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Scalable Semantic Product Data Stream Management for Collaboration and Decision Making in Engineering



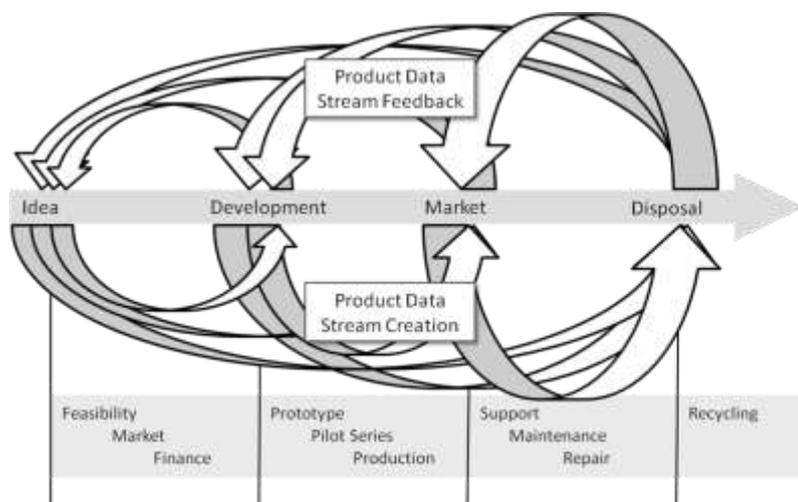
“Helping industry to cope with data deluge in Design & Manufacturing”

ANNUAL REPORT 2013

The SMART VORTEX project is a 48 months FP7 Integration Project started on October 1st 2010, under the domain of Strategic Objective 4.3 Intelligent Information Management.

The SMART VORTEX Project aims at providing a technological infrastructure and interoperable methods, tools, and services that will support large-scale industrial innovation and collaborative engineering projects; making possible that information management will underpin an intelligent analysis of massive data streams and growth of business value and capabilities.

In this project, the union of all product data streams, both along the direction of the product lifecycle and the product and innovation process feedback, is called **SMART VORTEX**. It comprises amongst other, sensors` data, design, simulation, experimental, and testing data, multi-media collaboration data and data from higher level inferred events generated by analyses.



IMPORTANT WORK AREAS

The course of action within SMART VORTEX project is organized in four overlapping cycles that comprises the development of all project processes towards accomplishing project objectives and thus generate expected results.

- **The Inception and Elaboration cycle** is the first cycle, aimed at creating “common ground” among all consortium participants. This cycle has started with the definition of requirements analysis, which comprised setting up the definition of the standard RTD workflow of requirements needed for the RTD cycle of the project.
- **The requirements analysis and identification of user scenarios** cycle; aimed at collecting the needs and expectations of end users and service providers for SMART VORTEX development. Key activities performed comprised organisation for setting up the analysis of user requirements, needs and usage scenarios.
- **The suite modelling, data & system architecture cycle**; aimed at creating information models of concepts, relationships, constraints and rules for the technological framework of the project. Key activities performed comprised organisation and setting up the evaluation for high-level semantic representations for streaming information and data sources as well as for information and semantic modelling.
- **The semantic data stream models and access language cycle**; aimed at developing semantic models for sensors` data streams and collaborative models. Key activities performed comprised evaluation of operational details for this area of work.

The development of the SMART VORTEX suite is being tested in three specific application scenarios and work areas representing real-world problems:

- Smart data stream enabled decision making and cooperation support in complex design and engineering environments.
- Efficient information life cycle and data stream management of individual data for functional products business models.
- Product data steam sharing and collaboration in complex cross-organizational scenarios.

TARGET OUTCOMES AND EXPECTED IMPACT

The SMART VORTEX of product data streams is the core concept, around which targeted outcomes are developed: capturing tractable information, delivering pertinent information, collaboration and decision support.

In SMART VORTEX we are creating a suite of innovative high-impact components, containing architecture, methods, tools and services for supporting large-scale collaborative engineering projects by intelligent management and analysis of massive data streams to achieve better collaboration and decision making. SMART VORTEX outputs are delivered as the expected results are generated.

The SMART VORTEX project was designed to produce high-impact regarding industrial application scenarios and research, as project outcomes are a natural match to the key problems presented by the SMART VORTEX industrial application scenarios. Thusly, we expect to lead industry into knowledge-driven and service oriented business models, by:

- Supporting the delivery of industrial functional products business models by capturing and analysing tractable information;
- Bringing the real-life experience and simulation closer together to increase product quality, cost savings and therefore the value for customers and vendors altogether;
- Innovating in goal driven collaborative cross-organisational setting, among all players in the entire product life-cycle.

As functional products business models are implemented in the industry, and the industries' service levels increase, the continuous feedback obtained from analysed tractable data could: a) be fed into the development of product updates or even totally new products; b) drive to high customer satisfaction; c) provide domain-knowledge based support; and d) increase knowledge based leadership. In addition, a goal-driven IP collaboration at cross-organizational level will enable a knowledge based extension of the value chains.

PROGRESS TO DATE

During 2013 efforts were focused on developing the SMART VORTEX Meta Data Schema (SVMDS), the Stream VALIDator (SVALI) functionality, the development and integration of SMART VORTEX tools and preparation of the demonstrators. For this purpose, efforts were centred in developing and integrating visualization tools; refining and adapting the collaboration tools for collaborative problem solving and decision making process at different phases of the Product Lifecycle, cross-organizational level and/or when sharing large volumes of industrial streaming data; developing and adapting IPR oriented collaborative environments; developing the trial prototypes in the selected scenarios and deploying services for executing the demonstrators.

The main achievements of SMART VORTEX along 2013 are:

- We have successfully tested the architecture of the SMART VORTEX suite and integrated the SMART VORTEX Meta Data Schema (SVMDS) and the Stream VALIDator (SVALI) functionality. The stream validation functionality enables on-line validation on expected behaviour of equipment based on data streams from sensor.
- The SMART VORTEX tools that support the visualization, management and analysis of massive data streams, as well as provide better collaboration and decision making, were successfully developed, refined, adapted and connected, in an integrated approach, for deploying services for trial prototypes.
- The developments of the social communication protocols have been finalised and the cross-organizational collaboration functions have been categorized under required level of trust
- Industrial use-cases prototypes were prepared, coordinated and developed into thriving demonstrators.

DISSEMINATION AND AWARENESS RAISING

During 2013, the third version of the Exploitation and Dissemination Plans targeting both scientific and industry communities were delivered. The plans comprised the partners' vision of exploitable outputs, proposed business model for SMART VORTEX and actions taken during this year in order to communicate the project results and increase SMART VORTEX visibility.

As part of the 2013 dissemination activities, 17 scientific articles have been published. The project characteristics, scope and research results and publications have been presented to targeted audiences in several events and conferences; including conferences such as the Semantic Models for Adaptive Interactive Systems, Human-Computer Interaction Series 2013, the 5th ACM SIGCHI symposium on Engineering interactive computing systems (EICS'13), the 7th ACM International Conference on Distributed Event-Based Systems, (DEBS) 2013, the 8th International and Interdisciplinary Conference on Modelling and Using Context (CONTEXT'13), the 17th International Conference on Information Visualization, the 21st Italian Symposium on Advanced Database Systems (SEBD 2013) and the 9th International Symposium on Visual Computing (ISVC'13).

Among publications we can mention the two papers presented at The 7th ACM International Conference on Distributed Event-Based Systems (DEBS2013) June 29 - July 3, 2013, Arlington, Texas, USA. [The Model-based Validation of Streaming Data](#) paper that comprised the results of including the stream validation functionality in SVALI; while the [Grand Challenge: Implementation by Frequently Emitting Parallel Windows and User-Defined Aggregate Functions](#) paper showed a benchmark that indeed the system meets very high scalability demands, where real-time data streams are monitored and analysed in real-time as shown in the publication.

Additionally, SMART VORTEX industrial partners have kept promoting the project's scope, goals and challenges among key people of R&D+i, production, business development and other internal departments, as well as through its partnership networks and associations, including commercial enterprises.

FUTURE WORK

During 2014 efforts will be focused in a twofold: finishing developments and integration of the final version of the SMART VORTEX suite and tools; and carrying out the verification and validation activities on the bases of the feedbacks and experiences of demonstrators.

Main activities will comprise: finalising an integrated and validated demonstrator, integrating major parts of the demonstrator abilities based on the SVMDM and the Smart Vortex Meta-Data Model, extending the functionality and scalable data stream validation, improving and validating the usability of the visualization tools and the social collaboration suite, improving the usability and integration of IPR functions, enriching the IPR protection, providing administrative services, polishing and quality assurance and establishing a full functional Mobility platform.

The corresponding business plan to the SMART VORTEX model will be formulated and delivered at the end of the project. A detailed experience report with the user feedback and assessment of the exploitation capabilities in other domains will be also delivered. Customised dissemination activities to targeted industrial groups will be performed. Video documentation for dissemination and exploitation will be used coupled with the actions driving proper dissemination of SMART VORTEX findings.

FURTHER INFORMATION

- EC ICT Information and Communication Technologies Projects: [SMART VORTEX](#)
- **SMART VORTEX Project website:** www.smartvortex.eu
- **Project Co-ordinator:** Ruben Riestra, INMARK