Making Virtual Research Environments in the Cloud: a Reality: the gCube Approach

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In recent years scientists have been rethinking research workflows in favour of innovative paradigms to support multidisciplinary, computationally-heavy and data-intensive collaborative activities. In this context, e-infrastructures can play a crucial role in supporting not only data capture and curation but also data analysis and visualization. Their implementation demands seamless and on-demand access to computational, content, and application services such as those typified by the Grid and Cloud computing paradigms. gCube is a software framework designed to build e-Infrastructures supporting Virtual Research Environments, on-demand research environments conceived to realise the new science paradigms.

The eScience community is currently examining the feasibility of setting up innovative Virtual Research Environments (VREs) to meet the requirements of collaborative activities. VREs are designed to support both small and large-scale computationally-intensive, data-intensive and collaboration-intensive tasks, and to serve research communities potentially distributed over multiple domains and institutions.

A promising approach for the building and operation of VREs is based on e-Infrastructures, ie frameworks that enable share/reuse these resources. The e-Infrastructure layer allows resource providers to “sell” their resources, and resource consumers to “buy” them and to use them to build their applications. It also provides organizations with logistic and technical support for application building, maintenance, and monitoring.

The e-Infrastructure vision shares many commonalities with Grid Computing and Cloud Computing. All three aim to reduce computing costs via economies of scale. They all attempt to achieve this objective by managing a pool of abstracted and virtualized resources and offering on-demand computing power, storage facilities and services to “external” customers over the internet. The differences mainly reside in the way they are abstracted, the users they are meant to serve, and the technologies that characterize them.

gCube is a software framework specifically conceived to develop and operate large scale e-Infrastructures, enabling the declarative definition and automatic deployment and operation of VREs. gCube is a software system specifically designed to offer on-demand computing power, storage and computing resources, and technologies that enable researchers and developers to “buy” them and to use them to build their applications. It also provides organizations with logistic and technical support for application building, maintenance, and monitoring.

The transition from mass production to personalized, customer-oriented and eco-efficient manufacturing is considered to be a promising approach to improve and secure the future competitiveness of the European manufacturing industries, which constitute an important pillar of European prosperity. One precondition for this transition is the availability of agile IT systems, capable of supporting this level of flexibility on the plant shop floor. As an example of the capabilities of a service-oriented IT system, this project is expected to add new functionalities to software applications.

The FP7 project, ManuCloud, has been set up with the mission to investigate the production-related aspects of this transition and to develop and evaluate a suitable IT infrastructure to provide better support for on-demand manufacturing scenarios, taking multiple tiers of the value chain into account. On this path, ManuCloud seeks to implement the vision of a cloud-like architecture concept (see Figure 1): it provides users with the ability to utilize the manufacturing capabilities of configurable, virtualized production networks, based on cloud computing, federated factories, supported by a set of software-as-a-service applications.

The objective of the ManuCloud project is the development of a service-oriented IT environment as a basis for the next level of manufacturing networks by enabling production-related inter-enterprise integration down to shop floor level. Industrial relevance is guaranteed by involving industrial partners from the photovoltaic, organic lighting and automotive supply industries.

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