INFORMATION SHEET

Systems engineering

Managing the system design cycle

Systems engineering is an approach that relies on methods, tools and standards to formalise and control the design chain. It starts from the very definition of needs, and realizes the implementation of the system, including its validation.

It consists of building and operating a system according to the needs and requirements expressed by the various stakeholders (designers, users, authorities, maintainers, etc.) throughout its life cycle. In this context, the complexity of the system is not only related to the different technological dimensions of the system. It must also consider the organisational aspects of the stakeholders.

CHALLENGES

There are multiple challenges of systems engineering: ensuring digital continuity in extended organisations, managing consistency in the design of large systems, analysing the impact and anticipating the control of architectures to guarantee costs, and finally controlling the safety of people and the system throughout the design cycle.

POSITIONING OF THE INSTITUTE

Since its creation and due to its focus on the engineering of complex systems, IRT SystemX has identified systems engineering as a research priority area. The institute has therefore acquired a large volume of skills in this field to provide state-of-the-art solutions and to carry out more upstream research work, in particular on collaborative engineering, system interoperability and requirements engineering.

EXPERTISE

Collaborative engineering, systems interoperability, integration, elicitation, requirements traceability, model engineering, heterogeneous models, MBSE (Model-Based Systems Engineering), reference architectures, extended enterprise.

Projects in this field

Project I(SC)²

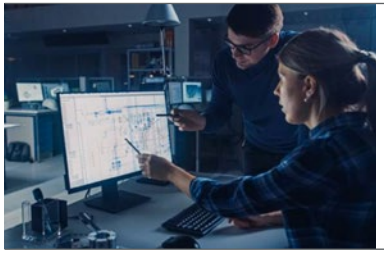
Collaborative System Engineering of Complex Systems to control complexity, costs and associated risks

- Defining and controlling collaboration processes between stakeholders
- Control of the complexity and make data exchanges smoother
- Control of architectures

CMI projet

On the development of an Interactive Multimodal Cockpit for the car with driver delegation, reducing the cognitive load of the driver and improving intuitiveness

- Contribution of meta-modelling to the product design process
- Designing a dedicated modelling language that connects and represents marketing, user experience, product families and underlying technologies



S2C projet

System & Safety Continuity: improving the development and certification processes of complex systems

- Tool-based process for implementing and maintaining consistency between models of system engineering and safety analysis
- Educational content on MBSA (Model-Based Safety Analysis) and co-engineering methodology

Exploratory research

- Instantiating reference architectures
- The human aspect in systems engineering
- Checking for the consistency of heterogeneous behavioural models in systems engineering and safety analysis

Roadmap

SCIENTIFIC AND TECHNOLOGICAL CHALLENGES	RELATED RESEARCH FIELDS
Collaborative engineering	• Reconciliation of views • Process orchestration • Improvement of socio-technical factors • Coupling of engineering (bi-engineering)
Interoperability of systems and integration	• Technical, semantic and syntactic interoperability • Dynamic interoperability (co-simulation, continuous heterogeneous simulation, event-driven, etc.)
Efficient requirements engineering for the MBSE (Model-Based System Engineering)	• Eliciting traceability • Consistency between requirements and models • Impact of system specification methods using AI techniques on system engineering - Improving the quality of requirements with AI techniques

Platforms and demonstrators

MOSAR

Autonomous Systems Assessment Platform

- Definition and management of safety-relevant scenarios for autonomous systems
- Case generation for the provision of test plans
- Application to safety validation of autonomous vehicle behaviour

Target of IRT SystemX publications in this field (HAL collection)

● JOURNALS

Journal of Systems Engineering, Journal on Software and Systems Modeling

● CONFERENCES

ISSE (International Symposium on Systems Engineering), SysCon (Annual IEEE Systems Conference), SoSE (System of Systems Engineering Conference), ICSEng (International Conference On Systems Engineering), ICECCS (International Conference on Engineering of Complex Computer Systems), EDOC (Conference in Enterprise Computing)

Systems engineering

ACADEMIC PARTNERS

CentraleSupélec
isae supméca
Institut Mines-Télécom
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE
SORBONNE UNIVERSITÉ
université PARIS-SACLAY

RESEARCH GROUPS AND SCHOLARLY ORGANIZATIONS

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Renault Group
SAINT-GOBAIN
SAMARES ENGINEERING
THALES Building a future we can all trust
transdev the mobility company
Valeo

ABOUT IRT SYSTEMX

SystemX is a technological research institute (IRT) with expertise in the fields of analysis, modelling, simulation and decision support for complex systems. As the only IRT dedicated to digital systems engineering, it coordinates partnership research projects, bringing together academics and industry in a multi-sector perspective. Together, they work to solve major scientific and technological problems in four priority application sectors: Mobility and Autonomous Transport, Industry of the Future, Defence and Security, Environment and Sustainable Development.
Through use-case oriented projects, SystemX's research engineers respond to the major societal and technological challenges of our time, and thus contribute to the acceleration of the digital transformation of industries, services and territories.
Located at the Paris-Saclay plateau and in Lyon, SystemX was created in 2012 as part of the future investment programme.

IN THE TEAMS

22 engineers-researchers

9 PhD projects
8 defended

(September 2021)

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