Goal-Oriented RE for e-services[1]

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Abstract. Current research in service-oriented computing (SoC) is mainly about technology standards for SoC and the design of software components that implement these standards. In this paper we investigate the problem of requirements engineering (RE) for SoC. We propose a framework for goal-oriented RE for e-services that identifies patterns in service provisioning and shows how to compose business models from them. Based on an analysis of 19 business models for e-intermediaries we identified 10 intermediation service patterns and their goals, and show how we can compose new business models from those patterns in a goal-oriented way. We represent the service patterns using value models, which are models that show which value exchanges business patterns engage in. We conclude the paper with a discussion of how this approach can be extended to include business process patterns to perform the services, and software components that support these processes.

1 Introduction

As a result of the diffusion of Internet technology in the mid-90s, the business world encountered a new disruptive possibility[5,6] to exchange data by computer networks at low cost. Like any disruptive technology, computer-based networking has changed business activities and constellations of businesses significantly. Because many of the equations upon which business models have been built have changed, a rethinking of these models is required. This especially holds for intermediaries; existing intermediaries like travel agencies disappear, while at the same time new types of intermediaries emerge.

Utilization of Internet technology by businesses spawned a new field of research, namely e-business research. Two main streams of e-business research exist[10]. The first stream aims at conceptualizing the principles that form the foundation of a business. The resulting business models describe a business model in general[1,3] in terms of structure and governance of transactions[3], customer value, scope, price revenue sources, connected activities, implementation, capabilities and

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sustainability[1]. The second stream aims at creating a taxonomy of business models of existing business in a specific domain[12,13,14]. Examples of business models in such a taxonomy are: brokerage, advertising, infomediary, merchant, manufacturer (direct), affiliate, community, subscription and utility[12]; and direct customer, full-service, provider, intermediary, whole of enterprise, shared infrastructure, virtual community, value net integrator and content provider[14]. Throughout this paper, we will refer to the first stream of research as the *conceptual* approach and to the second as the *taxonomy* approach.

Our goal in this paper is to compose business models from elements in a library of fragments of business models. Compared to the taxonomy and conceptual approaches, this approach is middle-out, while the taxonomy and conceptual approaches are bottom-up and top-down approaches, respectively. We are interested in fragments of business models that satisfy the following restrictions:

- A fragment must reoccur in several business models;
- Each fragment must reoccur in similar contexts;
- Fragments must be a solution to a readily identifiable problem or goal.

This is similar to restrictions posed to fragments of programming code—called design patterns[8] and to fragments of a building construction—called architectural patterns[2]. Therefore, we call them patterns. These patterns stand in the middle of the two research approaches mentioned earlier; they can be decomposed into business model components and presented in the terms of the conceptual approach; or they can be composed to form a complete model, which classifies the taxonomy approach in a specific group form.

We compose a business model for a specific e-business idea by following the structure of a goal tree that consists of this idea as the root goal. This root goal is decomposed in sub-goals, where every branch links nodes in a specific relation, e.g. an AND-relation, where all sub-goals must be satisfied in order to satisfy the 'parent' goal. We compose a business model following the structure of the tree by matching leaves (or entire sub-trees) and goals of patterns. We do not study how the business requirements can be decomposed into a goal tree in the first place; techniques from goal-oriented RE (GORE) can be used here[4,7,11].

Figure 1 presents our research framework in a table-like diagram with 3 rows and 4 columns. The rows represent composition levels: we need information systems to support business processes, business processes to deliver services, and service delivery to realize business goals. For example, from the top down: to realize the business goal of helping customers find the best product offer, an intermediary must offer its customers a price comparison service; to offer this service, it must execute the business process of periodically searching for product offers and comparing prices; and to support this process, a product information system must be maintained by the intermediary. Each of the rows in Figure 1 represents a different level of design decisions.

At each level, design decisions are structured further from assembling primitives (in the first column) into patterns (the second column) that can be assembled further into models (the third column). This third column presents complete models of a system at different composition levels. The fourth column is not part of our research but is shown for ease of understanding.

The relations between the different concepts in our framework are shown with arrows. We have three types of relations: includes, compose and realizes. An *includes* relation means that a composite consists of some elements, where the elements cannot exist independently. A *compose* relation means that entities that can exist independently are composed into a composite. A *realizes* relation shows that something is the means to achieve something else.

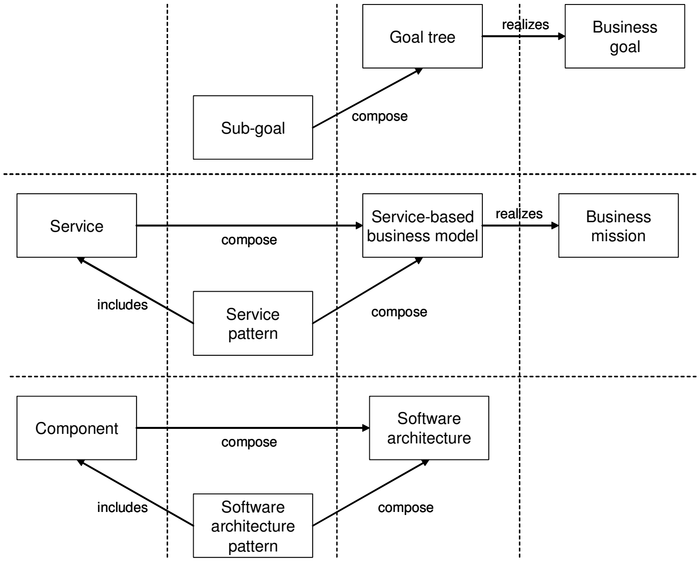


Fig. 1. Framework

In this paper, we focus on the composition of service-based business models from service patterns. Our results in other parts of the framework will be reported on in future papers.

The structure of the paper is as follows. In section 2, we first present the modeling ontology we use throughout the paper. Second, we show the classification of business models of intermediaries we have built. And third, we show an example of one such business model. In section 3, we give a definition of a value pattern and we list the patterns identified in intermediation business models. Moreover, we present the template for pattern description we use and by its means we show an example of a pattern. Section 4 presents our approach of applying goal-oriented RE to compose a new business model out of value patterns. We illustrate this with an example. In the last section, we conclude by summarizing our results and pointing out open issues. Further, we give ideas for possible applications and validation.

2 Business Models for Intermediaries

2.1 The e^3*value* Ontology

To show how we compose business models from service patterns, we briefly rehearse the notation used for business models here. In this paper, we use the e^3*value* notation to represent the value-exchange aspect of business models[9]. We illustrate e^3*value* by means of an education example (see Figure 2).

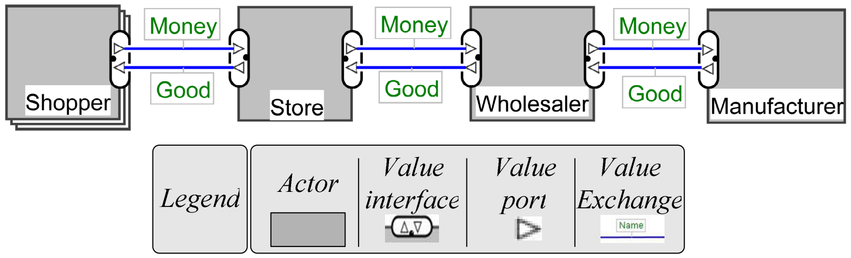


Fig. 2. An example e^3*value* model (Note: the Legend is only for explanatory purposes and is not part of the e^3*value* modeling technique itself)

Figure 2 consists of the following e^3*value* base constructs:

- **Actor.** An actor is perceived by its environment as an independent economic (and often also legal) entity. In a sound and viable business value model *every* actor should be able to make a profit. Actors are represented as rectangles. Store, Wholesaler, and Manufacturer are examples of actors. Shopper is visualized as stacked actors, denoting a *market segment*. In our interpretation of market segment, actors in a segment attribute equal economic value to objects. The decision to model an entity as an actor or as a segment is determined by the modeling and analysis purpose: e.g. in Figure 2 the motivation can be that we are interested in analyzing potential profit for a chain of companies in relation to an end-customer market segment.
- **Value Object.** Actors exchange value objects. A value object can be a service, a right, a good or even a consumer experience. The important point is that a value object represents a *value* for one or more actors. Value objects are shown as text next to arrows. Examples of value objects in Figure 2 are Good and Money.
- **Value Port.** An actor uses a value port to show to its environment that it wants to provide or request value objects. The concept of a port is important, because it enables to abstract away from the internal business processes, and to focus on how external actors and other components of the e-business value model can be 'plugged in'. Ports are shown as small triangles.

- **Value Interface.** Actors have one or more value interfaces. A value interface consists of value ports offering or requesting value objects. It shows the value object(s) an actor is willing to exchange *in return for* other value object(s). Such willingness is expressed by a decision function on the value interfaces, which shows under what conditions an actor wants to exchange a value object for another value object. The exchange of value objects is *atomic* at the level of the value interface; i.e. either *all* exchanges occur as specified by the value interface or *none* at all. Note that a value interface does not indicate the temporal ordering of objects to be exchanged on its ports. It only indicates which value object is available, in return for some another value object. A value interface is shown by a rounded box, connected to an actor. In Figure 2, value interfaces denote that actors offer/request a good and request/offer money in return.
- **Value Exchange.** A value exchange is used to connect two value ports with each other. A value exchange represents one or more *potential* trades of value objects between value ports. As such, it is a prototype for actual trades between actors. It shows which actors are willing to exchange value objects with each other. A value exchange is shown by an arrow.

2.2 Intermediaries

Our aim is to compose new business models based on reoccurring fragments in existing business models. To make our task manageable and to ensure a comparable context for our candidate patterns, we narrow down the business domain from which we select patterns to electronic market intermediaries that offer negotiation services. Examples of such intermediaries are mediators, arbitrators, auctioneers, price searchers, and certain decision support systems.

Based on an extensive survey of intermediation literature and of existing as well as proposed intermediaries on the web[15,17], we selected 13 intermediaries (see Figure 3). Based on their core business, we classified them into 5 groups, namely: Conflict resolution intermediary, Negotiation support system, Auction, Price discovery and Price comparator. The 5 groups are represented as classes in Figure 3, which are derived from the Negotiation intermediary class. Each of them has a number of instances presented as objects. These list the models of existing business that we selected.

We conceptualize the intermediation business models using the *e^3value* approach. Due to lack of space, we show only one example from our collection. The other business models have been conceptualized in a similar way. The complete list is available as a technical report[16].

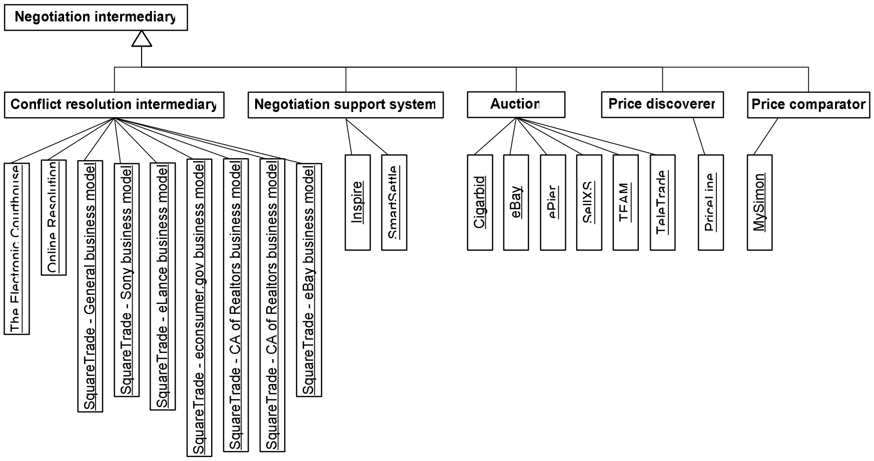

Negotiation intermediary
Conflict resolution intermediary
Negotiation support system
Auction
Price discoverer
Price comparator
The Electronic Courthouse
Online Resolution
SquareTrade - General business model
SquareTrade - Sony business model
SquareTrade - eLance business model
SquareTrade - econsumer.gov business model
SquareTrade - CA of Realtors business model
SquareTrade - CA of Realtors business model
SquareTrade - eBay business model
Inspire
SmartSettle
Cigarbid
eBay
ePier
SellXS
TFAM
TeleTrade
PriceLine
MySimon

Fig. 3. Classification of business models

Figure 4 shows our example. SellXS.com[2] is a business-to-business (B2B) marketplace for auctioning excess inventory in the semiconductor industry. SellXS.com enables high-tech companies to buy and sell excess inventory on the open market by leveraging dynamic pricing and a direct trade model to create greater market efficiencies and cost savings than is possible through traditional or online broker models. SellXS.com facilitates direct trade between buyers and sellers. Figure 4 illustrates how SellXS.com is modeled with the *e^{3}value* technique.

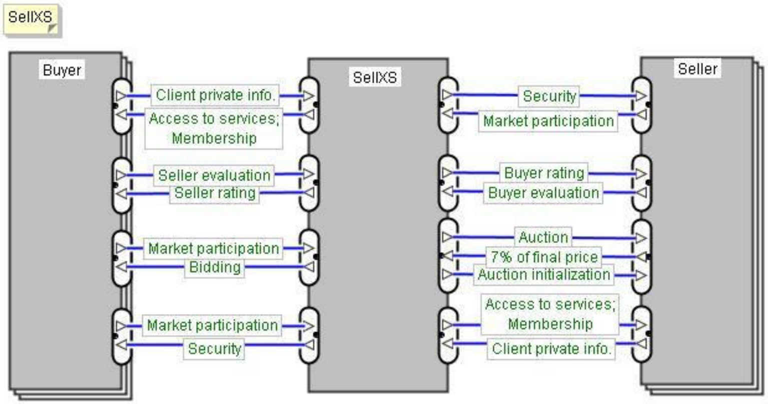


Fig. 4. SellXS value-based business model

[2] http://www.sellxs.com/

3 Value Patterns

A service-based business model has several aspects, including the data exchanged, communication channels used, and values exchanged. Our business models are value models and they only represent the value exchanges. Therefore, the patterns we identify are value patterns. A value pattern presents one aspect of a services pattern but because we do not investigate the other aspects we will use the two terms interchangeably.

The next step in composing business models is to find value patterns for intermediaries, based on the constructed value models. We define a value pattern as reoccurring fragments of value exchanges in similar contexts solving a specific problem or satisfying a specific goal. Therefore, we use a two-step approach to discover patterns. First, we look for *similar* value exchanges in various business cases, with a *similar* business context. Second, we check whether these fragments represent a *solution* to a readily identifiable *problem* or *goal* in their contexts.

We use the business model of Figure 4 to exemplify how we find and represent a value pattern. In the top-left part, we see the following value exchanges: a buyer provides client private information to SellXS, which in return gives access to services and membership. Then, we consider the other business models and, in some of these, we observe the same fragment. Thereafter, we identify the problem the exchanges solve: an intermediary wants to know its clients in order to identify them, to keep track of their transactions and wants to offer them better-targeted services. Therefore, this fragment is a pattern, which we name as the *Registration* pattern.

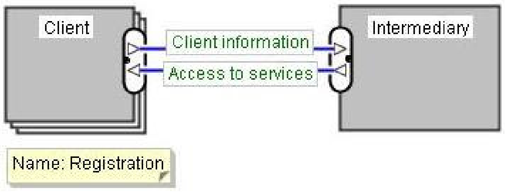
We have identified 10 of such value patterns out of 19 models of 13 businesses. Our list of patterns[3] includes Advertising, Insourcing, Technology renting, Market information, Registration, Personalization-Customization, Client connection, Core service extension, Screening, and Rating[16].

We use a template for the description of our patterns. The template consists of the following fields: *name*—presents the name of the pattern; *headline*—presents a short description; *context*—presents the business context in which the pattern occurred; *goal/problem*—presents a goal or a problem of an intermediary in concrete context; s*olution*—presents the pattern as a possible solution to the identified problem. The next three fields further describe the solution; *value exchanges*—explains the value exchanged in the pattern; *intermediation services*—presents the intermediation services that deliver the exchanged values; *value-based model*—presents the pattern as a partial *e^3value* model; *variations*—presents variations on the pattern; *occurred in*—lists the models in which the pattern occurred.

We illustrate our library of patterns and our template for description with an example. (see Table 1).

[3] http://wwwhome.cs.utwente.nl/~zlatko/Downloads/Library_of_Patterns.PDF

Table 1. Service pattern: Registration

Name	Registration
Headline	An intermediary offers a registration service to anonymous clients. In this way, the intermediary can keep track of its clients and offer better-targeted services.
Context	An intermediary is situated in a market with unknown buyers and sellers. It deals with practically anonymous clients.
Goal/Problem	An intermediary wants to know its clients in order to identify them, to keep track of their transactions and to offer them better-targeted services.
Solution	An intermediary requires registration from every new client and identification prior to use of its services. The registration requires client information.
Value exchanges	An intermediary offers access to its services in return for client information.
Intermediation services	An intermediary offers Registration service. Prior to services use, the intermediary requires Identification service (not shown in the model).
Value-based model	 Client Client information Access to services Intermediary Name: Registration
Variations	
Occurred in	Cigarbid, eBay, ePier, SellXS, TEAM and TeleTrade

4 Goal-Oriented Composition of Value Models Using Value Patterns

A next step is to use found value patterns to develop a business model, in our case specifically for an intermediary. We do so by using goal trees, which are well known from the realm of goal-oriented requirements engineering.

As an example, assume that there is a new market for products P, Q and R. In this market, we know from previous research that it is economically viable to execute a transaction through an intermediary. We want our intermediary to mediate at least A% of the transactions in the market. This is our top-level goal. To get a better understanding of our objective, we decompose the top-level goal into sub-goals. Figure 5 shows an AND-OR tree of the goals of our intermediary. In an AND-OR goal tree, an AND-node is satisfied if all sub-goals are satisfied and an OR-node is satisfied if at least one sub-goal is satisfied.

Goals can have different properties. The interaction of these determines the type of composition of sub-goals. Goal-oriented requirements engineering aims to determine how these interactions affect the system under development. In our approach, we want to investigate how the structure of a goal tree results in a complete business model. We want to find business model fragments that satisfy the leaves of the goal tree and then compose a business model out of fragments following the goal tree structure.

We now further restrict our goal by requiring that the intermediary uses an auction mechanism for price determination. We decompose our goal into sub-goals. Figure 5 shows the resulting goal tree.

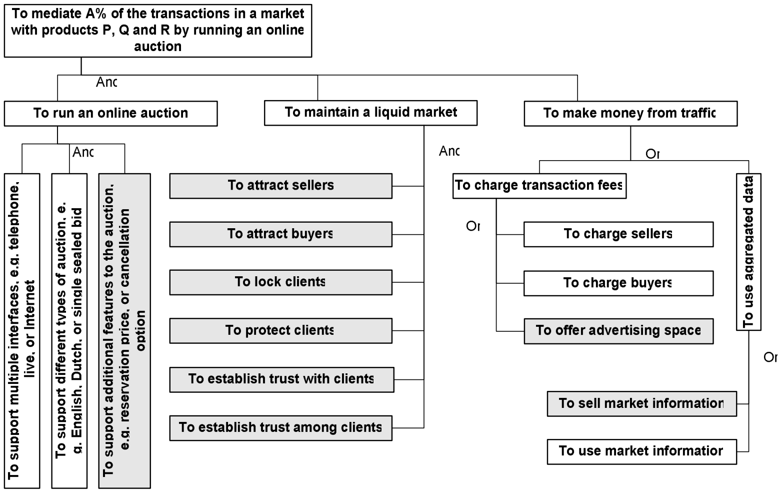

To mediate A% of the transactions in a market with products P, Q and R by running an online auction
Anc
To run an online auction
To maintain a liquid market
To make money from traffic
Anc
Anc
Or
To support multiple interfaces, e.g. telephone, live, or Internet
To support different types of auction, e. g. English, Dutch, or single sealed bid
To support additional features to the auction, e.g. reservation price, or cancellation option
To attract sellers
To attract buyers
To lock clients
To protect clients
To establish trust with clients
To establish trust among clients
To charge transaction fees
Or
To charge sellers
To charge buyers
To offer advertising space
To use aggregated data
Or
To sell market information
To use market information

Fig. 5. AND-OR goal tree

The leaves of the tree represent sub-goals with a granularity that is comparable with the goals mentioned in our value patterns. Thus, we match these leaf-goals with the pattern goals. For example, the intermediary under development has a goal to offer advertisement space (see Figure 5). We match this goal with the goal of the Advertising pattern, which is: to utilize access to clients and client information. These two goals match because to offer advertisement space means to take money for exploiting access to and knowledge about clients.

Our current approach to matching of sub-goals and pattern goals has two drawbacks. First, the goal-tree decomposition, the pattern goal definition and the matching of goals is currently done without following procedures or using explicit, objective criteria. Second, it is potentially biased because the goal-tree decomposition and the pattern definition is done by the same group of people, that may have a tendency to define the goals in a way that they match.

Matching goals is not always a straight-forward process. As we show below, the relation between matching sub-goals and patterns goals is many to many. Moreover, a difficulty originates in the various contexts, in which the goals are formulated. An illustration of the latter is that the sub-goals are derived with a particular implementation in mind, as the pattern goals are defined in general terms.

In our future work, we will investigate the possibilities for overcoming the weak points in our approach and for automation of the process of goal matching. Additional attention will be paid to the trade-off between a better automated matching process and more design freedom in the hands of the business architects.

After matching the leaf-goals from the AND-OR tree (Figure 5), the result shows that we could find one or more matches for many of our sub-goals. (Figure 5 depicts the sub-goals with one or more matches in grey.) Below, we list the pairs of goals specifying the sub-goal, the name of the pattern, and the goal of the pattern.

- *Sub-goal*: To support additional features to the auction, e.g. reservation price, or cancellation option
  - *Pattern*: Core service extension
  - *Goal of the pattern*: an intermediary wants to diversify its service from the competitors' one
- *Sub-goal*: To attract sellers or to attract buyers
  - *Pattern*: Client connection
  - *Goal of the pattern*: an intermediary wants to build a stronger relationship with its clients. It wants to give additional value to its client to keep them closer. It wants a better image than its competitors have
- *Sub-goal*: To attract sellers or to attract buyers
  - *Pattern*: Market information
  - *Goal of the pattern*: an intermediary wants to utilize the market information it has aggregated
- *Sub-goal*: To lock clients
  - *Pattern*: Personalization-Customization
  - *Goal of the pattern*: an intermediary wants to find the right product mix for its services. It wants to offer everything its individual clients want but not more than they need
- *Sub-goal*: To protect clients
  - *Pattern*: Rating
  - *Goal of the pattern*: an intermediary wants an evaluation mechanism for its clients but has no means to perform it
- *Sub-goal*: To establish trust with clients
  - *Pattern*: Client connection
  - *Goal of the pattern*: an intermediary wants to build a stronger relationship with its clients. It wants to give additional value to its client to keep them closer. It wants a better image than its competitors have
- *Sub-goal*: To establish trust among clients
  - *Pattern*: Screening
  - *Goal of the pattern*: An intermediary faces low participation because market participants feel vulnerable
- *Sub-goal*: To offer advertisement space
  - *Pattern*: Advertising
  - *Goal of the pattern*: An intermediary wants to utilize its access to clients and client information
- *Sub-goal*: To sell market information

- *Pattern*: Market information
- *Goal of the pattern*: An intermediary wants to utilize the market information it has aggregated

The results show that more than one pattern matches a sub-goal and more than one sub-goal matches a pattern. This gives us freedom in the design process of the business model. We could add in the model all matching patterns for a sub-goal, as well as add only once the pattern that matches more than one sub-goal.

We compose the matching patterns in the following way. First, we take all patterns that match sub-goals from AND-leaves and one or more (in the example below—all) patterns that match sub-goals from OR-leaves. If a pattern satisfies two or more sub-goals we take it only once. Second, we construct the overall business model by putting together the selected patterns. We do this in two steps: step on, determine the business actors and segments in the model and step two, connect the business actors with exchanges appearing in the patterns. In the first step, we form the set of business actors in the model as the union of business actors in each pattern: this means that if more than one pattern have one and the same business actor, this business actor will be present only once in the composed model. In the second step, we connect the actors with the exchanges occurring between actors in each pattern: this means that every exchange in every pattern will appear in the composed model.

Figure 6 shows the resulting business model. As we can see, it looks like a template which needs to be further specialized. This means that some of the exchanged values need to be specified with less abstract names. For example, the market information given to a seller can be information about demand of certain product, as it is in our example. Another possibility is to give information about market share. In Figure 6, we show several such specializations, shown in brackets. This illustrates how our generated model can be used by an entrepreneur. The model gives design freedom to add innovative value exchanges and to specialize it.

In the process of composition of patterns, certain conflicts may occur. By a conflict, we mean two or more incompatible patterns. Such conflicting patterns may occur in the final design because of conflicting goals in the goal tree or of inexact match between a sub-goal and a pattern goal. Although we have no reasons to believe that such conflicts will not occur; so far we haven’t encountered compositions with incompatible patterns.

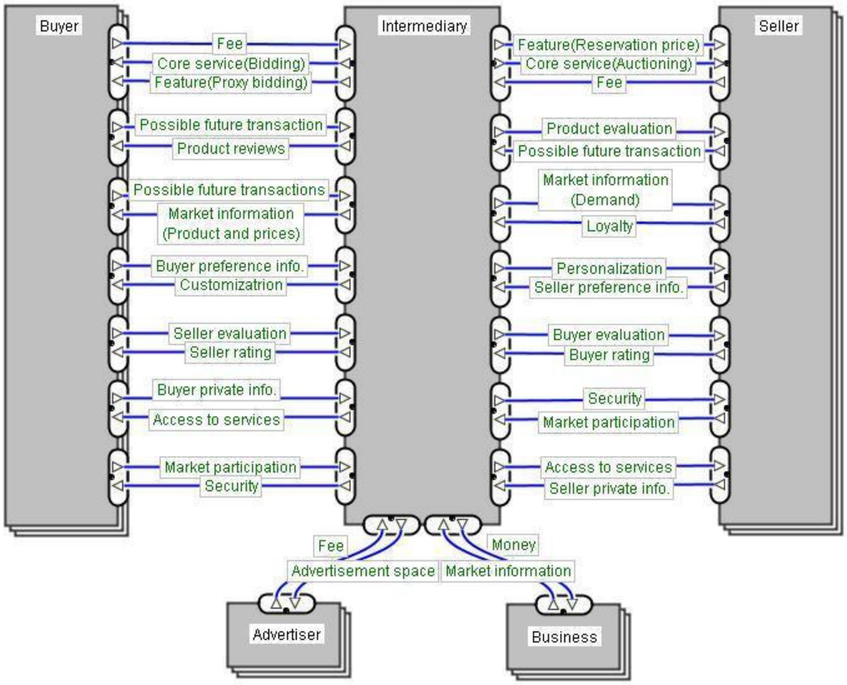


Fig. 6. Composed business model

5 Discussion and Conclusions

As we stated in the beginning of our paper, our ambition is to find service patterns from which we can compose more complex service-oriented business models. We identified a library of service patterns for e-intermediaries and showed how these can be used to compose new intermediation business models. To do so, we employ a goal oriented way of thinking, borrowed from Requirements Engineering. Basically, we match goals stated in the service value patterns with leaf-goals found for the case at hand. Identifying the structure of services is the central part of RE for the service-oriented software infrastructure needed to deliver these services.

Many topics for further research remain.

- Matching service patterns with goal tree leaves is currently done in an informal way. The matching may be inexact and we saw that it can be many-many. Can we operationalize this? Can it be formalized? Can decision support for this matching be provided?
- Another possibility to reduce the many-many relation can be the construction of multiple goal trees, one for each enterprise involved. Patterns can also be extended. Their goals can be represented with more complex structure: e.g. a

set of goal-actor tuples. Having a goal tree per each business, we can select value patterns by matching leaf goal-actor combinations with goal-actor combinations from the pattern library.

- We need to validate our library, and make it more robust, by experimenting with more business model compositions and confronting it with additional existing or proposed intermediaries.
- We plan to investigate the relationship between the service level and the software component level of our research framework. Can we identify software components that occur in a particular service pattern? Are there particular software architectures that support particular kinds of business models? What relationships exist between software architectures and the quality attributes of the services to be achieved?

Currently, a lot of research is done is the area of service composition. In our opinion, the way to composition may go trough decomposition. A composition of a service out of other services may be presented as a decomposition of the goal of the composed service to a goal tree and then composed back from individual services.

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