2 The BEinGRID Project

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2.1 Introduction

Most of the results presented in this book were created within the BEinGRID project. BEinGRID, Business Experiments in GRID, is the European Commission’s largest integrated project funded by the Information Society Technologies (IST) research, part of the European Union’s sixth research Framework Programme (FP6). This consortium of 96 partners is drawn from across the EU and represents the leading European organizations in Grid Computing and Service Oriented Infrastructures (SOI) and a broad spectrum of companies covering most vertical markets keen on assessing the benefits to their productivity, competitiveness and profitability from using Grid and Cloud Computing solutions.

The mission of BEinGRID is to generate knowledge, technological improvements, business demonstrators and reference case-studies to help companies in Europe and world-wide to establish effective routes to foster the adoption of SOI technologies such as Grid and Cloud Computing and to stimulate research that helps realizing innovative business models using these technologies. In terms of technology innovation BEinGRID has defined and steered the technical direction of Business Experiments (BEs) in all vertical market sectors by offering them best-practice guidance in each of the stages (requirements, design, prototyping, demonstration), thought-leadership in tackling innovative problems and technical advice for improving the BE solution.

Teams of technology and business experts achieved this mission by eliciting common technical requirements that solve common business problems across vertical markets, by defining innovative generic solutions, called common capabilities, that meet these requirements, by producing design patterns that explain how these solutions can be implemented over commonly used commercial and experimental platforms and by producing best-practice guidelines demonstrating how these solutions can be applied in exemplar business scenarios.

2.2 The BEinGRID Matrix

To meet the project’s objectives described above, BEinGRID has undertaken a series of targeted Business Experiments (BEs) designed to implement and deploy Grid solutions across a broad spectrum of European business sectors including the media, financial, logistics, manufacturing, retail, and textile sectors. The consortium conducted 25 Business Experiments that have been summarized at the BEinGRID project Web site (http://www.beingrid.eu/) and described in the BEinGRID Booklet (BEinGRID Booklet 2009). Each one of these 25 BEs is a showcase of a real-life
pilot application focusing on a specific business opportunity and addressing current customer needs and requirements. The involvement of all actors in a representative value chain including consumers and service providers has been considered crucial for producing successful case studies that build on the experiences of early adopters. Consequently participation of representative consumers and providers able to take a solution to the market has been ensured in each of the BEs. The BEinGRID Business Experiments have been classified according to their main vertical market, the business model they exploit, and the technological innovations they validate. These classifications are discussed in the next sections.

2.2.1 Vertical Market Sectors

Each BE addresses concrete business issues in a particular vertical market. Each of the main actors of a grid value network was represented. From this perspective, the 25 BEs of BEinGRID cover the following sectors:

- **Advanced Manufacturing.** This class comprises BEs that apply Grid technology to the design of products or components that are later manufactured, or to optimize some part of the production processes.
- **Telecommunications.** This sector covers the BEs that use SOI in order to improve existing or offer new innovative services that can improve the operational efficiency and the quality of services offered by network operators. These include services for sharing data and services among network operators and detecting fraud.
- **Financial.** This sector includes the solutions used by financial organizations to optimize existing business activities or to produce new and innovative services to their customers.
- **Retail.** This sector includes BEs that improve the business activities related to management of goods (acquisition, delivery, transformation ...).
- **Media & Entertainment.** This sector consists of BEs related to the management and processing of media content (capture, rendering, post-production, delivering) and, more broadly, the provision of on-line entertainment services including scalable and high-performing collaborative gaming.
- **Tourism.** This sector covers the BE that is used by the tourism industry in order to optimize existing business activities or to produce new and innovative services to their customers.
- **Health.** This sector is represented by the BEs that focus on processing of medical data, compute intensive algorithms for medical science and provision of services that optimize the quality and the cost of medical treatment covering all actors contributing to the treatment.
- **Environmental Sciences** covers the BEs that focus on processing geophysical data and applying compute intensive algorithms to analysis which will help avoid damage to the environment and offer protection against natural disasters.

Different BEs use different middleware in the same sector in order to solve specific real-world challenges. The anticipated commercial and social impact and innovation
dividend have been the main criteria in selecting the BE, in addition to the necessary use of Service Oriented Infrastructure technologies including Grid and Cloud Computing.

2.2.2 Business Models

The business models explored in these pilot projects have been categorized based on criteria that take into account their value propositions, their technological and economic incentives and emerging trends in the market of Grid and Cloud Computing.

The first category focuses on achieving optimized and flexible processes and lower costs by improving resource utilization. At the core of this category are innovations facilitating:

- better utilization of compute power and data storage,
- on-demand provision of additional compute power and storage in order to respond to peaks in consumption, and
- aggregation of heterogeneous data sources in virtual data-stores.

The second category focuses on collaboration and resource sharing. At the core of this category are innovations improving:

- the agility of businesses and their ability to respond to business opportunity by enabling the swift establishment of multi-enterprise collaborations,
- the execution of collaborative processes spanning across-enterprise boundaries,
- provision of, and access to, shared network-hosted (“cloud”) services that facilitate collaboration, and
- seamless access to heterogeneous geographically distributed data sources.

The third family of categories is focused on new service paradigms centered on “pay-as-you-go” (PAYG) and new paradigms of ICT services (*-aaS) including Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

2.2.3 Research and Technological Innovation Themes

The technological advancements and innovations inspired or validated by the BEs have been categorized in thematic areas. These are areas where we witnessed either significant challenges that inhibit widespread commercialization of Grid Computing or where the anticipated impact of the innovation (i.e. the “innovation dividend”) is particularly high.

- **Virtual Organization Management** capabilities help businesses establish secure, accountable and efficient collaborations sharing services, resources and information.
- **Trust & Security** capabilities address areas where a perceived or actual lack of security appears to inhibit commercial adoption of Grid Computing and SOI. These include solutions for brokering identities and entitlements across
enterprises, managing access to shared resources, analyzing and reacting to security events in a distributed infrastructure, securing multi-tenancy hosting, and securing the management of in-cloud services and platforms. These innovations underpin capabilities offered in Virtual Organization Management and other categories.

- **License Management** capabilities are essential for enabling the adoption of PAYG and other emerging business models, and had so far been lacking in the majority of Grid and Cloud computing solutions.
- Innovations to improve the management of **Service Level Agreements** cover the whole range from improvements to open standard schemes for specifying agreements, to ensuring fine-grained monitoring of usage, performance and resource utilization.
- **Data Management** capabilities enable better storage, access, translation and integration and sharing of heterogeneous data. Innovations include capabilities for aggregating heterogeneous data sources in virtual data-stores and ensuring seamless access to heterogeneous geographically distributed data sources.
- Innovations in **Grid Portals** enable scalable solutions based on emerging Web2.0 technologies that provide an intuitive and generic instrumentation layer for managing user communities, complex processes and data in SOI as Grids and Clouds.

The technological innovation results take the form of core, generic functionality or processes that can be implemented over commercial and experimental service oriented middleware and infrastructures in order to add or help realize business value that is known to be important for commercial success. These technological innovation results have been delivered by means of the following outputs of the program:

- **Common technical requirements** that identify specific challenges where technical innovation is required. These were elicited by analyzing BEs across vertical market sectors; their interdependences have been analyzed within and across thematic areas; and they have been prioritized in terms of innovation potential and anticipated business impact based on feedback from BEs in several market sectors and criticality\(^1\) in terms of their interdependences.
- **Common capabilities** that capture the generic functionality that would need to be in place in order to address these requirements. These are necessary for enhancing current service offerings and delivery platforms in order to meet the business challenges described at the introduction of this chapter.
- **Design patterns** that describe one or more possible solutions that describe how systems may be architected in order to realize each common capability.
- **Reference implementations** that realize selected common capabilities over commercial middleware. These were subject to quality assurance processes including: release testing (focusing on robustness, installation and usability of

\(^1\) In simple terms, criticality of a technical requirement is a function of the number and relative priority of other requirements that depend upon it.
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artifacts); *conformance testing* to assure that the artifacts are adequately implementating the functionality of the capability; *documentation* and *training material* explaining how to deploy, integrate and improve the artifacts.

- **Integration scenarios** illustrating how a critical mass of interdependent common capabilities can be implemented together to maximize added value.
- **Validation scenarios** illustrating the benefits of implementing selected common capabilities to enhance business solutions in real-life case-studies.
- **Best-practice guidelines** explaining how these common capabilities can be taken advantage of in indicative business contexts.

2.3 **Knowledge Repository for SOI, GRID and Cloud Computing**

Research and innovation in the BEinGRID project is complemented with the development of the public knowledge and toolset repository IT-Tude.com (http://www.it-tude.com or www.it-tude.eu), previously known as Gridipedia (http://www.gridipedia.eu/), that aims to concentrate a comprehensive selection of service designs, best practices, case studies, technology implementations, and other resources that may enable the adoption of SOI technologies such as Grid and Cloud Computing. This knowledge repository also includes descriptions of the capabilities produced by the BEinGRID project, as well as information and software for their reference implementations and other auxiliary content such as technical reports, white papers, presentations, demonstration videos and training material.
Grid and Cloud Computing
A Business Perspective on Technology and Applications
Stanojevska-Slabeva, K.; Wozniak, Th.; Ristol, S. (Eds.)
2010, X, 274 p., Hardcover
ISBN: 978-3-642-05192-0