research Director	Inria
Samir TOHME	Director of the PRISM Laboratory (Parallelism, Networks, Systems, Modeling)	Université Versailles Saint-Quentin-en-Yvelines (UVSQ)

"Systems of Systems" program Orientation Committee

Name	Position	Entity
Jean-Marc ALEXANDRE	Strategy and Programs Director	CEA LIST
Serge BERTRAND	Engineering Director	Alstom Transport
Yolaine BOURDA	Professor, Head of the Information Technology Department	Supélec
Alain DAURON	Head of Systems Engineering	Renault
Hervé DEBAR	Head of the Networks and Telecommunications Services Department	Institut Mines-Télécom (IMT)
Etienne GEHAIN	Head of R&D	GDF Suez
Louis GRANBOULAN	Senior Expert	Airbus Group Innovations
Athanasios KONTOPOULOS	R&D Director Applied Mathematics	Air Liquide
Daniel KROB	Professor	Ecole Polytechnique
Laurent PAUTET	Professor, Embedded Systems	Mines ParisTech
Gérard POIRIER	Head of R&D Partnerships	Dassault Aviation
Arnaud REICHART	Deputy Director	ENSTA ParisTech
Marc SCHONAUER	Research Director	Inria

Partners

Airbus Defence & Space (ex-EADS Astrium)	Safran Group
Airbus Group (ex-EADS)	Scaleo Chip
Alcatel-Lucent	Scilab Enterprises
Alstom Transport	Sherpa Engineering
APSYS	SOFYNE
Bertin Technologies	Supélec
Boost Conseil	Supméca
Bull	Sysnav
Capgemini	Systematic PARIS-REGION
CEA	Systran
Cenaero	TEMIS
Continental	Trusted Labs
Datakit	Université Paris 8
Distene	Université Paris-Sud
Ecole Centrale Paris (ECP)	Université Pierre et Marie Curie (UPMC)
ENSTA ParisTech	Université Versailles Saint-Quentin-en-Yvelines (UVSQ)
ESI Group	Valeo
ESTACA	Vecsys
Esterel Technologies	Vocapia Research
EXALEAD	Wallix
FCS Campus Paris-Saclay	
Geensyde	
Gemalto	
IFSTTAR	
Inria	
Institut Mines-Télécom (IMT)	
Intempora	
Kalray	
Krono-Safe	
LNE	
Ministère de la Défense	
M3 Systems	
OKTAL	
Open Wide	
Orange	
OVH.com	
PSA Peugeot-Citroën	
Renault	
SafeRiver	