A Sustainable Business Model Approach for Grid Computing – And a Life Sciences Example

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Abstract: The amount and shared use of digitalized data in scientific and business communities have increased. Several software applications require higher computing power and more sophisticated network solutions. Grid computing tackles these requirements by sharing and coordinating distributed resources dynamically. Several grid projects have passed the first hurdles and are becoming technologically stable thanks to a huge public funding effort. But public funding will not last forever and clear and sustainable perspectives are necessary. But little is being done to generate sustainable business models suitable for grid computing. We propose a business model reference framework based on e(lectronic)-business findings. A thorough adaptation of such a framework is necessary if grid ventures are to be successful – and turn a profit in the middle and long terms. In addition, a life science example is outlined: The business model reference framework is applied and special emphasis is placed on the crucial issue of revenue models.

1 Introduction

In many sectors the amount of digitalized information is increasing. It is more and more common to use information technology to facilitate collaborative tasks and to handle huge amounts of distributed data. New discoveries, like the ‘decompiling’ of the human genome in 2001, gave an additional push to IT-relevant fields like bioinformatics [KR04]. This increases the demand for computing power, network performance and systems capable of manage this data. Grid computing tackle these needs.

Grid computing infrastructures support the sharing and coordinated use of often large scale resources in a dynamic and distributive environment. These resources are generally provided by different institutions forming a virtual organization [Fo01, BV05]. It is one of the emerging research fields in several scientific communities and industries.

Entrepreneurs in several sectors might take advantage of the new technology. This is especially be true for the engineering environment, the financial, as well as the life sciences and pharmaceutical sector. In these sectors real markets exist and some corporate grid-like computing solutions are already in use.
A considerable amount of mainly publicly funded scientific grid initiatives around the world first led to technologically quite stable solutions. But public funding will not last forever and a sustainable future perspective will be demanded. On the commercial side, several suppliers provide already easy access to computing as well as storing resources and deliver proven grid software solutions. In addition, potent internet companies like Amazon are developing services similar to those of common grid initiatives.

However, many grid projects lack a clear view how to remain viable in the long run. Little research is being done to develop sustainable business models in this field. Thereby business models help to understand the big picture of the potential market and address crucial business-related issues.

Research efforts labeled as ‘grid economics’ concentrate mainly on models for efficient resource allocation within grids, e.g. [BS04], [Bu05], [Yu05]. While this is important for the inner view of the grid infrastructure, to understand the big picture a comprehensive discussion on sustainable and customer-oriented business models must be initiated. The internet ‘.com’ breakdown at the beginning of the 2000s demonstrated what it meant to push a new technological approach without understanding the specific business and its environment entirely. In the year 2000 alone, 210 internet companies with about 15,000 employees were closed down worldwide [HF02].

Economic research analyzed e-business relatively thoroughly and developed conclusive business model reference frameworks for e-business. Since the idea of grid computing can be considered as a further development of the internet approach [Ge06], business model frameworks from the e-business world might be a right basis for a sustainable business model approach in the grid computing environment.

In the following, we present a business model reference framework for grid computing based on considerations developed for e-business solutions. Taking the example of medicine and life sciences we demonstrate how to apply main elements of the presented framework to a promising field for this technological approach. We look in more detail at two customer-oriented aspects: the utility of applications and services offered, and revenue models. We link both concepts in our example of medicine and life sciences.

2 Methodology and Approach

This study is mainly based on grounded theory, considering the main academic literature (‘state of the art’) and a thorough market analysis – reviewing more than 20 grid projects in medicine and life sciences. Furthermore, we talked to several community experts in order to prove our considerations.

In the following, we spotlight different e-business model reference frameworks and, in a next step, we transfer the distilled expertise to a business model framework for grid computing. We then discuss the main elements in more detail. In the fifth section we apply two crucial elements of the model to grid computing activities in medicine and life sciences. The work concludes with suggestions for further research areas.
### Table 8: Utility of revenue partner per application group

<table>
<thead>
<tr>
<th>Application group</th>
<th>Revenue partner</th>
<th>Industry</th>
<th>Researchers</th>
<th>Specialists</th>
<th>Physicians</th>
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<tbody>
<tr>
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++ high utility (frequent use)  
+ low utility (sporadic use)

In a final step, we merge all our results as seen in Table 10. We can derive two main conclusions from the last table. First, every combination of revenue partner and application group will have its unique revenue model. Second, certain activity categories are only interesting for a narrow group of revenue partners. Thus, before pursuing concrete pricing models, grid initiatives need to define their activities and customers clearly. They have to identify the concrete value that each particular application promises to the users.

### Table 10: Generic revenue models for healthgrid application groups

<table>
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<tr>
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DPR – dynamic direct pricing, LPR – level direct pricing, FPR – fixed direct pricing,  
MS – membership fee

### 6 Conclusions and Outlook

Grid computing is maturing and entering a stage where economic objectives come to the fore. From a business point of view it is crucial to draft the big picture before targeting the details. Business model reference frameworks, when adapted to grid computing requirements, help to face this challenge. The experience of the World Wide Web and e-business facilitates the development of such frameworks.

Based on these frameworks grid entrepreneurs learn to understand the final market and the needed resources and capabilities. On the market side often unanswered questions arise: Who will be the final customer? What specific needs do they have? What size is the market, what is the revenue? Finally, entrepreneurs have to prove whether potential users are willing to pay a sufficient price for applications and services to run a sustainable business.
As soon as these questions are answered, grid providers can concentrate on the resources available and needed to provide appropriate services. Hurdles with regard to the ‘orchestration’ of a virtual organization have to be solved. A convincing approach is needed for how to manage the virtual organization efficiently. This includes elaborated Service Level Agreements. Resource allocation and accounting models are already available. However, these models generally lack a real world business check. Another problem arises from the issue of software licensing. If services and application will be shared throughout a distributed environment, new licensing models will be needed.

In addition, community and application-specific conditions and restrictions have to be considered. In life sciences, data protection and security are crucial issues that have yet to be solved satisfactorily. Different legal systems might restrict ‘across border approaches’ for distributing resources.

Taking the example of life sciences and medicine, we demonstrate how to approach the market side and how to identify potential sources of added value. Finally we propose a framework for how to address the difficult topic of revenue models. Further studies are needed to enhance and validate the proposed framework.

Reference frameworks are strongly needed in order to understand the big picture of a business. Nevertheless they are still abstract models. Researchers should walk down the business model hierarchy introduced here, and identify viable types of business models for grid computing within the value network. They should also consider existing niche vendors of commercial grid solutions and understand their business models.

Grid computing offers attractive opportunities based on a new technology. But while pushing the mentioned topics forward, we should never forget one thing: customers do not ask for a technology – customers want us to solve a specific problem or satisfy a certain need, i.e. customers ask for a relevant service.

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