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Roadmaps and Recommendations for Strategic Action in the field of Systems of Systems in Europe



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EXECUTIVE SUMMARY

This document summarizes the findings of the Road2SoS project, co-financed by the European Commission under the 7th Framework Programme to develop a roadmap and recommendations for strategic action required for future deployment of Systems of Systems.

The term *System of Systems (SoS)* describes the super-system resulting from the large-scale integration of many independent, self-contained systems in order to satisfy global goals. SoS may vary in the degree of temporal stability, they may just come into existence for an ad-hoc cooperation or show longer term stability. The resulting meta-system is assumed to offer more functionality and performance by synergy than the sum of the constituent systems.

Two trends make SoS both *possible* and *necessary*: Driven by technological maturity and thus cost reduction, the first trend is an increasing number of IT systems and sensors dispersed in the world, moving or at fixed locations, ranging in dimension from very large to very small. The second trend is an increasing interconnection among such systems. Most of these systems are equipped with communication capabilities, they can be networked either permanently or communicate wirelessly from time to time. The number of connected devices has already exceeded the number of people on the planet. According to a recent study by IDC, a technology consultancy, 30 billion connected devices will exist by 2020.¹ A similar report of Cisco's Internet Business Solutions Group

predicts a number of 50 billion connected devices for 2020.²

The described two trends have an *enabling quality* and a *demanding quality* at the same time: On the enabling side, such a connected world offers an almost boundless innovation potential in diverse domains and helps tackle grand societal challenges. Never before in history has information been so available and never before have distributed actors been able to cooperate so easily. Coming historically from a world in which people lived under a lack of information, we are at the start of an era where information abounds, enabled by the described trends. With these trends, however, comes also an unprecedented and drastic increase in complexity. If society is to be increasingly based on such complex technological systems then effective ways of dealing with and reducing complexity are required. Traditional approaches of central control and superordinate management seem incapable of dealing with the vast ecosystem of networked systems that, today, is only in its infancy. In this regard, a paradigm shift and the need to enhance the classical view of System Engineering (SE) toward Systems-of-Systems Engineering (SoSE) is considered necessary.

In the Road2SoS project, a range of *priority themes* have been identified that require strategic action for Europe in order to benefit from the described trends (enabling quality) while effectively limiting the evoked complexity (demanding quality). To identify them, four application domains have been analyzed in parallel: Multi-modal traffic control, emergency and crisis management,

¹ MacGillivray, Turner, Lund, Kumar, Tiazkun (2013)

² Evans, Dave (2011)