Software Forum Research & Innovation Roadmap: The way forward in SW engineering

Concertation and Consultation on Computing Continuum: From Cloud to Edge to IoT
10–11 May 2023
The Claridge - Brussels, Belgium
R&I roadmaps in SWForum.eu

**Phases**

1. **Identification of research topics**
   - Multi-sourced approach
   - Analysis of academic venues
   - Online surveys
   - SWForum workshops
   - Landscape report
   - European research activities

2. **Classification & scoring**
   - Multi-factor scoring approach
   - Identification of factors and dimensions
   - Scoring and weighting methodology
   - Detailed analysis of research topics

3. **Consultation and further analysis**
   - Multi-sourced approach
   - Interviews to experts
   - Open consultation
   - SWForum Workshops
   - Further analysis

**Activities**

**Results**

- Research challenges
- Scoring methodology
- Updated Research challenges
- Recommendations and Roadmap
- Lessons learnt

European research roadmap in software technologies, including **open-source software**, **digital infrastructure** and **cybersecurity**

- **D3.3 SWForum research roadmaps v1 (Nov 2021)**
- **D3.4 SWForum research roadmaps v2 (Dec 2022)**
- **D3.5 SWForum research roadmaps v3 (June 2023)**
Identification of research topics

Implementation of the first phase of the methodology “Identification of research topics”

Analysis of sources → Identification of research topics → Characterization of Research CH

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<tr>
<th>CH1: OSS</th>
<th>CH2: Self-healing</th>
<th>CH3: CSE</th>
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<tr>
<td>CH4: REQ &amp; ARCH</td>
<td>CH5: CYBER &amp; Privacy</td>
<td>CH6: Specific technology domains</td>
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Research challenge:
- Description
- Expected time
- Societal impact
- Technological impact
- Business impact
- Source
Classification and scoring: Approach

1. Identify factors
   - Framework conditions
   - Technology
   - Competitiveness
   - ...

2. Scale and weight the factors
   - Definition of the scales of each factor
   - Weight of the factors
   - Algorithm

3. Score the research topics
   - Prioritization based on the scoring methodology
   - Open consultation
   - Workshops
   - Next phase

4. Represent the results
   - Graphical representation of the results
   - Lessons learnt

D3.3 SWForum research roadmaps v2
Classification and scoring: Results

Methodological framework: Factors and Scoring methodology

Factor 1: Framework Conditions for the given Challenge. Framework Conditions are assessed following two Criteria:

- **C1.1. Digital Decade 2030.** The potential alignment of the challenge, topic, and subtopics with the Digital Decade principles is assessed.
- **C1.2. Digital Compass.** The potential contribution of the challenge, topic, and subtopics to the priorities – skills, public services, business, infrastructures regarding the Digital Compass principles – are assessed and scored.

An additional criterion has been suggested for the expert’s validation, as there is not enough information currently on the existence of policies/strategies at Member State level for all the given challenges.
The way forward: Identified research challenges

Reviewed Research and innovation topics & their characterization

- Research challenge
  - Description
  - Research objectives
  - Research outcomes
  - Limitation of current practice
  - Research sub-topics
Open Source Software

OS for next generation technologies

- OS for quantum computing
- OS for AI
- OS for open data spaces

OS sustainability and interoperability with proprietary software

- Open standardised practices to develop, implement, test and validate OSS along the different phases of the SDLC and SOLC

Open-Source Computing Continuum

- Open Source Hardware and Open Source processors
- Open Source Computing Stack (Cloud-Edge-IoT)
Self-repairing and self-healing software (AI-enabled)

Towards “Cognitive” code
- Autonomous code repair and code adaptiveness (self-healing code)
- Code error detection and prediction

Towards “Sustainable code”
- Sustainable consumption of infrastructural resources
- Smart and green code

Towards trustable code
- Cybersecurity threats detection through AI techniques
Continuous software engineering

Smart (re-) assurance

Agile and novel Co-engineering

Optimized DevOps

- From “one-size-fits all” to extended DevOps
Requirements, architecture and development

AI augmented software development

• Re-envisioned software development lifecycle
• Identify new forms of evidence of quality
• Automate design, evolution, and analysis tools

Engineering AI-Enabled Software Systems

• AI-enabled system specification methods
• Data management in support of AI-enabled systems
• Uncertainty management methods
Cybersecurity and privacy

Automatic (Cloud) Security Posture Management

Next generation risk assessment tools

• Based on AI and Quantum Computing capacities.

New and advanced architectures, technologies and methodologies to protect sensitive data in the computing continuum
Software Engineering for Quantum computing

Quantum software viability studies

Quantum software architecture

• Middleware
• QaaS
• Quantum DevOps
• Quantum testing

Quantum software interoperability
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SW engineering challenges: The way forward. Which research topics need more focus.

Overall assessment of the challenges

- Challenge 6: Quantum Software Engineering
- Challenge 5: Cybersecurity and Privacy
- Challenge 4: Requirements, Architecture and Development
- Challenge 3: Continuous Software Engineering
- Challenge 2: Self-Repairing and Self-Healing: Defect Prediction and Fault Localization Using...
- Challenge 1: Open-Source Software
SW engineering challenges: The way forward. Analysis from the factors

Assessment of the identified challenges towards the selected factors

- **CH1. OS**
- **CH2. Self-repairing SW**
- **CH3. Continuous SW engineering**
- **CH4. Req., architecture and development**
- **CH5. Cybersecurity and privacy**
- **CH6. Quantum SW engineering**

F1. Framework conditions
F2. Technology Readiness
F3. Competitiveness of EU industry & SMEs
F4. Ecosystem development and interaction: EDIHs, partnerships and Digital infrastructures
F5. Cross fertilisation for added value

May 2023
“Software and software technologies are the glue that holds together current and future key emerging technologies, such as quantum computing, post-classical computing and communications, augmented human activity, advanced AI, sensing and mobility, and the computing continuum, among others. All these trends will significantly impact the way software is designed, built, developed and consumed, opening a set of research challenges to be addressed in the coming years by the European software community.”
Thank You!

Get in touch with us!

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