



Software Engineering for ECS

Towards Dev-Ops-Adapt

Dr. Andreas Metzger
NESSI Steering Committee Vice Chair
andreas.metzger@paluno.uni-due.de

SW in ECS based digitisation

4 May 2021

About NESSI (www.nessi.eu)

- The **European Technology Platform for Software, Services and Data**
- **17 partners** and over **400 members** representing major ICT stakeholders
- Promoting horizontal nature and critical role of software and software engineering



Key Digital Technologies

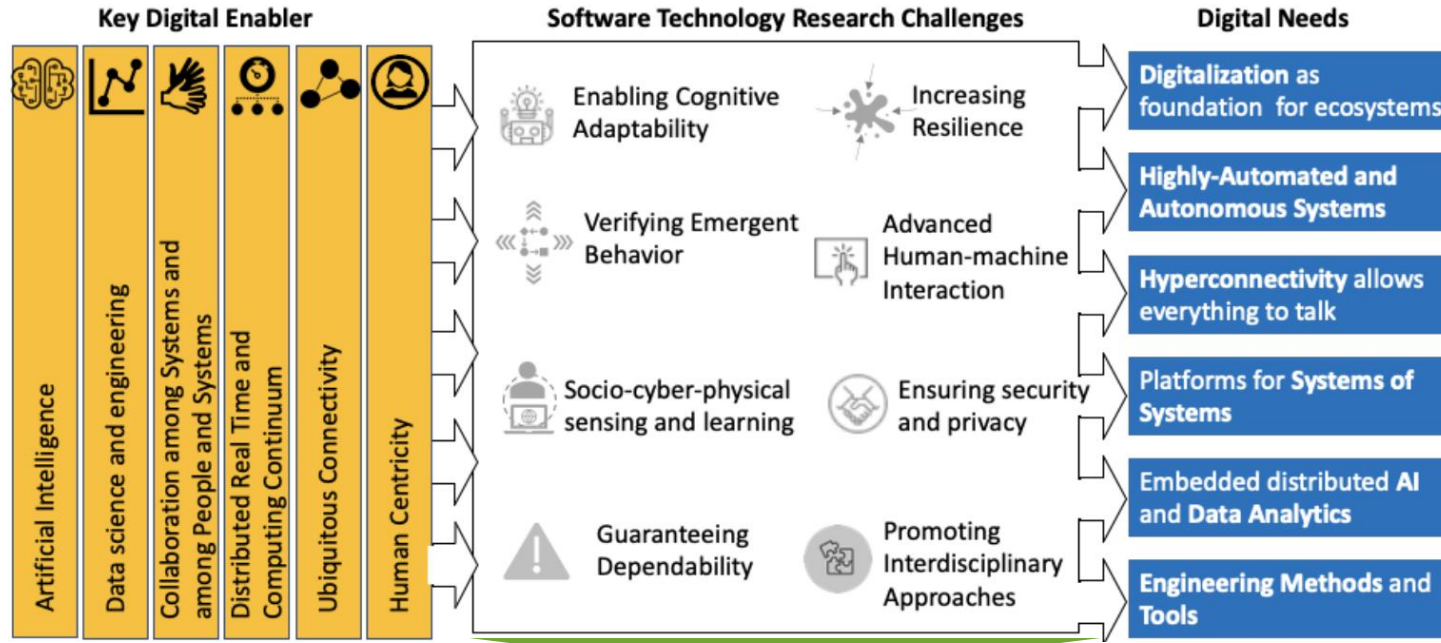
Smart Networks and Services

AI, Data, Robotics

NESSI: Relevance of Software + Software Engineering

The Big Picture

Software and KDT



NESSI R&I Topics

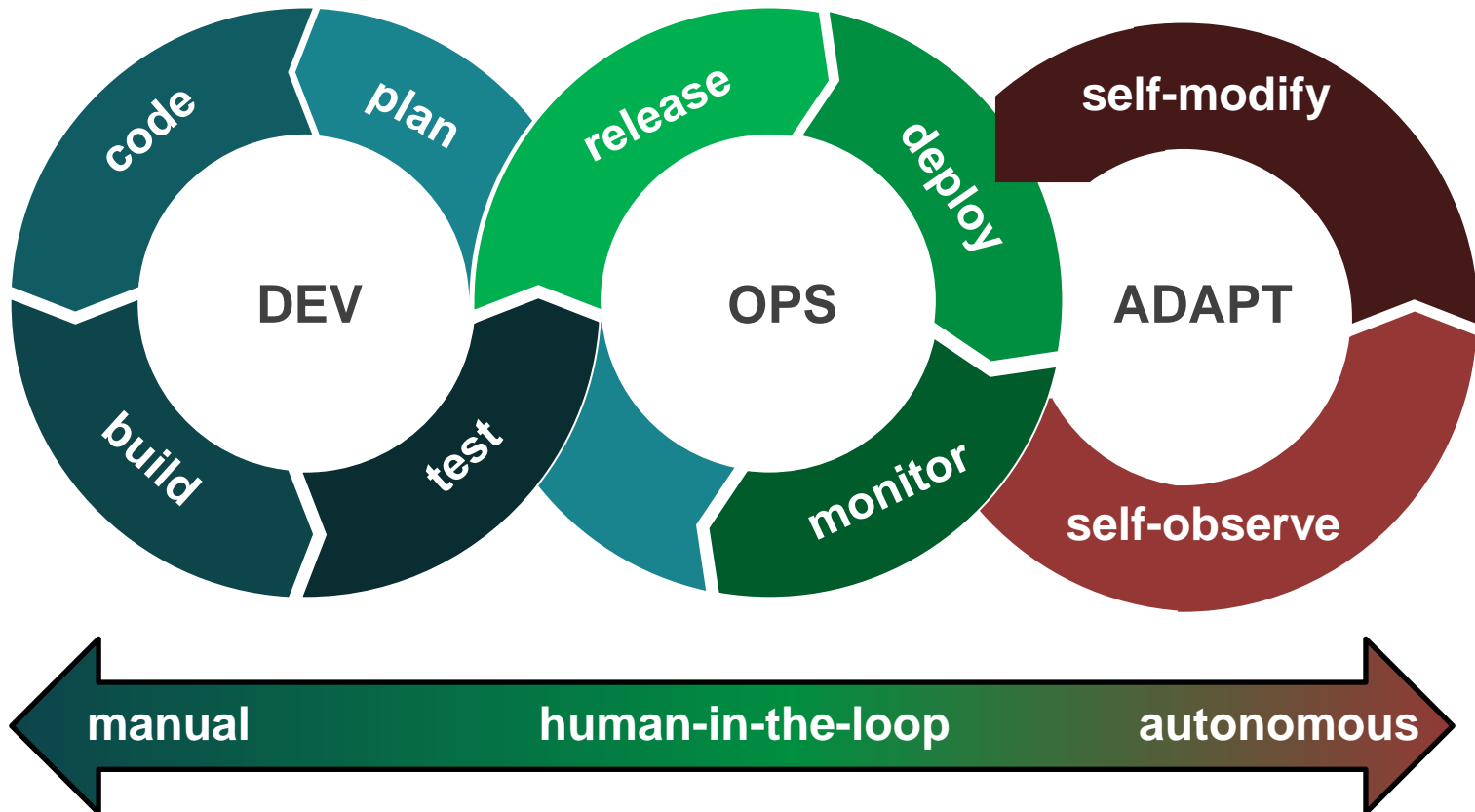
Focus today

1. Advanced software development methods for electronic components and systems
2. Software-driven integration of KDT applications
3. Trustworthiness of software and software development for KDT
4. Managing complexity, dynamics, and uncertainty of KDT applications
5. Software for Spatial Computing
6. Software for sustainability and energy efficiency

White paper:
<https://bit.ly/3sZOiqE>

Software Engineering for ECS

Need for advanced **life-cycle models, processes and tools**



Software Engineering for ECS

Processes and Methods

NESSI R&I Topic #1:

Coping with heterogenous and distributed components during seamless development, deployment and operations

ECS Challenge #1:

Extending development processes and frameworks to handle connected, intelligent, autonomous and evolvable systems

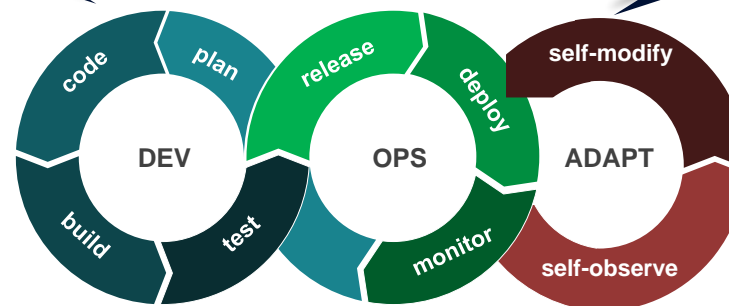
Opportunity/Priority:

Raise level of automation along the SW DevOps life-cycle

Model-based engineering (incl. code generation, testing, V&V, ...) based on digital twins

Automatic deployment (across different devices); Analysis of operational data (feedback to DEV)

Self-adaption based on run-time observation; Identification of evolution needs (feedback to DEV)



Software Engineering for ECS

Trustworthiness

NESSI R&I Topic #3

Trustworthiness of software and software development

ECS Challenge #2

Managing new functionality in safe, secure and trustable systems

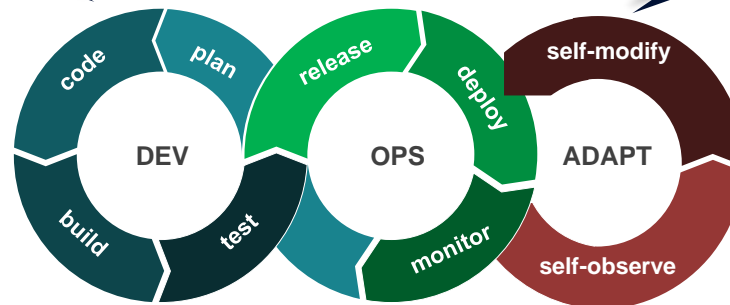
Opportunity/Priority

Complementing „trust-by-design“ with run-time trust management

Trustworthy development processes; Development-time risk analysis

Continuous monitoring and analysis of risks and threats to trigger fast release-cycles

Adaptive trust management for dynamic changes / interactions and evolving threats



Software Engineering for ECS

Complexity and Uncertainty

NESSI R&I Topic #4:

Managing complexity, dynamics, and uncertainty

ECS Challenge #3:

Managing complexity... continuous change of system functionality over their life-time

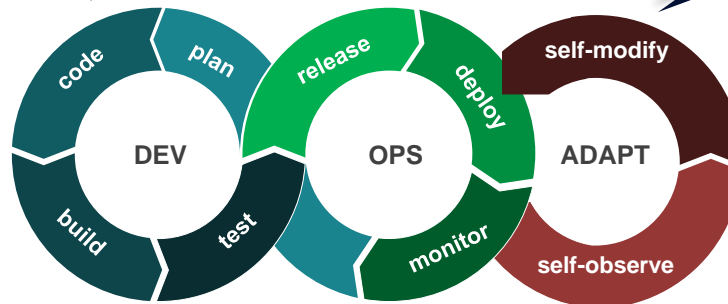
Opportunity/Priority:

AI / ML to handle complexity and uncertainty

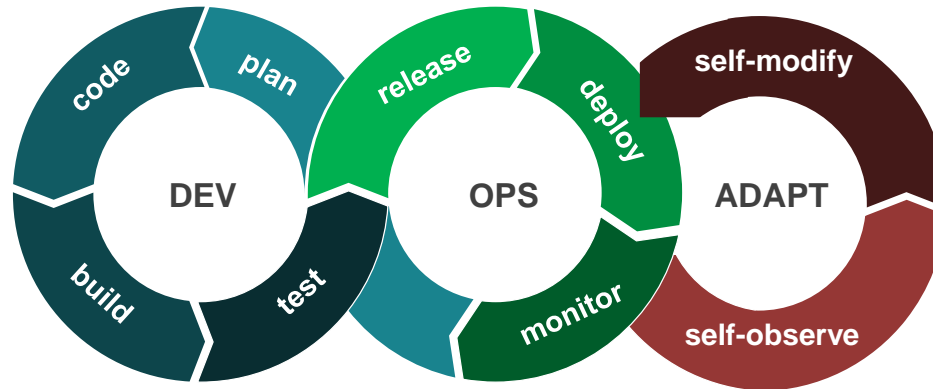
AI / ML for software engineering based on data (from Dev and Ops)

AI-supported configuration and deployment on heterogenous devices

Cognitive adaptability via online (reinforcement) learning



Thank You!



Software and Key Digital Technologies

Executive summary

This position paper is an analysis by NESSI¹ about the role of software technology in Key Digital Technologies (KDT), one of the proposed institutionalised European Partnerships under Horizon Europe (2021-2027).

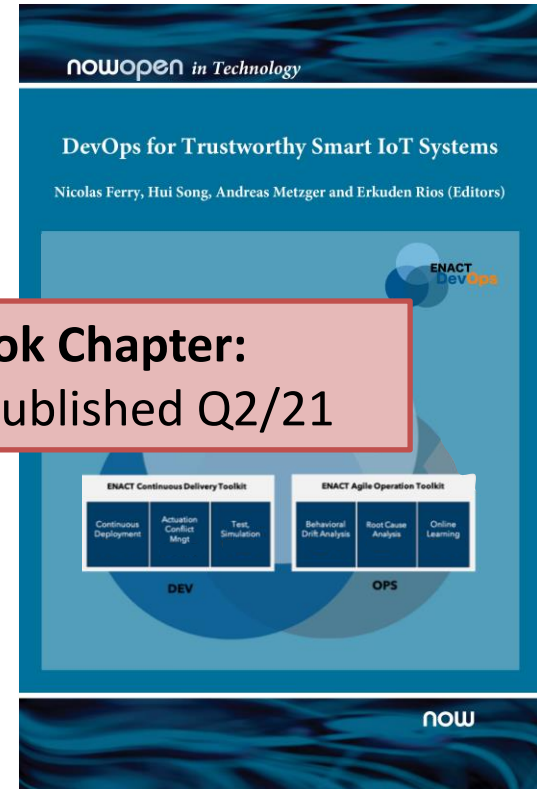
Software already plays an important role in the value chain of electronic components and systems, which is the focus of the ECSEL partnership, a predecessor of KDT. Embedded software, compilers and frameworks

ent and operation of software
 It on ECSEL, the KDT partnership
 ronic components and systems,
 mplete value chains/networks,
 er industries”?. To achieve this, it
 ons on the software aspects of
 as software technologies have

proven to be a game changer for digitalisation in different industry sectors. At the same time, the way we develop and operate software is evolving significantly, powered by multiple key enabling technologies emerging recently, such as AI and ubiquitous connectivity. However, advances in software engineering are mainly within the original software industry, and are adopted only with significant delay in other industry sectors. In this paper, we analyse the important challenges that hinder the improvement of software development in the KDT context. To address the challenges and to support the area of KDT with advanced software technologies, NESSI has identified and recommend the following research and innovation topics:

- DevOps for electronic components and systems, involving all players along the KDT value chain.
- Platformization of KDT applications to support software-driven integration and to build ecosystems.
- Digital trust in systems with large number of components in a distributed and context-aware way.
- Management of complexity in the presence of dynamicity and uncertainty arising from, and addressed by, AI-powered self-adaptation.
- Spatial Computing that utilizes advanced human-machine interactions enabled by novel electronic components.
- Software support for sustainable and efficient computing.

White paper:
<https://bit.ly/3sZOiqE>



Book Chapter:
 To be published Q2/21