

# The **SUPERSEDE** project

First University of Kentucky Requirements Engineering Workshop Wednesday, May 3rd

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# What is SUPERSEDE?

- An HORIZON 2020 project
- Call: H2020-ICT-2014-1 (Tools and methods for Software Development)
- Title: SUpporting evolution and adaptation of PERsonalized Software by Exploiting contextual Data and End-user feedback
- Type of Action: **RIA** 
  - to establish new knowledge and/or to explore the feasibility of a new or improved technology, product, process, service or solution
  - basic and applied research, technology development and integration, testing and validation on a small-scale prototype in a laboratory or simulated environment
- Consortium: 8 Partners (4 Academic/Research; 4 Industrial)





## Outline

- Project Overview
  - Motivations
  - Project Objective
  - Use Cases
- SUPERSEDE at Y2
  - Glimpse on main achievements
- The way ahead

## **Motivations** Example scenario: SEnerCon ESA *service*



# **SUPERSEDE Vision:**

#### Software engineer / providers

- support them to take better decisions in evolving software application and services and to enact them
- support them to integrate and extend their services with mechanisms for a more situated dynamic adaptation

- - End-user
  - enabling them to express feedback easily
  - making users and developers closer
  - providing *better* software applications
    - context-awareness, personalization (improve QoE)

## SUPERSEDE

## **Objective:**

## Support avfeedback-driven engineering process



- Obj-A: methods and tools to collect end-users' feedback and runtime data which will be efficient, scalable and adaptable
- Obj-B: methods and tools to perform an integrated analysis of the collected data in order to establish a sound basis for evolution and adaptation decision-making
- Obj-C: methods and tools to support decisionmaking in the evolution and runtime adaptation of services and applications based on user's feedback and contextual data
- Obj-D: methods and tools to enact the decisions made and means to assess the impact of these decisions both in terms of QoE and organization productivity
- Obj-E: validate data and feedback-driven software evolution and adaptation for the improvement of software qualities along different industrial use cases

## Approach: Knowledge areas / challenges





- *CH1 Feedback Gathering*: Multimodal feedback communication channels
- *CH2 Run-time monitoring*: Comprehensive monitoring solution
- CH3 Big data analysis: Integration of heterogeneous sources
- *CH4 User-Feedback Analysis*: Combining sentiment analysis and conversation analysis approaches
- *CH5 Software Quality*: Framework that integrates QoE and QoS
- *CH6 Decision-making support*: Automated and mix-initiative decision-making techniques
- CH7 Run-time Adaptation & Personalisation: Scalable solutions – customizable to specific domain settings

# Approach:

## 3 Use Cases will ensure

the elicitation of relevant domain knowledge

## SIEMENS

## SMART CITY INFORMATION PLATFORM



- Smart City Information API provision and consumption
- Ecosystem for Smart City Information exchange

## **SEnerCon**

ESA service Energy Savings Account



- User can check their house energy consumption
- Calculate costs and savings for energy efficient actions



SMART PLAYER Sport Media Application in Real Time



- Webscasting Media platform for large sport events
- Allows people to watch sport videos on demand
- Give stats with: live results and sport info
- Application in Real Time

## Approach: 3 Use Cases



 a progressive validation of the methods and tools produced to ultimately provide evidence of potential for productivity gains



- Scope: individual components (product parts)
- TRL3: Experimental proof-of concepts validated on realistic scenarios
- M24 validation
  - Scope: first toolset integrating the methods developed in the project
  - TRL5: Technology validated in relevant environment (scenarios for software evolution and dynamic adaptation)
- M36 validation
  - Scope: toolset integrating all the methods developed in the project
  - TRL6: Technology demonstrated in relevant environment



## Outline

## ✓ Project Overview

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## SUPERSEDE at Y2 Main achievements





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## Feedback Gathering & Monitoring

#### WP1 General Architecture





- Unified architecture realized
  - explicit and implicit feedback
- Provision of multimodal feedback gathering mechanisms
- First heterogeneous and distributed monitors are implemented and running

## SUPERSEDE at Y2 Main achievements





## Integrated analysis of data



- Big Data architecture running on UPC cloud <sup>(1)</sup>
- A UC-agnostic integration-oriented ontology to model ingested data streams
- Combined speech-act based analysis and sentiment analysis for deriving requirements out of user feedback<sup>(2)</sup>
- Analysis of tweets <sup>(3)</sup>

REFERENCES

- (1) Abello et al. IST (under revision) A Software Reference Architecture for Semantic-Aware Big Data Systems
- (2) Moralez-Ramirez, Kifetew, Perini, CAISE 17 Analysis of Online Discussions in Support of Requirements Discovery
- (3) Guzman, Alkadhi, Seyff. A Needle in a Haystack: What Do Twitter Users Say about Software? RE16

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## Big Data architecture



## Speech-act & sentiment analysis Textual online discussion



Techniques:

- NLP techniques for pre-processing
- speech acts and the sentiment as parameters for training three machine learning algorithms (Random Forest, J48 and SMO) classify comments into Enhancement, Feature and Defect

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- Results:
  - Found association between types of speech acts (e.g. Informative, Responsive, Requestive, etc.) and type of issues (e.g. Enhancement, Defect)
  - Distribution of speech acts for the first ten comments for Defect and Enhancement, and identified common patterns

REFERENCES

16 • Moralez-Ramirez, Kifetew, Perini, CAISE 17 Analysis of Online Discussions in Support of Requirements Discovery

## SUPERSEDE at Y2 Main achievements





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## Decision Making 1) for software evolution





**Context monitoring** 

# The techniques



- Automated reasoning. Currently included:
  - Analytic Hierarchy Process (AHP) method that was selected because its pairwise comparison mechanism allows us to perform a fine-grained analysis of the motivations that lead to a resulting ranking, thus exploiting at best the different skills and expertise of the decision makers
  - **Genetic Algorithms** (GA) because it allows to overcome some of the limitations of AHP, at the cost of a reduced granularity of the ranking

## Gamification

- To foster user engagement, game elements are included, such as:
  - **Progress**, that is user completion rate is reported to each user
  - *Time Pressure*, that is the process has a fixed duration, and actions done after the process expiration are discarder;
  - Pointsification, that is a point attribution mechanism has been designed, with the purpose of
    providing an incentive to (i) perform the voting task quickly, and (ii) perform an accurate

REFERENCES

P. Busetta, F. Kifetew, D. Munante, A. Perini, A. Siena, and A. Susi. Toolsupported Collaborative Requirements Prioritisation. In Proceedings of the IEEE Int. Conference COMPSAC, Torino, Italy, July 4-7, 2017 The tool is accessible at: https://github.com/supersede-project/dm\_game

# Decision making2) for dynamic adaptation in the (MAPE-K process)





## SUPERSEDE at Y2 Main achievements





## Release Planning The Replan tool



#### Dashboard:

Provides a usable human interface

#### Controller:

Collects all the necessary information to generate a release plan: features, and resources and sends it to the Replan Optimizer

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The release plan that this latter returns is then stored and sent back to the Replan Dashboard

#### Replan Optimizer:

Genetic Algorithms: jMetal4, a framework with an extensive portfolio of available multi-objective optimization algorithms: NSGA-II, MOCell, PESA-II, SPEA-II

#### REFERENCES

- David Ameller, Carles Farré, Xavier Franch, Antonino Cassarino, Danilo Valerio, Valentin Elvassore, *Replan: a Release Planning Tool, SANER 2017*
- David Ameller, Carles Farré, Xavier Franch, Antonino Cassarino, Danilo Valerio, *Towards Continuous Software Release Planning, SANER 2017*

## SUPERSEDE at Y2 Chain of methods & tools have been validated





- User-feedback (tweets) + Decision-Making+ Release planning has been validated in ATOS UCs
- Events from monitored data were simulated to validate dynamic adaptation in ATOS UC (both decision-making and enacting)

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# SUPERSEDE at Y2

### Dissemination

#### Tutorial

Release Planning (ICSE'16), Xavier Franch and
Vorkahon:

Workshop:

- PRIORE17@REFSQ
- RE17 CrowdRE17

Int Journal Papers:

- JOA 15
- IEEE software 17
- REJ, IST submissions

Int. Conferences papers

- PROFES16
- RE16
- SANER17
- CAiSE17
- COMPSAC17
- ...

Int. Workshop papers

- PRIORE17
- iStar17

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Industrial Workshop in Berlin on September 2017



## What's next?

- Project perspective:
  - M30 (October 17) final release of the tool suite to be validated in realistic setting
  - M36 (April 18) final results for all the components
  - Validation of the tool-suite in realistic settings
- Struggling to attract external evaluators, please contact me if you are interested to use SUPERSEDE components
- Integrating components into issue tracking systems
- Research advancement in datadriven RE
  - Further research results in addressing CH1---CH7





# Thank you for your attention **Questions**?

Credits: some of the slides have been adapted from presentations of Norbert Seyff (FHNW, UZH), Alberto Abello (UPC), Angelo Susi (FBK), David Ameller (UPC)) Figures Credits: Characters designed by MDF16 Milestones and road pictures: @continues





## SUPERSEDE at Y2 Tool suite architecture



## Speech-act categories

Category	Subcategory	Analysis	<b>Definition</b> (excerpt) <sup>1</sup>
		category	
	Informatives	Not used	
	Assertives		Assertives: speech act that is con-
	Confirmatives	Assertives	sidered as having a strong be-
Constantives	Concessives	-	lief and intention by a sender
	Suggestives	Responsives	who maintains his/her belief about
	Suppositives		something, e.g., "I know the choco-
	Responsives	-	late is good for your health".
	Requestives		Suppositive: speech act conveying
Directives	Questions	Requestives	that is worth considering the conse-
	Requirements		quences of something regardless of
	Thank	Not used	whether it is true, e.g. "I suppose
	Accept	Accept	the configuration file" Reques-
Expressives	Reject	Reject	<i>tive: speech act</i> expressing sender's
	Negative opinion	Negative	intention that the receiver take the
		opinion	expressed desire as reason to act,
	Positive opinion	Positive opinion	e.g., "I kindly ask you to provide
	URL link		me"
Attach (non-linguistic)	Code line	Attach	
	Log file		

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# The objective (for SE)

- Support decision-makers in using explicit<sup>(1)</sup> and implicit<sup>(2)</sup> feedback from the users to evolve the system
  - <sup>(1)</sup> Get feedback from your stakeholders continuously
  - (2) Monitor their context and the operational context of the system they are using
  - Analyse the combined data to identify new stakeholders' requirements or requests for system adaptation/reconfiguration



## The SIEMENS use case

# SMART CITY INFORMATION API PLATFORM

- Smart City Information API provision and consumption
- Ecosystem for Smart City Information exchange
- Advanced Smart City Apps and Services for energy providers, grid operators and citizens
- Runtime monitoring of platform
- API access patterns and KPIs

## With SUPERSEDE

- Collect and analyse developer and publisher feedback
- Supporting platform evolution
- Improving maintenance planning
- Performing SLA-driven service adaptation

SIEMENS



## The SEnerCon use case

## Interactive Energy Savings Account

 SENERCON (software developer, management) Home Energy Efficiency
 Energy evaluation application (https://www.energiesparkonto.de)

## With SUPERSEDE

 Set up an effective communication channel between end-users and developers to improve the software development based on the end-users

#### needs

 Help developers to find problems in the software faster and give them the possibility to decide which are the most important features/bugs to work on

SEnerCon

# The ATOS use case

## SMART PLAYER Sport Media Application in Real Time

- Webscasting Media platform for large sport events
- Sports Event Live
- Allows people to watch sport videos on demand
- Application in Real Time
- Give stats with: live results and sport
   info
- Multi-audio in different languages

## With SUPERSEDE

- Win-win for end-users and content providers
- Dynamic configuration on the production side

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- Collect and analyse user feedback in realtime
- ATOS' business services composition tool
- Improve end-user quality of Experience





## Meta data & ontology (1)



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## Meta data & ontology (2)



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## **Examples of queries**



**Decision Making for adaptation** 



- Thanks to the analysis of monitoring data, that allows to trigger a change in the configuration of the system
- Search for new (possibly alternative) configurations given feature model, current configuration, monitoring data, constraint from the trigger

# An example of Adaptation condition SUPERSEDE

Alert  $response_time > 30$  seconds

Action find a set of new configurations  $C = \{c_1, c_2, ..., c_n\}$  such that

- 1. for  $c_i \in C$  response\_time  $(c_i) < 30$  seconds
- 2. C represents optimal thread-off between memory consumption and availability ability

## SUPERSEDE

## **Release Planning & Enacting Adaptation**

### **Research topics**

- Models@runtime representations of runtime behavior
  - Variability expressed as feature models
  - AOM on UML for system modeling (e.g., the target use case)
  - Adaptability managed by our own DSL
- Generic (highly reusable) top-down MDE approach
  - M2M/M2T transformations for the models@runtime
  - Platform specific adaptation hooks







## Results obtained: Front-end Interface Technical Design



