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Business Case Modelling for E-Services

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Abstract
In this paper we show how business value modelling and enterprise architecture can blend into an integral approach for modelling e-services business cases. The approach, building upon *e^3value* and ArchiMate, allows to link revenues and cost in a single model. The approach is illustrated on by the business case model of a virtual laboratory in the process industry. First experiences have shown significant value in the approach for different stakeholders (managers and engineers).

1 Introduction

Advances in ICT offer companies opportunities to improve their operational efficiency and to differentiate themselves among competitors by providing innovative ICT-based services. To exploit these opportunities companies need to develop new services, build computer networks, buy software licenses and more. Since most industry players currently lack the resources and capabilities to do so, ICT-based services are increasingly being developed and provided by networks of *cooperating organizations*. Various studies (see, e.g., Levine & Byrne, 1986; Bleeke & Ernst, 1993) indicate, however, that companies encounter serious difficulties in achieving the anticipated benefits from co-operation. These studies indicate that 40 to as many as 60 percent of all business co-operations fail. Designing innovative ICT-supported services seems to be a daunting task. Given the disappointing success rates of inter-firm co-operations and the risks and cost involved in the introduction of new ICT supported services, it is not surprising that practitioners and academics pay a great deal of attention to the concept of business models and business networks.

Traditionally, there has been a substantial gap between business models and business strategy on the one hand, and business architecting on the other hand. Systems' design barely touches upon the business model questions, such as organisational and financial aspects; business modelling and business model analysis, on the other hand, only incidentally moves beyond the save borders of discussion and analysis to actual design and architecting. Moreover, the role of business modelling as a means to bridge the gap between strategy/business on the one hand, and design on the other hand is controversial (Grey et al. 2003, Osterwalder & Pigneur 2003, Winter 2003).

Business model research became popular during the dot.com bubble during which venture capitalists needed concepts to judge and understand the viability of new ICT-based business initiatives. Gradually the scientific community adopted the concept. The research field has developed over the past few years from defining business models, via exploring business model components and classifying business models into categories, to developing descriptive models (see Pateli & and Giaglis, 2003, for an overview). The emphasis in more recent literature is shifting away from classifications to representations or descriptive models of business models. The majority of researchers (see, e.g., Tapscott et al., 2000; Gordijn & Akkermans, 2001; and Weill & Vitale, 2001) focus on the actors, relationships, and value objects exchanged.

One of the main issues today is that business models do not stand on itself, but relate to many other perspectives, such as an interorganisational business processes and supporting ICT. How to relate these perspectives is still a matter of debate. Therefore, an enterprise can be viewed as a complex "system" with multiple domains (business value, process, ICT) that may influence each other. In general, *architectures* are used to describe components, relations and underlying design principles of a system (IEEE 2000). Constructing architectures for an enterprise may help to increase insight and overview required to successfully aligning the business and ICT.

Although the value of architecture has been recognized by many organizations, mostly separate architectures are constructed for various organizational domains, such as business processes, applications, information and technical infrastructure. The relations between these architectures often remain unspecified or implicit. *Enterprise architecture* focuses on establishing a coherent view of an enterprise. In the end it is all about service offering and realization. This is where enterprise architecture and business modeling methodologies meet. In general, business models focus on the service value generated by a business, whereas enterprise architecture models show how a business realizes these services. Linking these approaches results in a powerful modeling tool that couples the value exchange between businesses and the costs that are required to realize these services.

In this paper, we study the research question of *how to bridge the gap between strategy and design using a model-based approach*? In doing so, we integrate methods for business model analysis, such as *e^3value* (Gordijn & Akkermans, 2001), and enterprise architecture and design (Janssen & Steen 2000; Jonkers et al. 2003; Lankhorst 2005). We argue that business architecture and business value can be seen as different views (IEEE, 2000) on the same object, being the service under construction. This can be deduced from a conceptual analysis of the domain of business models and enterprise architecture, where a substantial coincidence in concepts can be found. Therefore, a joint business network ontology forms a solid basis for an integral approach. The paper is primarily a conceptualisation of the idea, more than a proven concept. First validations have been done, and are illustrated in the paper. A more thorough validation is forthcoming.

We use a running example of an innovative service to illustrate our ideas. The service is a virtual laboratory, allowing analysts in the process industry to access advances analysis instruments in a controlled way over the Internet. The example is introduced below.

Running example: a virtual laboratory

In the Collaboratory.nl project[1], industry and research partners cooperate in the design of a virtual lab for material analysis that is suitable for commercial exploitation. The idea is that partners can make their equipment and expertise remotely available through the virtual lab and/or can remotely use the equipment and expertise of others. The industrial setting enforces strict requirements on security and trust between partners. From a business perspective, it also requires satisfactory accounting/billing and management support. From a user perspective, the virtual lab involves multiple actors working at multiple locations, using an instrument such as an electron microscope or a mass spectrometer. Operators operate the instruments, researchers and experts determine and discuss experiments, and the work is done for a customer with a specific purpose. In the present working practice, this involves collaboration with people that might be geographically dispersed. The virtual lab facilitates collaborations and may even improve or simplify the way of working. It should support the daily work of an industry material analyst, who forms part of the primary production process.

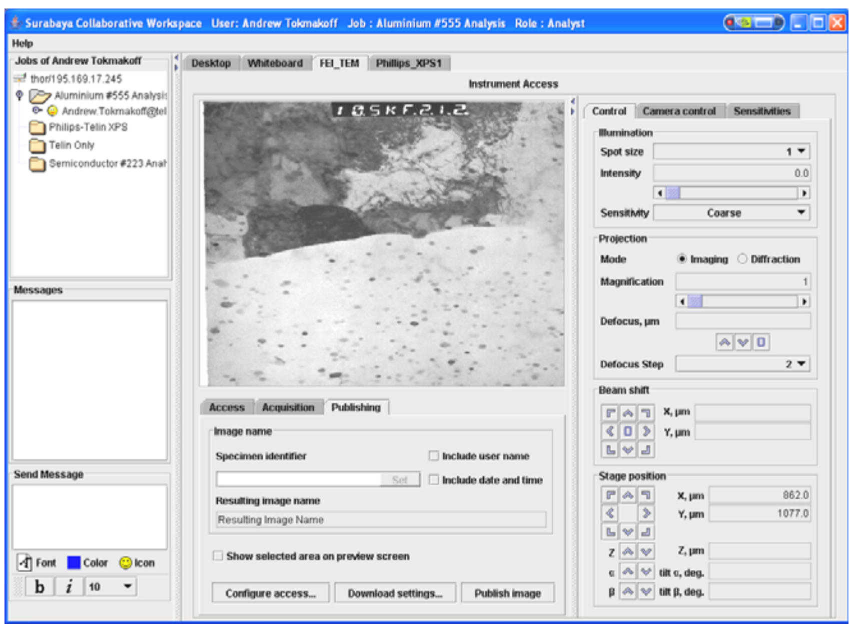

Figure 1. User interface of a virtual laboratory.

The user interface of a virtual laboratory is presented in Figure 1. At the left hand side we have implemented a selection of possible collaborative tooling. The folders present different jobs. At the top-middle the shared resources and shared workspaces are represented by tabs. In this example, there is a desktop,

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[1] www.collaboratory.nl

whiteboard and remote control tab. The centre of the example user interface shows the selected remote control interface of an instrument.

In the following two sections we introduce the modelling methods *e^3value* and ArchiMate, for business models and enterprise architecture, respectively. Both take the virtual laboratory to illustrate the concepts. In section 4 we introduce the integral business case model, and illustrate this with the actual business case analysis for an instance of the virtual lab. Section 5 concludes with the main findings and research steps to be taken.

2 *E^3value* modelling

A first step in developing an Internet-enabled service is to develop its business model. Such a model states the actor (enterprises) involved as well as the object of value these actors generate, distribute and consume. Below, we summarize the *e^3value* modelling constructs for describing a business model only briefly (for more details, see Gordijn & Akkermans 2003, Gordijn & Akkermans 2002). The methodology has been previously applied for analysing business scenarios in a series of case studies including media, news, banking and insurance, electricity power, and telecommunication companies to design value models of network organisation.

The virtual lab case consists of a number of **actors** and **market segments**. An actor is entity that is perceived by its environment as an independent economic (and often legal) entity. An actor makes a profit or increases its utility. In a sound, sustainable, business model each actor should be capable of making profit. A market segment is a set of similar actors, for which we suppose that they assign economic value in a same way. In **Figure 2**, the customer, analyst and instrument owner are all market segments. Since we suppose there is only one virtual lab, the lab is an actor. An actor (sometimes part of a market segment) may have a need. This need is expressed by means of a **start stimulus** that triggers exchanges of goods and services between actors and market segments. Here, the need is a *solution for an analysis problem*.

In order to satisfy the need, an actor exchanges objects of economic value with other actors (or market segments). The **value objects** are services, products, money, or even consumer experiences. The important point here is that a value object is *of value* for one or more actors. In the case at hand, *problem solving* as well as the *fee* to paid are both examples of value objects. These value objects are offered/requested via value ports of an actor. The concept of **port** enables to abstract away from the internal business processes, and to focus only on how external actors and other components of the business model can be 'plugged in'. Ports are grouped into a *value interface*, expressing that all objects via ports in the interface should be exchanged or none at all. This models economic reciprocity and bundling. So, a customer can only obtain a solution for the problem if he pays for it, and vice versa.

The start stimulus and the value interface of the customer are connected by means of a **dependency segment**, representing that in order to satisfy a need, the customer should exchange value objects via that specific interface. Ports are connected via value exchanges. **A value exchange** is used to connect two value ports with each other. It represents one or more *potential* trades of value objects between value ports. Additionally, actors can perform value activities. Such a **value activity** is an operation with which an actor creates profit. In this case, the instrument owner earns money with *instrument provisioning*.

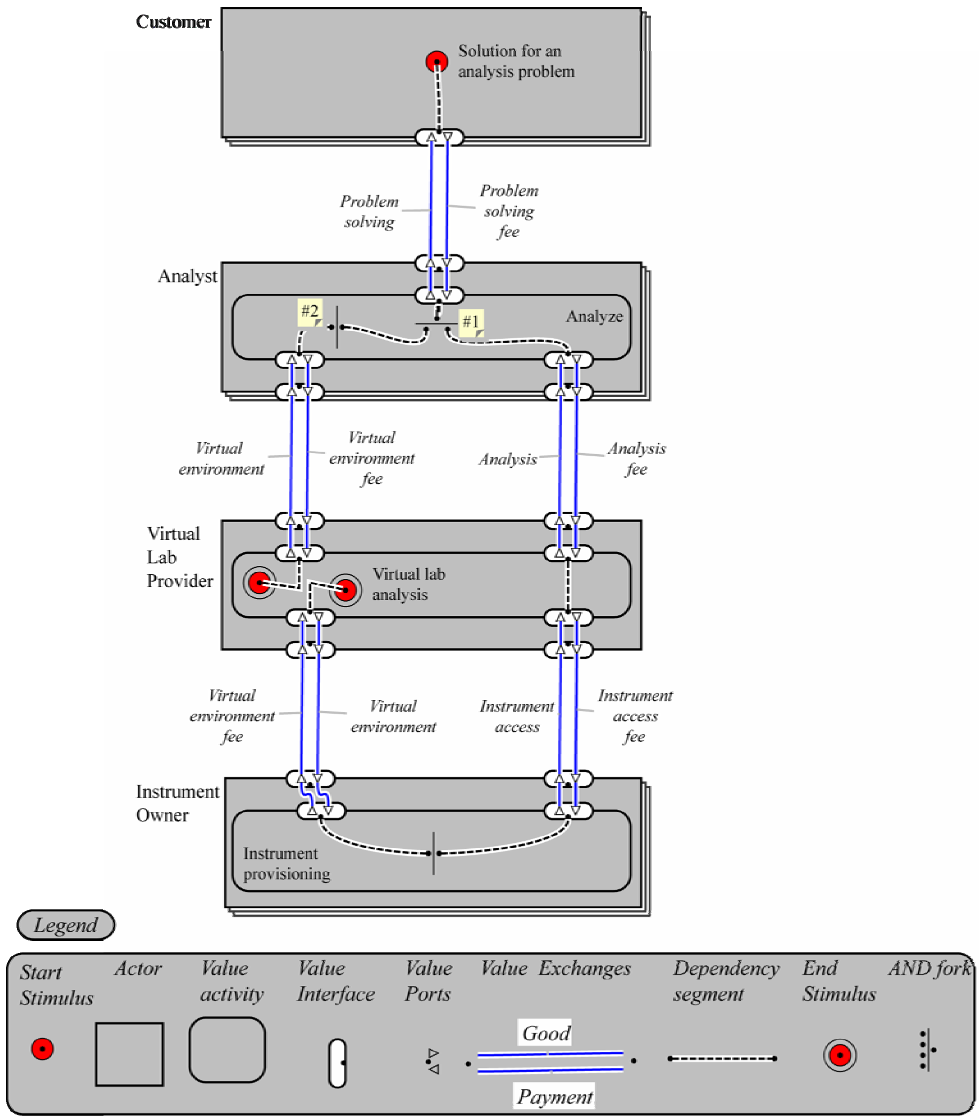

Figure 2. Value model for the virtual lab.

Connected dependency segments and exchanges form **a dependency path** (with on the path the value exchanges). This path is used to count the number of value exchanges as a start stimulus occurs. These counts are used to generate net cash flow calculations, to assess whether the business value model is profitable for every actor involved. The **end stimulus** represents the end of the path, and signals that counting of the number of exchanges can be stopped.

For the case at hand, the analyst will do his work and uses a virtual lab for the sample to be analyzed. The virtual lab offers *analysis* and *charges* a fee per analysis. Additionally, the analyst also needs a *virtual* (lab) *environment* and pays a monthly *fee* for it. For the problem solving task of the analyst, *both* the analysis and the virtual environment of the virtual lab is needed, as expressed by the AND fork annotated #1. Moreover, the analysis fee is a per usage basis whereas the virtual environment fee is on a monthly basis. Consequently, the implosion construct (a special case of an AND fork, and annotated #2) models that for *N* analyses, only *one* virtual environment fee has to be paid. To provide analysis, the virtual lab provider obtains from an instrument owner (remote) *access* to *instruments* and pays a *fee* for doing so. The instrument owner needs for this instrument access also access to the virtual environment and pays a monthly fee. We use a similar implosion construct here, as discussed earlier, to model that for *N* times instrument access, only one virtual environment (per month) needs to be paid.

Typical in the current business model is the fact that the Virtual Lab Provider shields the customer from the Instrument time provider. In this case, this means that for further analysis the customer can be left out.

3 Enterprise architecture

A coherent description of the enterprise architecture provides insight, enables communication among stakeholders and guides complicated change processes. In the ArchiMate project (Lankhorst 2005) an integrated language was developed and validated. It identifies concepts that relate architectural domains.

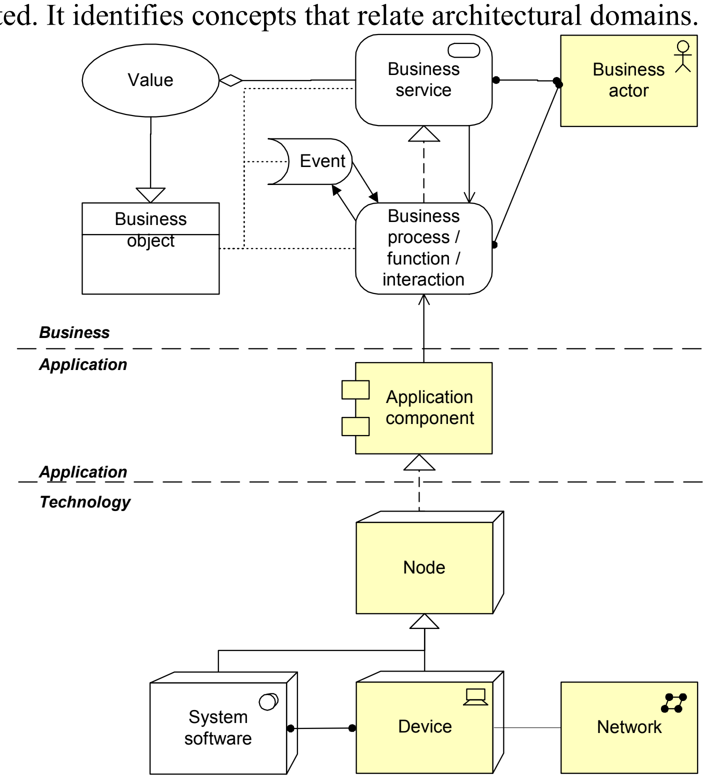

Figure 3. An ontology for enterprise architecture

In ArchiMate concepts for describing the relationships between architecture descriptions at the business, application, and technology levels play a central role, related to the ubiquitous problem of business–ICT alignment. For each architectural domain ArchiMate conforms to existing languages or standards, such as UML. In particular, usage of services offered by one layer to another plays an important role in relating the behaviour aspects of the layers (see **Figure 3** for a subset of the concepts in ArchiMate, used in the context of this paper). This enterprise architecture ontology builds upon the work that has been done in systems' analysis and design, notably UML, as well as business process modelling and e-business modelling (de Vos et al. 2000, Janssen & Steen 2000).

Using enterprise architecture modelling, a holistic approach to enterprise can be taken, as enterprise architecture covers all different relevant domains. We illustrate this using the running virtual lab example. We already described the main organization roles and services. This can be expanded towards the technology domain, by identifying the services and components that implement the services delivered. These components, in their turn, build upon a technological infrastructure, consisting of servers and analytical instruments. This is illustrated in **Figure 4**.

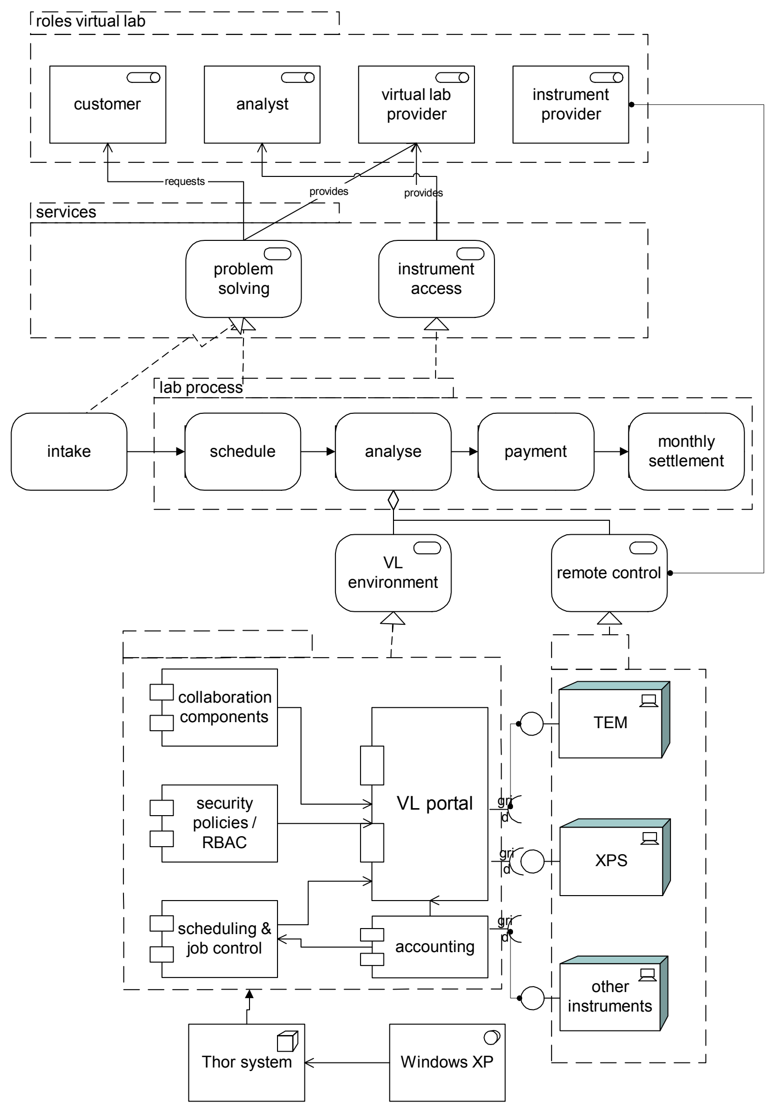

Figure 4. Overall architecture of a virtual lab.

The upper part of the model describes the services delivered externally to the actors or roles involved. The middle part identifies the steps in the analysis process, in relation to those services. The lower part, finally, shows what application services and components and systems have been used to implement the services delivered. This includes the analytical machines, such as X-ray photoelectronic spectroscopy (XPS) and transmission electron microscopy (TEM). It thereby closes the gap between the value model and the ICT implementation. Please note that the models shown are not the actual models, but have strongly been simplified for the sake of this exposition; they do not reflect the full complexity of the implementation, nor the range of possibilities in the business model.

4 From business model analysis to service design

When we compare the meta-models of *e³value* and ArchiMate, we see a striking similarity on the business level. This can be exploited to combine both approaches to allow for an integral approach to model e-services, stretching from revenue to implementation aspects, as is illustrated in **Figure 5**. The idea now is to link the *revenue* defined in the business part and analysed in *e³value*, to the *cost* defined in the application and technology layers. For the enterprise architecture we can use the business processes and supporting applications and technical infrastructure to determine the cost of the service offering. In this way, the cost for each actor in the value chain can be unambiguously determined, or the savings when outsourcing of current activities is taken into account. In the ArchiMate language a value concept is coupled to the ultimate service offering, which provides the link with the *e³value* models.

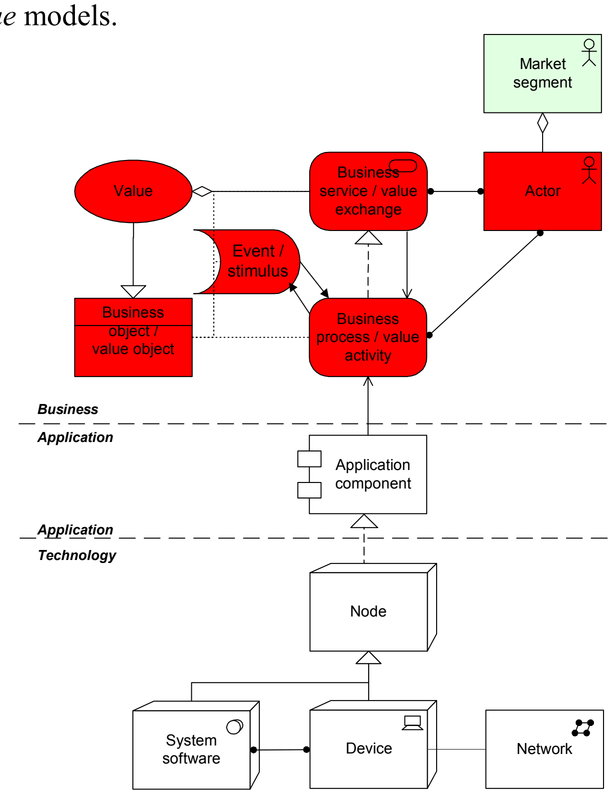

Figure 5. Combined conceptual model.

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In order to show the possibilities of the presented combination of modelling approaches, we consider an example business case for the virtual lab, depicted in **Figure 6**. In this example, there are three labs that work with a specific analytical instrument: a TEM. The lab in Arnhem has a very low utilisation rate and wants to outsource the ownership of the instrument. The lab in Bilthoven has a reasonable utilisation rate and wants to own the TEM because of specific business considerations. However, cost can be reduced when the over-capacity of the instrument is used by external parties. Finally, we have the lab in Capelle that has under-capacity with respect to the TEM and wants to obtain the additional instrument hours from outside. The VLP in this case provides the supporting ICT infrastructure, has the customer of instrument locked in and acts as a broker for the instrument owner.

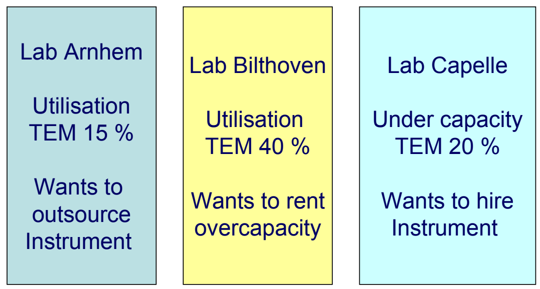

Figure 6. Case example for determination of an integral business case.

By means of the overall architecture in **Figure 4** we can now determine the cost which are involved in the specific service offerings and demands. The cost for owning a TEM is around € 354.000 per year. This includes, among others, interest, depreciation, and infrastructure. This is the basis to determine the value of the remote control service in **Figure 4**. Equally, we can determine the costs of maintaining and building the software required for the virtual laboratory. For this purpose we have assumed a relatively small VLP enterprise, arriving at a total cost of around €577.000 for the VLP (calculation details omitted). This relates to costs of the virtual environment service in **Figure 4**, supported by the specific applications components and required hardware. Furthermore we assume that the cost for owning a TEM are equal for all three labs.

Next to the cost infrastructure we require a settlement schema to couple the revenues to the costs. In this case we assume that the parties add 10% to the cost for services involving the instrument. This means that the instrument owner adds 10% to its hourly cost rate for the VLP, and the VLP in its turn, adds 10% to this amount for the analyst of a certain lab. For the virtual environment services we assume that the total cost for the virtual environment are 20% of the total costs/revenues involved for instrument. Taking this costs and settlement schema's into account we arrive at the figures in **Table 1**.

The table shows that lab Arnhem can save a lot of money by hiring a instrument, instead of buying a new one. This conclusion is not very surprising, as lab Arnhem now only pays for the small amount of time it really uses the instrument. Exploiting its overcapacity pays off for lab Bilthoven. The only additional cost lab Bilthoven has to pay is the contribution to the virtual lab.

Table 1. Cost and revenues for the example case.

Lab Arnhem	Savings	274.350
Lab Bilthoven	Additional revenues	102.218
Lab Capelle	Additional revenues	–28.320
Virtual Lab	Virtual environment revenues	71.242
	Instrument mediation revenues	12.390

Of course, in real life there will be variable costs, which have to be taken in consideration. From the table we conclude that it is not profitable for lab Capelle to hire instrument time for its under-capacity: Lab Capelle offers a fixed price to its customers. In this example, where each party applies the same margin, it pays more than it receives. When lab Capelle has to deliver all requested instrument time to its mother company, it might take the loss: the loss is still far less than the cost of a new instrument.

For the current situation the business case is not positive for the lab Capelle and the VLP. We argued that for this settlement schema it will never become attractive for the lab Capelle. So, when is there an overall positive business case for the lab Arnhem, lab Bilthoven and the VLP?

The costs of the VLP are € 577.000 a year and the yearly maximal (based on a 100% TEM) income for the VLP on a TEM is € 238.950. Therefore, the VLP needs to rent 3 full TEMs a year to make ends meet. When we assume that lab B is representative for all providers, we need 5 providing labs to reach 5 x 60% = 300 % TEM time. When we assume that the demand of lab A is representative for all customer labs, we need 20 customer labs to reach 20 x 15% = 300% TEM time.

5 Concluding remarks and tentative research agenda

In this paper we indicated that there are strong conceptual analogies between value modelling as in *e³value*, and enterprise architecture modelling as in ArchiMate. This analogy can be exploited in order to come to an integral business case modelling framework for e-services. In doing so, business cases can move from high-level strategic analysis to analysis rooted in the actual process and systems architectures. Thus, the business case can be substantiated, and on the other hand, the consequences of architectural choices can be translated to the business case level.

First applications of this approach in our research have shown added value of this integral approach, and we seek a more extensive validation of the route taken in other cases. At this stage, it is too early to conclude under what circumstances this approach proves its value best, and what type of support is needed. Our experiences, however, already indicate that there is substantial value in the approach, allowing to bridge the gap between engineers and managers to a certain extent: making managers aware of the technological consequences, and have engineers think in terms of business cases. In doing so, we move way beyond informal approaches, such as Grey et al. (2003), and Patelli & Giaglis (2003). As a next step, the conceptual correspondance should be formalised, and integrated into the tool environments that have been defined for both modelling language (Obelix and ArchiMate workbench). Also, the right viewpoints for stakeholders involved in the analysis must be identified (Lankhorst 2005, IEEE 2000). On the basis thereof, and by performing additional cases, a well-supported methodology will be developed, that has a solid scientific basis on the one hand, and is applicable in practice as well.

References

Franken, H., Bal, R., Berg, H. van den, Janssen, W. & Vos, H. de (2000). Architectural design support for business process and business network engineering. International Journal of Services Technology and Management, 1(1), 1-14.

Gordijn, J. & Akkermans, J.M. (2003), Value-based requirements engineering: Exploring innovative e-commerce ideas, Requirements Engineering Journal , vol. 8, no. 2, pp 114-135, Springer Verlag, Berlin, D

Gordijn, J. & H. Akkermans (2001), Designing and Evaluating E-business Models, IEEE Intelligent Systems, July/August: 11-17.

Grey, W., Katircloglu, K., Bagchi, S., Shi, D., Gallego, G., Seybold, D., & Stefanis, S., An analytic approach for quantifying the value of e-business initiatives. IBM SYSTEMS JOURNAL, Vol. 42, No. 3, pp. 484-497.

Haaker, T., E.Faber & H. Bouwman (2004), Customer and network value of mobile services: balancing requirements and strategic interests. In: proceedings ICIS conference 2004.

IEEE Computer Society (2000), IEEE Std 1471-2000: IEEE Recommended Practice for Architectural Description of Software-Intensive Systems, IEEE, New York.

Janssen, W., & Steen, M. (2000). Rapid service development: An integral approach to e-business engineering. In S. Murugesan & Y. Deshpande (Eds.), Web Engineering - Managing Diversity and Complexity of Web Application Development. LNCS 2016, pp. 119-132, Berlin/Heidelberg: Springer-Verlag.

Jonkers, H, et al. (2003), Towards a Language for Coherent Enterprise Architecture Descriptions. In Proc. 7th IEEE International Enterprise Distributed Object Computing Conference (EDOC'03), Brisbane, Australia, pp. 28-37. IEEE Computer Society.

Lankhorst, M. (ed., 2005), Enterprise Architecture at Work – Modelling, Communication and Analysis. Springer-Verlag. Forthcoming.

Magretta, J. (2002). Why Business Models Matter, Havard Business Review, May: 86-91.

Osterwalder, A. & Y. Pigneur (2003), Towards Strategy and Information Systems Alignment through a Business Model Ontology, In: proceedings of the 23rd

Annual International Conference of the Strategic Management Society (SMS), Baltimore.

Pateli, A.G. , Giaglis, G.M. (2003), A methodology for business model evolution: application in the mobile exhibition industry, paper presented at the M-business conference 2003.

Porter, M.E. (2001), Strategy and the Internet, Havard Business Review (March) 62-78.

Tapscott, D (2001), Rethinking Strategy in a Networked World (or why Michael Porter is wrong about the Internet, Strategy + Business, Issue 24, Third Quarter:1-8.

Winter, R. (2003), Conceptual Modelling of Business Networks and Business Strategies. In: proceedings 16th Bled Electronic Commerce Conference eTransformation, Bled, Slovenia.