



Editorial

Dear Reader,

It is our pleasure to present to you the first issue of our Road2SoS newsletter, marking the beginning of a series of publications aimed at giving you an insight into what is going on in the project.

In this first issue, we would like to start by introducing you to the general concept of a system of systems and the Road2SoS project.

We hope you will enjoy reading and are looking forward to sharing future news with you in the coming issues. Moreover, we would like to invite you to visit our website at [www.road2sos-project.eu](http://www.road2sos-project.eu) which is also intended to keep you updated about all project activities.

Yours sincerely,  
**The Road2SoS consortium**

The system of systems concept and the Road2SoS project

What is a system of systems?

In today's developed economies, an increasing number of interacting systems can be observed. In all sectors, the several systems involved in performing various tasks tend to not be self-contained any more, not being controlled individually, but rather communicate with other relevant systems taking into consideration inputs from other systems for their behaviour. Among the innumerable examples, you may consider systems for traffic control, for energy distribution, or for controlling multi-site industrial production (see case studies on the following pages). In any of these cases, the resulting meta-system is assumed to offer, by synergy, more functionality and better performance than the sum of the constituent systems.

The increasing number of such systems has triggered a need to enhance the classical view of the domain of complex systems engineering and thereby a paradigm shift to the emerging, more holistic concept of a system of systems (SoS). To date, there is no universally agreed formal definition of an SoS. However, there is a common understanding with respect to the characteristics of a system of systems:

**Interconnected constituents:** Constituent systems and their stakeholders are the elements that together constitute a SoS.

**Autonomous operation:** The several constituent systems of an SoS can and may be required to exist as a coherent whole apart from the SoS.

**Emergent properties:** An SoS behaves as a collective whole dynamically inter-

acting with its environment and may become greater than – and even different from – the sum of its parts.

**Evolutionary development:** The conceptual, functional, physical and temporal set up of the SoS is continuously evolving and affected by both the internal collective behaviour and by interaction with the environment.

**Geographic distribution:** The constituent systems may possibly be widely distributed.

**Dynamic stakeholders:** The roles and responsibilities of all stakeholders and their interactions with each other can potentially enable or impede the development of the SoS, its management and its operation.

The inherent complexity and dynamics of an SoS raise many questions which

Development of strategic research and engineering roadmaps in Systems of Systems Engineering and related case studies

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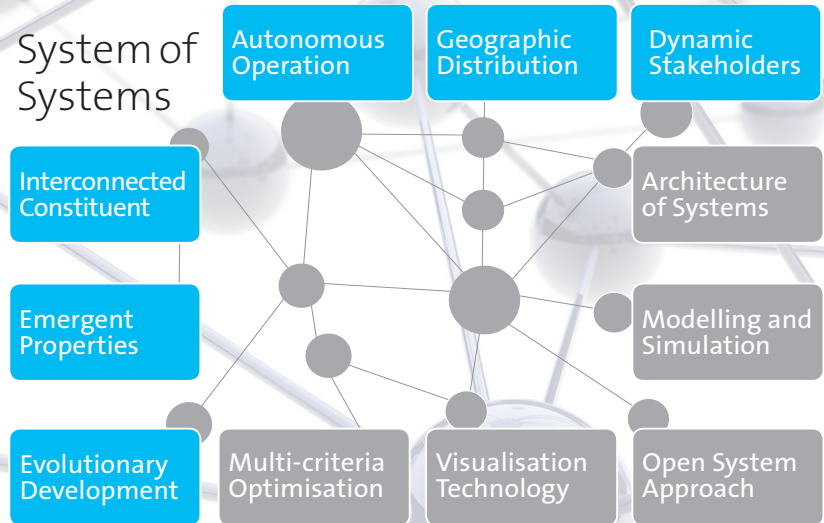
nowadays are subject of important research efforts concerning e.g. the architecture, the modeling and simulation, the optimisation as well as the visualization of these systems.

The SoS approach promotes a new way of thinking in order to address grand societal challenges where the interaction of technology, policy and economy are the primary drivers. Identifying the most crucial fields of research and providing the new domain of SoS with identity and direction is thus of great importance to be able to leverage the power of SoS for the European economy.

**This is where the Road2SoS project comes into play.** The overarching aim of Road2SoS is to develop research and engineering roadmaps to identify future RTD and Innovation (RTD+I) strategies for Europe in the field of SoS Engineering in four key domains, represented in the figure below. In each domain, we will identify the most relevant trends and upcoming SoS developments. This will enable us to deliver recommendations on most relevant SoS research priorities and, along the way, facilitate a clear understanding of the SoS concept and build collaboration links among the SoS community.

The roadmaps will comprise the latest high-level scientific results in research, development and innovation relevant to SoS engineering and identify trends. They will outline which of them are technically, socially and economically most promising and possess the highest potential for problem-solving and present SoS concepts, methods, tools and architectures that address existing societal needs. The roadmaps will help research institutions as well as companies to adapt their development of novel methodologies and engineering

## System of Systems

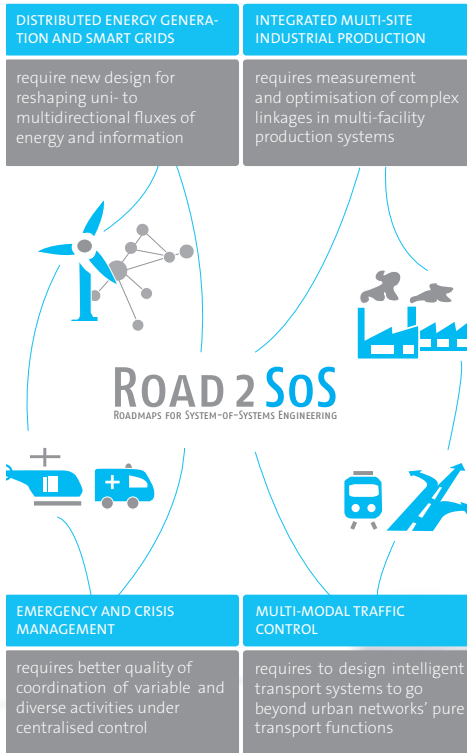


approaches for designing, developing and running large scale, complex, distributed and cooperating systems. Road2SoS will thus support European

organisations in staying at the forefront of these new developments, reinforcing the leading position of the European industry in Complex Systems Engineering.

Road2SoS started in October 2011, so we are still in the early stages of gathering data as a basis for the roadmapping.

Find out more about our approach and follow our progress on [www.road2sos-project.eu](http://www.road2sos-project.eu).



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## The Road2SoS Partners

We believe that the development of research and engineering roadmaps adapted to the industrial and societal demands of European economies is only adequately approached through the collaboration of several types of organisations from several European countries.

The partners of the Road2SoS project have therefore been carefully selected, each bringing complementary expertise to the consortium.

Two groups of organisations from four European countries will strongly collaborate in the project:

**Organisations specialized in knowledge transfer and the development of technology roadmaps**

**Leading research organisations in the field of SoS and in the four industrial domains investigated**

For more information about the partners and their background, please visit our website at [www.road2sos-project.eu](http://www.road2sos-project.eu)



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Get to know some of the exciting domains investigated in Road2SoS through the show cases on the following pages! Can you find the System of Systems in them?

## Show Case I - System of Systems for Road Dynamic Allocation

Traffic jams in urban areas have a very important impact on the transport system quality, and even more so on mass transport. Busses are directly affected by traffic jams caused by personal vehicles. Delays are the consequence, a reason why busses are often considered as less punctual than other means of public transportation. Also, these chronic disturbances of the public transport system have the direct consequence of reinforcing the competitiveness of personal vehicles versus public transport.

While bus corridors are effective in limiting the impact of traffic jams on public bus transportation, they constitute an inefficient use of road space. Moreover, in certain locations, the creation of permanent bus corridors is not even

possible. In such settings the system of systems approach can be a promising way of developing innovative systems of traffic control in order to increase the quality and efficiency of the busses network.

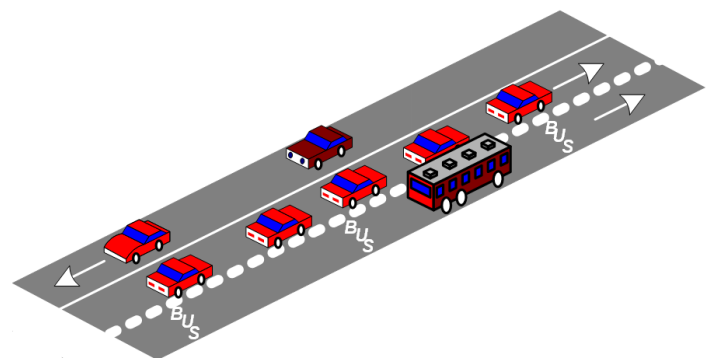
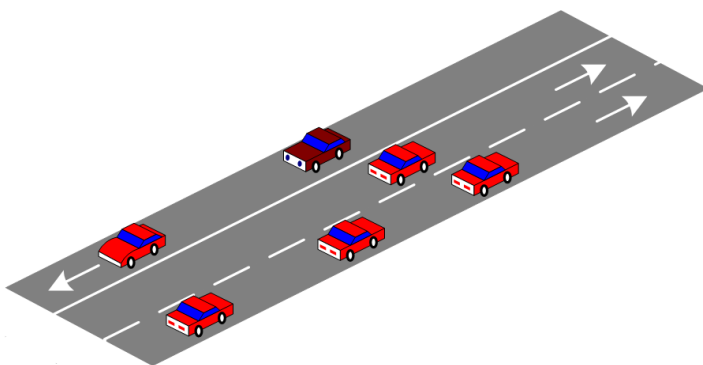
CEA and IFFSTAR are developing a road dynamic allocation system, the aim of which it is to allocate a part of the road network to a certain class of vehicles defined as high priority vehicles. Among them may be vehicles for public transportation or safety vehicles. In the case of public transportation a temporary bus corridor would be created whenever public transportation requires it to maintain its service quality.

The creation of a dynamic driving corridor is based on an innovative technol-

ogy allowing to classify in real time vehicles and informing drivers to avoid the reserved corridor.

The different systems which are composing this Systems of Systems are:

- Road marking System : on road LEDs
- Control Systems : traffic lights
- GPS
- On road sensor network System : detection and identification of vehicles
- RF Communication system : information exchange
- Dynamic heterogene traffic flow model : prediction and support for traffic control



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## Show Case II - Multi-site manufacturing

In many high-tech branches, like semiconductor, automotive and aerospace industry, where production is executed throughout various manufacturing sites, there is a need for the exchange of process details across the production sites.

Currently, in most cases only the (sub-) products are exchanged between the sites, the related production data is not transferred. This may lead to reductions of yield and quality due to the fact that this information could be useful for the execution of later production steps, e.g. it could provide support to decisions about further processing alternatives or the adjustment of process parameters. By means of tracking single products throughout the supply chain, i.e. not just tracking packaging entities etc. and by exchanging the data con-

cerning that certain products, e.g. test results or dates when certain manufacturing steps were executed, those losses could be minimised.

For such an information exchange, it is necessary that the participating organisations in a production network trust the infrastructure and information management system behind. Furthermore, the supply chain partners' facilities have to be integrated with regard to information exchange. Common interfaces specifying the protocols and contents are needed to enable on-demand communication of production data across production sites.

It is precisely in scenarios like this where the SoS perspective may prove especially fruitful. An SoS, suitably integrating the several systems at the several pro-

duction sites, could, of course, go even beyond simply approaching the challenges and solving the problems outlined above – for it is the very feature of an SoS to potentially provide enhanced capabilities not even thought of before.

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## Upcoming events

### **Workshop on System-of-Systems Engineering**

Karlsruhe, Germany

Month DD, 2012

For more information on the event and to enrol, please visit [www.emcl.kit.edu](http://www.emcl.kit.edu).

### **ARTEMIS Spring Event 2012**

Nürnberg, Germany

February 28 - March 1, 2012

For more information on the event and to enrol, please visit [www.artemis-association.eu/se2012](http://www.artemis-association.eu/se2012)

### **First Road2SoS Partner Meeting**

Cambridge, United Kingdom

April 17-18, 2012

For more information on the event please visit [www.emcl.kit.edu](http://www.emcl.kit.edu).

### **embedded world 2012**

Nürnberg, Germany

February 28 - March 1, 2012

For more information on the event and to enrol, please visit [www.embedded-world.eu](http://www.embedded-world.eu).

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