Designing and Evaluating E-Business Models

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Business models are usually represented by a mixture of informal textual, verbal, and ad-hoc graphical representations. However, these representations typically limit a clear understanding of the e-business issues that confront the stakeholders, and often perpetuate the existing gap between business executives and the IT developers who must create the e-business information systems. This article presents a conceptual modeling approach to e-business—called e^3-value—that is designed to help define how economic value is created and exchanged within a network of actors.

This article presents an e-business modeling approach that combines the rigorous approach of IT systems analysis with an economic value perspective from business sciences.

Doing e-business well requires the formulation of an e-business model that will serve as the first step in requirements analysis for e-business information systems. The industry currently lacks adequate methods for formulating these kinds of requirements. Methods from the IT systems analysis domain generally have a strong technology bias and typically do not reflect business considerations very well. Meanwhile, approaches from the business sciences often lack the rigor needed for information systems development.

A tighter integration of business and IT modeling would most certainly benefit the industry, because the integration of business and IT systems is already a distinct feature of e-business. This article shows some ways to achieve this kind of modeling integration. Our e^3-value method is based on an economic value-oriented ontology that specifies what an e-business model is made of. In particular, it entails defining, deriving, and analyzing multi-enterprise relationships, e-business scenarios, and operations requirements in both qualitative and quantitative ways. Our e^3-value approach offers distinct advantages over traditional nonintegrated modeling techniques. These advantages include better communication about the essentials of an e-business model and a more complete understanding of e-business operations and systems requirements through scenario analysis and quantification.[1]

The value viewpoint

Requirements engineering entails information systems analysis from several distinct perspectives. Figure 1 shows what requirements perspectives are relevant to e-business design: the articulation of the economic value proposition (the e-business model), the layout of business processes that "operationalize" the e-business model, and the IT systems architecture that enables and supports the e-business processes. These perspectives provide a separation of concerns and help manage the complexity of requirements and design.

Our emphasis on "the value viewpoint" is a distinguishing feature of our approach. There are already several good ways to represent business process and IT architectural models, but the industry lacks effective techniques to express and analyze the value viewpoint.

We illustrate the use of the e^3-value methodology with one of the e-business projects where we successfully applied our approach: provisioning a value-added news service. A newspaper, which we call the *Amsterdam Times* for the sake of the example, wants to offer to all its subscribers the ability to read articles online. But the newspaper does not want to pass on any additional costs to its customers. The idea is to finance the expense by telephone connection revenues, which the reader must pay to set up a telephone connection for Internet connectivity.

This can be achieved by two very different e-business models: the *terminating* model and the *originating* model. Figures 2 and 3 illustrate these mod-

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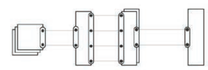
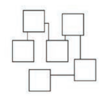
Requirement viewpoint	Stakeholders involved	Requirement viewpoint focus	Requirement viewpoint representation
Business value viewpoint	 C*O's Marketeers Customers	 Values, actors, exchanges	 *e³–value* ontology and UCM scenarios
Business process viewpoint	 Tactical marketeer, Operational management	 Processes, workers, information, goods, and control flows	 UML • Activity diagrams • Sequence diagrams • Interaction diagrams High-level Petri Nets
System architecture viewpoint	 IT department	 Hard/software, components, data and control flows, code organization	UML • Class diagrams • State transition diagrams • Sequence diagrams • Interaction diagrams • Deployment diagrams Architecture description languages

Figure 1. For the development of e-business information systems, three distinct perspectives are important: the value viewpoint represents the way economic value is created, exchanged, and consumed in a multi-actor network; the process viewpoint represents the value viewpoint in terms of business processes; and the system architecture viewpoint represents the information systems that enable and support e-business processes.

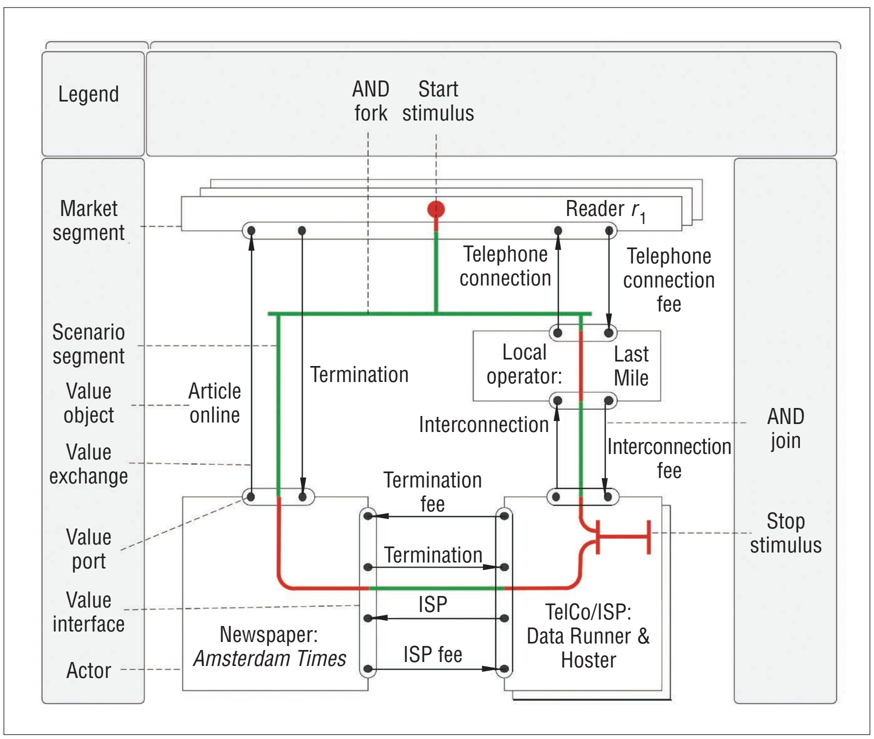


Figure 2. The terminating e-business model.

els. Many features and implications of these e-business models were difficult to discover during the project without help from our model representations. Our graphical modeling constructs are visualizations of constructs taken from the e^3-value ontology, which we discuss in the "The e^3-value Ontology" sidebar. Our scenario techniques are based on Use Case Maps, which we outline in the "Use Case Maps for E-Business" sidebar.

In Figure 2, by following the colored scenario path, you can see which values must be exchanged if an *Amsterdam Times* reader wants to read an article online. The reader must exchange value with two parties. First, the reader receives an article online from the *Amsterdam Times*, and in return presents a termination possibility. Termination means that if someone tries to set up a telephone connection by dialing a telephone number, another actor must pick up the phone. If someone is willing to terminate a large quantity of telephone calls, most telecommunication operators will pay an actor for that. Because of its large subscriber base, the *Amsterdam Times* has the potential to generate numerous terminations.

Second, in Figure 2, the reader pays the local operator (Last Mile) a fee for a telephone connection. This fee is partly used to pay the telco Data Runner for interconnection and eventually the *Amsterdam Times* for terminating traffic. For hosting services, the *Amsterdam Times* pays a hosting fee to Hoster. For the entire transaction to be a zero-cost operation for the *Amsterdam Times*, the received termination fees must be larger in total than the paid Internet service provisioning fees.

A specific property of this e-business model is that the local operator Last Mile sets the price for the service mainly provided by the *Amsterdam Times*, the company that owns the content. Figure 2 shows the legend of the graphical constructs in separate boxes. These constructs are graphical representations of concepts from our e^3-value ontology for e-business models. Note that in Figure 2 we only represent exchanges between objects that are of value to actors; we do not represent business processes or information system components exchanging information.

In contrast to Figure 2, Figure 3 illustrates how the reader directly pays for the *Amsterdam Times*. The newspaper, in turn, pays the ISP (Hoster) and long distance carrier (Data Runner). The long distance carrier pays the local loop provider (Last Mile). In this model, *Amsterdam Times* sets the price instead of Last Mile.

The value ontology

Our ontology and scenario techniques—suitable for value-based business modeling in general—let us represent objects of economic value that are created, exchanged, and consumed. Multiple actors typically create innovative products, so our ontology can represent a network of actors that together offer a complex product or service consisting of separate products and services. Furthermore, our ontology explicitly represents who is doing business with whom, in contrast to the value chain and constellation approaches from business science.[2,3] The value chain and constellation approaches show how value is added along a chain, which is different from who is doing business with whom.

In e-business projects, it is important to show the exchange of value objects between specific actors, because new parties can be relatively easily added to or removed from the buyer-seller chains. This process of disintermediation and intermediation presents specific e-business risks for traditional sellers. For instance, intermediaries, such as brokers and marketplaces, might easily appear and disappear in e-business projects. Buyers might decide to use a middle person to increase their combined buying power and achieve a better negotiation position. Showing who is doing what with whom is important because e-business is immensely more flexible than traditional business.

Our approach is also capable of modeling power elements. We can model not only the prices themselves but the actors who select the service or product. Modeling the actors who make the selections is important because e-business may decrease switching costs and increases market transparency, thereby allowing buyers to select other suppliers more easily.

When designing e^3-value, we opted for a lightweight approach that could be graphically expressed to communicate our ontology easily to intended users. We believe the industry needs a lightweight approach because of the

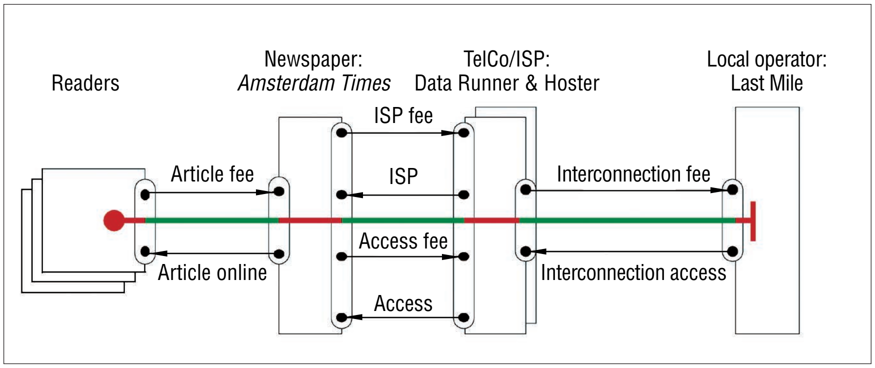


Figure 3. The originating e-business model.

The e^3-value Ontology

Our e-business ontology—which we have described extensively elsewhere[1]—is based on concepts derived from recent economic and business science literature. We combined several of these concepts with formal systems theory ontology.[2] The ontology components have graphical representations that make our model particularly well suited to lightweight use. For diagramming purposes, you can download a Visio tool stencil from our Web site at www.cs.vu.nl/~gordijn/research.htm. What follows are some definitions of terms and concepts we employ in our model.

Actor. An actor is an independent economic (and often legal) entity. By carrying out value activities, an actor makes a profit or increases its utility. In a sound, viable, e-business model, each actor should be capable of making a profit.

Value object. Actors exchange value objects, which are services, products, money, or even consumer experiences. A value object is valuable to one or more actors.

Value port. An actor uses a value port to show that it wants to provide or request value objects. The concept of port enables us to abstract away from the internal business processes and focus only on how external actors and other components of the e-business model can be plugged in.

Value interface. Actors have one or more value interfaces, grouping individual value ports. A value interface shows the value object an actor is willing to exchange in return for another value object through its ports. The exchange of value objects is atomic at the level of the value interface.

Value exchange. A value exchange connects two value ports with each other. It represents one or more potential trades of value objects between value ports.

Value offering. A value offering is a set of value exchanges that shows which value objects are exchanged via value exchanges in return for other value objects. A value offering should obey the semantics of the connected value interfaces: Values are exchanged through a value interface on all its ports or on no ports at all.

Market segment. A market segment is a concept that breaks a market (consisting of actors) into segments that share common properties.[3] Accordingly, our concept of market segment shows a set of actors that for one or more of their value interfaces, value objects equally.

Composite actor. For providing a particular service, several actors might decide to work together and to offer objects of value jointly by using one value interface to their environment. We call such a partnership a composite actor.

Value activity. An actor performs a value activity for profit or to increase its utility. The value activity is included in the ontology to discuss and design the assignment of value activities to actors. As such, we are interested in collecting activities that can be assigned as a whole to actors. Consequently, such an activity should be profitable or increase utility.

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Use Case Maps for E-Business

We adapted use case maps[1] for e-business purposes in conjunction with our ontology-based diagramming approach. This sidebar charts some of the most important adapted concepts.

Scenario path. A scenario path consists of one or more segments related by connection elements and start-and-stop stimuli. A path indicates which value interfaces objects of value must be exchanged as a result of a start stimulus or as the result of exchanges through other value interfaces.

Stimulus. A scenario path starts with a start stimulus, which represents an initiating event caused, for example, by an actor. The last segment of a scenario path is connected to a stop stimulus. A stop stimulus indicates that the scenario path ends.

Segment. A scenario path has one or more segments. Segments relate value interfaces to each other (through connection elements, for example) to show that an exchange on one value interface causes an exchange on another value interface.

Connection. Connections relate individual segments. An AND fork splits a scenario path into two or more subpaths, while the AND join collapses subpaths into a single path. An OR fork models a continuation of the scenario path into one direction that is to be chosen from several alternatives. The OR join merges two or more paths into one path. Finally, the direct connection interconnects two individual segments. A scenario path must obey the semantics of the value interface connected by value exchanges: Either objects are exchanged on all its ports or on none at all. To illustrate this, these parts of the scenario path are colored green, while other scenario segments are colored red.

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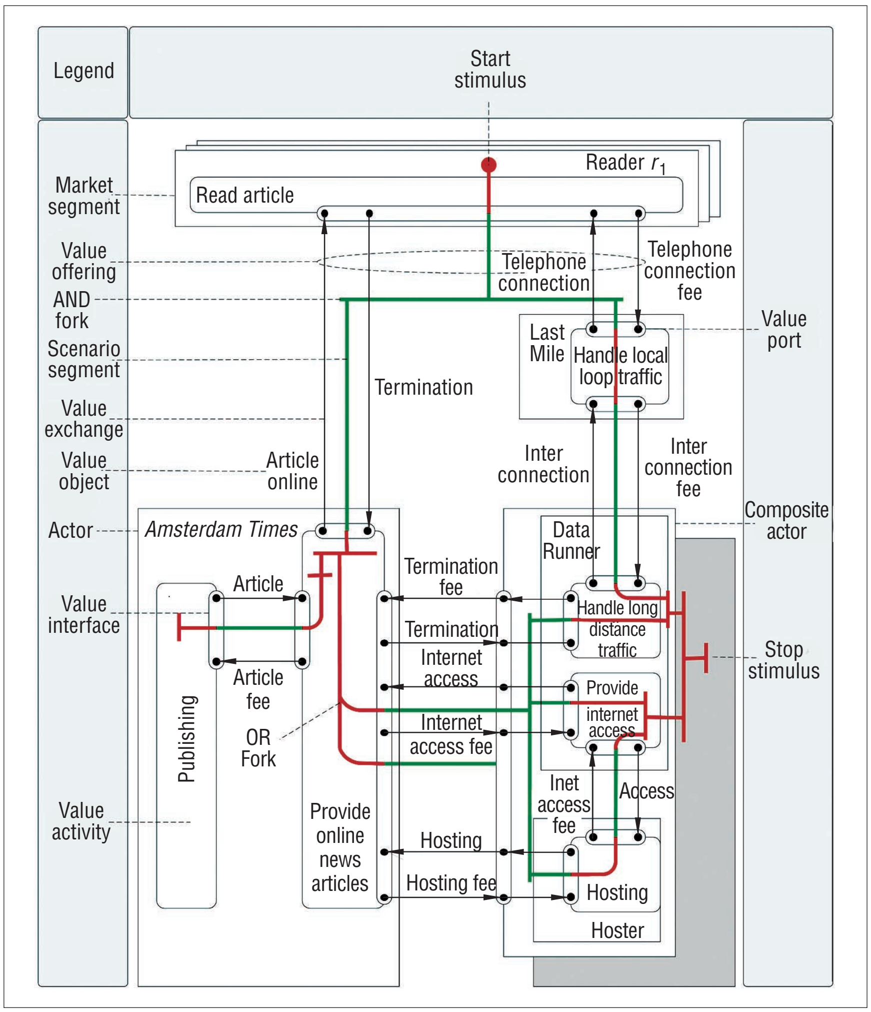

Figure. 4. A more detailed version of the terminating e-business model. Data Runner and Hoster form a partnership to offer long distance traffic and Internet service provisioning to *Amsterdam Times*. The companies decide to have one shared-value interface, thereby offering hosting and Internet access jointly as a bundle for a single price, which this model assumes to be cheaper than obtaining the products separately. Hoster collocates its hardware (servers, access devices, and so forth) on Data Runner's network, thereby avoiding costly connections between Hoster and Data Runner.

general agility of e-business projects themselves. Most e-business development projects are done very quickly, so having a model that can help rapidly define, explore, and execute a business idea can provide a distinct advantage over traditional modeling techniques.[4] The heavyweight ontologies like Toronto TOVE[5] and Edinburgh Enterprise[6] do not come with graphical scenario methods.

Another important difference between the e^3-value ontology and traditional business ontologies is that the traditional ontologies tend to focus on business processes (distinguished as a separate viewpoint in Figure 1) rather than on economic value. Our ontology-based graphical approach should not be confused with formal approaches such as the unified modeling language or other approaches that rely on activity, sequence, or state diagrams. Such techniques do not semantically represent the exchange of economic value, which we have discussed elsewhere extensively.[7] With some effort, it is possible to use UML stereotypes and packages to map most of our ontology constructs onto UML constructs, but doing so is merely syntactical.

Analyzing alternative models

When developing a specific business idea, we instantiate our ontology concepts and relations for specific use cases. Doing so provides a basis for analyzing the characteristics and implications of alternative e-business models. Initially, we developed several global business models and then detailed the most promising ones, as Figures 4 and 5 show.

The terminating model

We enhanced the terminating model shown in Figure 2 into the more detailed approach shown in Figure 4. The money flow in the terminating model is initially between the reader and Last Mile, which is only responsible for the local loop data traffic. All other money flows are generated from the money Last Mile earns.

Actors might decide to offer or request objects of value only as a bundle. Bundling and unbundling in general is a key e-business strategy that works especially well for digital products and services. You can clearly represent bundling with our methodology. For example, in the terminating model, the online article, telephone connection, termination, and connection fee are bundled into one *value interface* from the reader's perspective. In this case, the value interface illustrates that the reader only actually values an article online and a telephone connection in combination with each other. In other words, an online article is worthless without the required telephone connection to provide access to it. Because we bundle these value objects, and because a reader needs to offer a compensation for these objects as a whole, we consider all these objects to be part of the same value interface.

If a customer buys a product from only one seller regularly, the seller builds a relationship with that customer and thus—according to our model—"owns" the customer. Owning a customer is important, because it lets a seller offer that customer more personalized products. If an offering is between two actors (a seller and a buyer), the seller owns the buyer for that offering. However, if an offering contains more than one seller, customer ownership will be partitioned. For the terminating business model considered here, the reader has to exchange values with the *Amsterdam Times* and Last Mile. Last Mile is the only party that actually receives payment for the delivered service. In this case, our model sees this as a shift in customer ownership from the *Amsterdam Times* to Last Mile, which might be unwanted from the *Amsterdam Times*' point of view.

In terms of price, Last Mile is in control here. The reader pays for the entire service delivered through Last Mile. Unfortunately, no one except Last Mile and perhaps a market regulation authority can actually influence the pricing structure. Consequently, the success of the e-business model depends largely on Last Mile.

Figure 4 shows two partnerships or composite actors. These partnerships are equivalent, in one sense, because they offer comparable objects of value to their environment. Each partnership consists of several acting participants. The two partnerships are not grouped into a market segment, because the way in which partnerships value the objects will differ.

The *Amsterdam Times* can choose, on a per-scenario-execution basis, from two different partnerships to offer the article online, essentially from an access or a hosting perspective. The *Amsterdam Times* does not want to depend on one provider for access and hosting altogether. By distributing the amount of data traffic over these two providers, the *Amsterdam Times* controls the distribution of revenues for the two composite actors and motivates both partnerships to deliver a high-level quality of service. In Figure 4, we illustrate this graphically using an OR fork in the scenario path, which models the *Amsterdam Times*' service selection.

The originating model

In the originating e-business model, illustrated in a more detailed version in Figure 5, we reversed the revenue causality. A start stimulus from the reader now causes value exchanges at the interface of the *Amsterdam Times*, which leads to the need to buy Internet access and hosting and in turn leads to local loop access.

In the originating model, the reader only sees the *Amsterdam Times* and does not see Last Mile. Also, the reader pays the *Amsterdam Times* directly for everything needed to read an article online. Because the reader

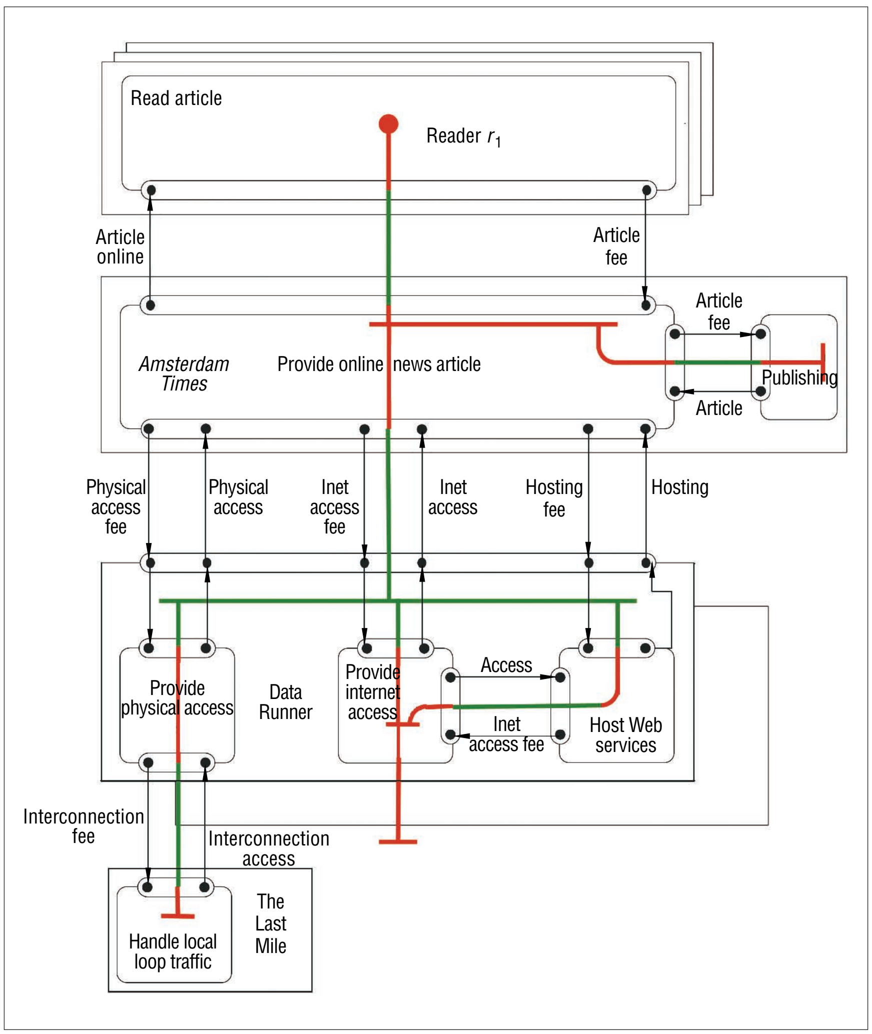

Figure 5. A more detailed version of the originating e-business model. In this model, the newspaper sets the price of telephone access and gets paid accordingly. Also, Data Runner now offers both the handling of long distance traffic and Internet service provisioning.

Table 1. Profit sheet for the "Read article online" scenario.

Actor	Value Object In	Value Object Out
Last Mile	Telephone connect fee = (telephone start tariff + telephone connect tariff * duration)	Interconnection fee$_{\text{Data Runner}}$ = telephone connect fee * distance factor$_{\text{Data Runner}}$ * interconnect factor
Data Runner	Interconnection fee = see Last Mile	Termination fee = see *Amsterdam Times*
Amsterdam Times	Termination fee$_{\text{Data Runner}}$ = telephone connection fee * termination factor$_{\text{Data Runner}}$ * distance factor$_{\text{Data Runner}}$	Internet access feeData Runner = ...

Table 2. Different valuation scenarios.

Scenarios	*Amsterdam Times* profit	Last Mile profit	Data Runner profit	Hoster profit
Null-scenario	Euro 74,727	Euro 46,364	Euro 51,727	Euro 3.636
Decrease in interconnect factor from 1.0 to 0.4	Euro 74,728	Euro 157,636	Euro –3,870	Euro 3.636
Decrease in termination factor from 0.5 to 0.1	Euro –8,727	Euro 46,364	Euro 93,455	Euro 3.636

pays the same party that delivers the service, there is no shift of customer ownership. The *Amsterdam Times* controls the price of the service by being able to set the telephone costs. The *Amsterdam Times* can even decide ways to reward the reader for reading articles online, which is impossible to do in the terminating e-business model.

In the originating business model, there is a change in who is doing what. The Data Runner actor now takes care of physical and Internet access provisioning and hosting. We can easily shift these activities among different actors, assuming that these activities are profitable for the performing actor.

Evaluating e-business models

After creating detailed models, the next step is to evaluate the economic feasibility of an idea in quantitative terms that are based on an assessment of the value of objects for all actors involved. Feasibility of an e-business model means that all actors involved can make a profit or increase their economic utility. Again, our technique for determining feasibility is a lightweight approach. We focus mainly on building confidence that an e-business idea is of real interest for all actors involved rather than on a precisely calculating all profits, which is an unrealistic goal anyway.

Our approach is to take into account the net in and out flows of value objects. The net value of these flows should be sufficient to cover all other expenses. An additional confidence-building step is to analyze what-if scenarios, which can help companies understand the sensitivity of e-business models with respect to financial parameters, future trends, and other parameters such as customer behavior. Analyzing what-if scenarios can also help find the weak and strong points of e-business models. Our evaluation approach consists of creating profit sheets, evaluating the objects in the profit sheet in terms of their cost and benefit to the participating actors, and evaluating what-if scenarios.

We create profit sheets based on either the actor or value activity level. We use the actor level to create confidence in an e-business idea. And we use the value activity level to evaluate how profitable activities actually are. (We show only a fragment of the profit sheets for enterprise actors here, and we leave out the utility-increase analysis for the reader actor because we have discussed end-customer utility analysis elsewhere.[8,9])

To create the example profit sheet shown in Table 1, we follow the scenario path from the initial stimulus. Each time the path crosses an actor's value interface, we update the sheet with value objects that flow in and out of the actor. We reduce details on the profit sheet by removing all value objects that are not money streams and that enter the actor and leave the actor on the same scenario path. For example, we remove telephone connection and interconnection from the actor Last Mile because the telephone connection is an enriched interconnection. Last Mile enriches the interconnection by exploiting a district telephone switch and the last mile of copper or fiber optics.

Value objects in the profit sheet must be assigned a value, expressed in monetary units such as Euros or dollars. The telephone connection fee per scenario occurrence is based on a start tariff and a connection-time-dependent tariff. The interconnection fee (shown only for Data Runner in Table 1) is based on a fraction (the interconnection factor) of the telephone connection fee and on the physical distance that Data Runner bridges. A market regulator typically determines the interconnection factor to increase competition between telecommunication operators. In effect, strong incumbent operators are typically forced to pay a larger interconnection fee to other operators than to new market entrants.

We calculate the termination fee the *Amsterdam Times* receives by making it analogous to the interconnection fee, except that we use a termination factor rather than an interconnection factor. Typically, the termination factor is smaller than the interconnection factor. By using this strategy, we can analyze the effects of a decreasing interconnection factor while the termination factor remains the same. This models a situation in which Data Runner takes on the risk of a decreasing interconnection factor.

What-if scenarios can be useful in representing the fluidity of e-business models.[10] They can help capture structural changes in e-business models, such as a change in actors and the activities they perform. What-if scenarios can also help capture changes in value, as Table 2 shows. Such changes are typically caused by expected future trends or events that affect the value of important e-business model design parameters. In Table 2, for example, the null scenario assumes an initial valuation of objects. The second scenario expects a decrease in the interconnection factor due to an increase of competition between telecommunication operators. Our analysis shows that the *Amsterdam Times* is not affected by this scenario, but Last Mile and Data Runner are. The third scenario supposes a drop in the termination factor between Data Runner and the *Amsterdam Times*, which harms the *Amsterdam Times*.

By valuing the objects for each actor and by making reasonable assumptions about scenario occurrences, we can perform a sensitivity analysis for the business idea under consideration. In many cases, this sensitivity analysis can potentially be of greater interest than the numbers themselves.

In the scenario we described here, the hosting tariff is based on the assumption that equipment can be hosted at the same physical location as the access points. Costly data connections between access points and servers can be avoided by doing so. The physical location of equipment is truly an important analysis point. In our model, equipment location and cost can be expressed through the system architecture viewpoint (shown in the bottom layer of Figure 1).

Complex ideas can be clearly represented using our e^3-value methodology, which is capable of expressing and analyzing several general mechanisms that are important in e-business, including revenue streams, value objects, customer ownership, price setting, alternative actors, and partnership issues. In the application project setting, our approach turns out to be especially useful in articulating e-business ideas much more precisely than through conventional models.

The e-business model embodies decisions that impact other requirements, especially business process and information system requirements. E-business value modeling can help yield a framework for such requirements, and can aid in determining the first step in requirements engineering for e-business information systems. The concept of value provides the crucial vantage point to understand innovative e-business models. ■

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