Rethinking Bundling of Services in the Deregulated Power Market: A Case Study of Norwegian Electricity Utility

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Introduction: Reasons for bundling of products and services on Norwegian power market

Only three years ago, when the “dotcom” wave still was rolling, it was almost impossible to find an electric utility in Norway, which did not offer so-called product bundles via its website. One could observe a great variety of products and services, which were offered together with electricity retail contracts. The experience however shows that bundling of occasional services without investigating the bundles creation process and disregarding customer demands may cause severe financial losses. [1,2] Despite costly market campaigns, these offers were mostly not appreciated by customers and failed. Today the word bundling has vanished from websites of electric utilities. Does this mean, that bundling, as a business method, is abandoned in the Power sector? In this paper we discuss and demonstrate how we applied semi-formal and formal techniques to investigate the economic viability of service bundles in the energy sector.

The electricity market in Norway is deregulated; market liberalization implied a separation of tasks related to the trade and transport of electric energy. While production and trade in electric energy were liberalized, the transmission and distribution were maintained as regulated natural monopolies. As a result, former vertically integrated utilities are split up, either in totally separated companies or as subsidiaries in the same group (concerns or holdings). Due to a fierce competition in generation and supply of electricity, the difference in electricity retail prices per kWh between different suppliers is diminishing. Electricity fits ideally to the definition of “perfect substitute”, since electricity, which is sold from one supplier, has exactly the same physical characteristics as electricity sold by another supplier, excepting the price. Consequently, many suppliers are seeking for ways to improve marketing via differentiation of their product and increase their market share. One way to do so is to add complementary and additional services such as Internet access and home comfort management.

The second strong reason for bundling lays in the existing infrastructure of electricity companies. Electricity suppliers and Distribution System Operators inherited vast databases about virtually all households in their respective concession areas and respectively big structures (skilled manpower, soft- and hardware) for billing. Bundling of products has been driven by an attempt to rationalise the operation and increase the utilisation of existing assets.

OBELIX is one of the first projects, which successfully exploits methodologies from Knowledge Management (KM) and Artificial Intelligence (AI) in the Energy domain. The present study applies an ontological approach. Ontology can be defined as “a formal specification of a shared conceptualization” [8]. Ontologies are formal representations of a domain, and serve as an important tool in making domain knowledge machine-readable. Making domain knowledge machine-readable is an absolute condition for the creation of software that implements business logic and makes business decisions that were so far made by humans. The case study is based on two ontologies:

- The *value* Value Ontology – a multi-actor approach for developing business models, taking into consideration the importance of economic value for all actors involved, and the intertwining of business and technology, which is so dominant in e-Business initiatives.

- The Service Ontology (see remark in the footnote text), providing a framework for creating feasible service bundles and identifying differences between and redundancies among possible service bundles. The Service Ontology was developed during the OBELIX project and includes unique characteristics of services, which provide a description of services and of business dependencies between them (e.g. core and supporting services).

¹ This work has been partially supported by the European Commission, as project IST-2001-33144 OBELIX (Ontology-Based EElectronic Integration of compleX products and value chains) http://www.cs.vu.nl/~obelix/
TrønderEnergi AS: facing new business opportunities and difficult strategic choices

Following the deregulation process, the company has become a strong player on the Norwegian market, both when it comes to traditional core products as electricity and new products and services as providing of broadband access to Internet or delivery of hot water to final customers. TrønderEnergi AS is involved in several non-utility businesses such as broadband access to Internet (BA), IT-services, sale of electrical appliances, centralized heated water systems, treatment of hazardous waste, a service enabling the end user to remotely control loads and more. Participation in several business activities requires a more rational and dynamic corporate organisation, which would allow efficient utilisation of the existing skills and assets (both capital and human). At the same time the experience has shown that direct involvement in new business areas means a considerable risk for the existing company. In order to minimise the risk exposure, these involvements are often done via establishment of new subsidiaries, which can be closed down or sold out. The company seeks to use the new corporate structure in order to improve its position on the market. The corporate structure of TrønderEnergi AS is presented on Figure 1.

The study presented in this paper successfully applies service and value ontologies as well as existing work on configuration theory using a project we carried out for TrønderEnergi AS. This company wishes to offer bundles of services to its customers via a website. Given a list of predefined services, modelled based on the service ontology (see Section 4), customers can define a set of services (a service bundle) that meets their demands. The various services are offered by a group of service suppliers, thus a customer’s choice of a service bundle implies also a choice of suppliers. In the present analysis suppliers analyze possible bundles that they can offer to their customers through a website. Also from the supplier’s perspective, the choice of services to offer implies a choice of other suppliers to work with. Due to a limited space, the present paper describes only snapshots from the case study, while the detailed presentation of the whole case study can be read in [3].

Conceptualisation of the business idea: construction of an $e^3$value business model

Liberalised electricity market is a multi-actor business network, where a successful assessment and further implementation of new business ideas requires a clear overview over all processes and involved actors. The study applies the $e^3$value methodology, which allows conceptualising a business case by constructing a value model, representing it graphically in a rigorous and structured way, and performing a financial sensitivity analysis. In particular, the $e^3$value methodology provides modelling concepts for showing which parties exchange things of economic value with whom, and expect what in return. Actors exchange objects of economic value, which can be physical objects, services or fees. The methodology models only things of economic value and not, for example, information required for business processes.

The $e^3$value methodology consists of several consequent steps, which are described in [4]. The first step in the study was mapping of all relevant actors in TrønderEnergi and their business activities and further definition of value exchanges between them as it is shown in Table 1.
### Table 1  TrønderEnergi AS – an overview over actors and business activities

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<tr>
<th>ID</th>
<th>Actor</th>
<th>Activities</th>
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| DSO | Distribution System Operator | **Electricity Distribution**: DSO on deregulated electricity markets provides electricity transmission services to the Final Customer.  
**Metering and Billing**: DSO is responsible for metering of electricity, consumed by Final Customer and billing routines. |
| FC | Final Customer | **Consumption of Energy**: The Final Customer satisfies his needs and wants related to the indoor comfort and operation of home appliances via consuming energy (electricity and hot water). However, use of heat pumps, for example, will reduce the total electricity consumption. The Final Customer can substitute a part of his electricity consumption (space and water heating) by consuming hot water for these purposes. Purchase of hot water will make use of heat pumps unnecessary.  
**Networking**: These services are necessary in order to cover FC’s communication needs. This activity requires access to Internet and ASP services (for commercial customers). |
| ES | Electricity Supplier | **Electricity Supply**: Electricity Supplier markets and retails electricity to the Final Customer. The Supplier can produce electricity himself or purchase it via bilateral agreements or on the Electricity Exchange. |
| TEA | Trønder Elektro AS | **Installation of electric appliances**: Personnel from TrønderElektro installs technology for Broadband access at the site of the customers – on behalf of Loqal.  
**Heat pump**: Trønder Elektro sells heat pump for reduced electricity consumption. The heat pump can also be used for air conditioning.  
**Energy Control System**: The system gives the customers the possibility for load control for reduction of electricity consumption. |
| SK | Smartkonsept AS | **Remote Control**: SK provides a possibility for the Final Customer to pre-program and control his electricity appliances remotely. |
| OFAS | Orkdal Fjernvarme AS | **Supply of hot water**: Supply of hot water for space heating purposes. |
| Loqal | Loqal Bredbånd in Trøndelag | **Providing Broadband Access**: Loqal provides a broadband access to Internet to customers, living in rural areas, where the alternative ways as cable, fibre-optics or ADSL are not available. |
| Nidit | Nidit AS | **Providing ASP Services**: Nidit provides ASP-services to Industrial Final Customers. |

Based on this information, an e’value business model was constructed, which is shown in Figure 2. Distribution System Operator (DSO) is a **market segment**, which has Electricity Transmission and Metering and Billing as its two value **activities**. DSO offers electricity transmission services to Final Customer (FC) as a **value object** and receives transmission fee (distribution network tariff) in exchange from the Final Customer. **Value objects**, are offered and requested via **value ports**, depicted by triangular arrows. The arrow shows whether a particular actor requests or delivers an object of value to or from its environment. These ports are grouped into **value interfaces**, depicted by small rounded boxes surrounding two or more value ports. Such a value interface represents that objects are requested/offered only in combination, and fulfils two modelling purposes:

- Value interface models economic reciprocity (transmission services in exchange for transmission fee).
- Value interface may represent bundling of several products or services, saying that two or more value objects are offered (or requested) only in combination.

Additionally the model includes a **scenario path** (stippled line) that consists of one or more scenario segments, related by connection elements, and **start- and stop stimuli**. Scenario path indicates via which value interfaces objects of value must be exchanged, as a result of a start stimulus, or as a result of exchanges via **other** value interfaces. A scenario path starts with a **start stimulus**, which represents a consumer demand. In our example it is FC’s demand for electricity transmission services, which are necessary in order to deliver the electricity on the customer’s doorstep. The last segment(s) of a scenario path is connected to a **stop stimulus**. A stop stimulus indicates that the scenario path ends. The scenario path includes connections (AND, OR) are used to relate individual scenario segments.
The value model in Figure 2 represents the actors, the activities they perform, the objects of value they offer as well as what they request in return for these. However, it does not represent which meaningful bundles of value objects or value activities can be constructed since it does not model complicated relations between products and services in a bundle. In order to resolve this, the OBELIX consortium developed and successfully applied the service ontology.

The Service Ontology

In this section we present the service ontology that formalizes business knowledge on services. The ontology includes a set of concepts and relations between these concepts. Once these concepts are used to describe a firm’s services, and the relations between these concepts are also defined, this information can be made machine-processable, for example for automated bundling of services.

On a high level of abstraction, the service ontology embodies three interrelated top-level viewpoints or perspectives: service value, service offering and service process. The service value perspective describes the service from a customer’s perspective; the service offering perspective describes it from a supplier’s perspective; the service process perspective describes how the service offering is put into operation, in terms of business processes.

The service value perspective captures knowledge about adding value. First and foremost, it represents a customer viewpoint on value creation: it expresses customer needs, expectations and experiences and is driven by a customer’s desire to buy a certain service of a certain, often vaguely defined quality, in return for a certain sacrifice (including price, but also intangible costs such as inconvenience costs and access time).

The service offering perspective, in contrast, represents the supply-side viewpoint: it provides a hierarchy of service components (a core service and supplementary services) and outcomes, as they are actually delivered by the service provider in order to satisfy a customer’s need. The service process perspective encapsulates knowledge about putting the service offering into operation in terms of business processes. In contrast to the usual production process of physical goods, customers often take active part in the service production.

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1 The model constructed with the e-value software tool, downloadable from the project’s website
2 This process can be supported by a software tool, to be downloaded at www.cs.vu.nl/~ziv/tool.
process. We will elaborate on the service value and service offering perspectives, as they are required for understanding our work.

**Service Value Perspective**

The sub-ontology representing the *service value* (customer) perspective (see Figure 3) includes the following concepts:

**Needs, wants and demands.** Human needs and wants are the starting point for the discipline of marketing [9]. A formal definition is given by Kotler, who distinguishes needs, wants and demands [9]:

- A human *need* is a state of felt deprivation of some basic satisfaction.
- *Wants* are desires for specific satisfiers of these deeper needs.
- *Demands* are wants for specific products that are backed up by an ability and willingness to buy them.

Needs are often vague; the need for "financial security", for example, can be interpreted in many ways. Customers concretize their needs by transforming them into wants and demands, for example based on their exposure to existing services and to marketing campaigns. In many cases, when a customer is interested in some service, he has already transformed his needs into wants and demands.

*Example:* indoor comfort (need); lighting (want); electricity supply (demand).

**Service quality.** Service quality is the degree and direction of the discrepancy between a customer’s expectations and the perception of the service [10]. Customer expectations embrace several different elements, including desired service, predicted service and a zone of tolerance that falls between the desired and adequate service levels [11]. Expectations are based on word of mouth communications, personal needs, past experiences and external communications from service providers [12]. At least two widely accepted generic methods for defining service quality exist: that of the Nordic school [13] and that of the North American school (SERVQUAL, see [12]). Nevertheless, quality definition is domain- and market-specific.

*Example:* high level of reliability; highly individualized service; fancy conference location.

**Sacrifice.** The customers’ long-term sacrifice includes the price of the service as well as relationship costs. These can be direct (e.g. investment in office space, additional equipment), indirect (related to the amount of time and resources that the customer has to devote to maintaining the relationship) or psychological costs (e.g. lack of trust in a service provider; unpleasant sensory experiences such as noise) [13].

*Example:* time spent waiting to be served; travel costs; switching costs (from one supplier to another).

![Figure 3](image-url) Service sub-ontology representing the service (customer) value perspective
Service Offering Perspective

The Service offering (supplier) perspective, lengthily discussed in [5], describes how a business intends to add value. It is centred on the concept service element, which is what the business literature defines as "business activities, deeds and performances of a mostly intangible nature" [9, 12, 13 and more]. The bundling process can be compared to the building of a Lego-castle using a subset of many available Lego-blocks: a task referred to as ‘configuration’. Configuration has been studied in Knowledge Management and Artificial Intelligence research. In order to facilitate the service bundling (configuration) process we describe the business essence of a service with constructs from configuration theory [15, 16, 17, 14]. We describe a service similar to a Lego block: in order to combine it to another Lego block, they need to have certain interfaces.

A service element is a business activity that involves the exchange of values between the actors involved. Hence, it requires a set of service inputs, and results in the availability of a set of service outcomes. Very often the outcomes of a service reflect the customer benefits from a service, whereas the customer sacrifice is expressed as service inputs (e.g. payment). Service inputs and service outcomes are referred to as resources. Resources are described using objective, measurable parameters. For example the service element ‘broadband Internet access’ for household customers has an outcome resource ‘broadband Internet capability’ with properties ‘download speed’ and ‘upload speed’, specified in Kbps. Hence, the resource description provides the objective and measurable benefit of a service; this objective benefit may be interpreted differently by customers who have differing expectations and quality perceptions, leading to their subjective value perceptions of the same service.

The input/outcome interfaces of a service denote the providing of benefits, or resources in our terminology. Figure 4 shows an example service element, modelled according to configuration theories. Note that it has an input interface (a payment resource must be available to provide the service), and it results in the availability of two resources (on the right hand side of the figure).

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Bundling Services Using the Service Ontology

The process of service bundling (or serviguration: service configuration) – spans over both perspectives: service value and service offering. Serviguration is the process of defining sets of service elements (a supply-side description of services, part of the service offering perspective), that satisfy the customer description of his desired service (service value perspective). The process is sketched in Figure 5.

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Figure 4 Example service element: hot water

Figure 5 Serviguration: configuring service bundles based on customer demands
The process is triggered by customer demands, defined in the service value perspective of the service ontology. Demands can be satisfied by resources, mostly benefits of services. Services, in their turn, are described by resources.

Suppose the customer has certain demands. We then use relations as “demand… can be satisfied by resource…” to select resources that satisfy these demands. Subsequently, these resources are provided by certain services (for example the resource energy of type hot water is provided by the hot water service), so the selection of a resource implies also a selection of services. This way we create initial sets of services, which will be included in service bundles. Then we implement business logic (e.g., relations as core/supporting services) to check the feasibility of the initial bundles, and possibly to add more services to the bundle (e.g. enhancing services). The result is zero or more sets of service bundles that satisfy the specified demand. The bundling process also takes price limitations into consideration, so we can create bundles that cost no more than a certain amount of money.

**Applying the service ontology for construction of bundles of products and services**

**Customers’ Needs and Demands.** The earlier experience shows that misinterpretation of customers’ demand is one of the key reasons for failed implementation of bundles of products and service. Therefore the first step in the modelling was to make a clear definition of the “Needs, Wants and Demands” and map them for different types of customer.

**Service elements – properties and constraints.** In the study simple service elements were firstly identified and then formalized. TrønderEnergi AS offers today a variety of services. Electricity remains to be the main core service element, while other products and services can be bundled with it. Some of the services offered by TrønderEnergi are required to be bundled together with electricity supply, while others will add value or help TrønderEnergi to differentiate themselves when selling electricity. Examples of service elements that were identified in the case study:

- **Electricity supply**: Retail of electricity to final customers.
- **Electricity transmission**: Delivery of electricity to final customers
- **Electricity supply contract**: Definition of the pricing model for the electricity sold to the final customer.
- **Heat pump**: Uses electricity for space heating. It provides maintained comfort (space heating during the winter and air-conditioning during summer) with less use of electricity.
- **Broadband (Internet) access**: Radio-based access to a broadband Internet connection (offered in a limited geographical area)
- **Contracting**: General contracting service element used by all services except the electricity supply and electricity transmission.
- **Billing**: Generic service element that several service elements require. It always requires information about the contract and results in an invoice.

A graphic example of a service element has been presented in the Figure 4.

**Dependencies between different service elements – Functions.** Construction of the different service elements has made it possible to model the logical business dependencies – referred to as functions – between the different service elements. Based on possible services offered by TrønderEnergi, a matrix of service elements is established (see Table 2). Every slot in this matrix specifies function type, existing between two service elements. The service ontology identifies a set of dependencies, for example a service may have a supporting role (meaning it is required in order to provision some core service), or one service may be sold only with another (referred to as bundled) due to marketing reasons or other business logic. The following abbreviations are used: CS (Core/supporting), OB (Optional Bundle), SU (Substitute) and BU (Bundled). The notation ‘-’ means that there is no dependency between the two associated service elements.

The matrix has to be read as follows: Every slot defines a function Function(row, column). In other words, service elements in the rows are the first argument of a function, and service elements in a column are the second argument of a function. For example: The service element Electricity supply has a CS (core/supporting function) bundle with the service elements Contract electricity supply, Billing and Electricity transmission, meaning that all these services must be consumed as well, if ‘electricity supply’ is to be consumed. In addition the electricity supply has an optional bundle (OB) with the rest of the service elements, meaning they may be added to the bundle (if no other limitations such as price prohibit that). In the row having the Hot water service element, the notation ‘SU’ is used in the column for Electricity supply. This shows that hot water can replace (substitute) some of the customer’s electricity consumption, but not all
of it. (Both electricity and hot water can be used for space heating and heating of tap water, but only electricity can be used for lighting, washing machines etc.)

Table 2 Definition of functions between different services, offered by TrønderEnergi AS

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<thead>
<tr>
<th>Service Elements</th>
<th>Electricity supply</th>
<th>Contract electricity supply</th>
<th>Billing</th>
<th>Electricity transmission</th>
<th>Heat pump</th>
<th>Energy Control System</th>
<th>Broadband access</th>
<th>ASP-service</th>
<th>Providing Hot water</th>
<th>Remote control</th>
<th>Safety check</th>
<th>Internal control</th>
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The further work has been focused on HOW different bundles of products and services can be constructed to make electricity from TrønderEnergi AS to a less anonymous product for consumers.

Test-configuration of service bundles in the Electricity Market – Relations between demands and services. The whole range of products and services, offered by TrønderEnergi AS has been modelled as a set of service elements, including definition of inputs, outcomes, external constraints and specification of the functions between different service elements. This formalisation and modelling allows development of proper service bundles that will meet the demands from different customers. It is equally important that it is also possible to identify service bundles, which are irrelevant, redundant or obsolete and thus should not be offered to the customers. The use of the service ontology has therefore given us new knowledge concerning the different services and possible bundles of these.

Examples of incentives for bundling of the different services are:

a. Due to functions (dependencies between different service elements)

b. To meet customer demands

c. Business reasons: Reducing costs, enhancing customer relationships, increased sale, marketing etc.

Initially the test-configuration of service bundles was done manually in matrix forms, based on the described Service Ontologies. The configuration developed and assessed five different bundles of products and services. The configuration of bundles was later successfully repeated with a software configuration tool for an automated reasoning. The configuration tool was developed for this purpose in OBELIX project. After the configuration a set of feasible bundles has been identified and checked against customers’ demand. Additionally it was identified which bundles are beneficial to TrønderEnergi AS.

Construction of specific e³value models

The next step returns the study back to the initially developed e³value model. As earlier mentioned, in the initial e³value model it was rather problematic to define the scope of the model and relevant actors. Similarly, definition of all the significant value exchanges was complicated as well. Therefore the Service Ontology has been developed and applied together with the configuration tool for construction and assessment of relevant service bundles. The resulting service bundles from the Service Ontology are further used for construction of specific e³value models for each bundle. The following example (Figure 6) involves four actors: Final Customer, Nidit AS, Loqal AS and TrønderElektro AS.
Loqal AS, which is a subsidiary of TrønderEnergi AS, provides radio-based Internet access to Final Customers. TrønderElektro AS provides installation and maintenance of the necessary hardware. The Final Customer also buys ASP (Active Service Provider) services from Nidit AS, another subsidiary of TE. The specific value model quantifies all value exchanges between all actors, participating in the scenario. These exchanges are further used for generation of profitability sheets for all actors. Summary of the profitability sheets is presented Table 3, showing annual cash flows for all actors.

Table 3 Summary of the profitability sheet for the bundle, presented on Figure 6 (Values in Norwegian Crowns)

<table>
<thead>
<tr>
<th></th>
<th>Final Customers</th>
<th>Nidit</th>
<th>Loqal</th>
<th>TrønderElektro</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROFITABILITY</td>
<td>0.00 (-4425)</td>
<td>1800</td>
<td>2250</td>
<td>375</td>
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</table>

Based on these profitability sheets we developed an example of sensitivity analysis, calculating accumulated NPV with the number of final customers as a parameter.

Conclusions

The study has developed and applied techniques for assessment and configuration of service bundles in the energy sector. This work has NOT focused on finding THE BUNDLE with both highest profit and benefit for all actors included. The work has rather been focusing on WHY and HOW to apply the specified methodology to identify and present the different bundles and the services included in those. The use of the e-value model and service ontology has given new knowledge of how to model the services in the energy domain, and to evaluate different bundles before they are introduced to the market. This could reduce unnecessary costs and the use of the previous “trial and error” method, used by electric utilities for identification of economically feasible service bundles.

The Value Ontology in Business Perspective

The Value Ontology has been successfully applied in this study, giving the following results:

- Clear definition of all relevant actors involved in the business scenario.
- Identification of objects of economic value created, exchanged and consumed by the actors. Presentation of the mechanism for economic reciprocity.
- The Value Ontology provides a formal methodology for assessment of perspective business scenarios and investment decisions.
Development of specific e-value models provides input for construction of financial sheets and development of sensitivity analysis

The Service Ontology in a Business Perspective

The generic component-based service ontology provides a means for conducting automated reasoning on the selection of one service or another, resulting in one or more feasible service bundles that will satisfy the customers’ demands. An automated reasoning will simplify significantly a process of introduction and assessment of new services and products on a market or, alternatively, a withdrawal of obsolete or abundant services from the market. The study had automatically applied a software tool for an automated reasoning.

Furthermore, the service ontology allows an automatic reasoning about all theoretically feasible service bundles, and making a choice about preferred bundles, based on the assumption that a supplier wants to offer service bundles that satisfy its customers’ needs and demands. This is modelled when linking the customer demands to available services and service outcomes.

The Service Ontology provides a methodological framework for marketing analyses before introducing services, and an innovative construction of new service bundles. The Service Ontology allows identifying properties for new service elements and dynamically integrating them into the existing configuration solutions.

References


