Value and Goal Driven Design of E-Services

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Abstract - E-services are used as the cornerstones for modeling interaction points of cooperating IT systems, within and between enterprises. So far, research and development of e-services have mainly focused on an operational perspective, such as the development of standards for message exchanges and service coordination. However, on a strategic level, the success of e-services depends on its ability to work as a catalyst for the business values that are being exchanged. In this paper, we present an approach that utilize value and goal models as the foundation for designing e-services. The approach can be used to strategically ensure that the developed e-services support the desired business values for involved actors. A case study from the Swedish health sector is used to ground and apply the presented approach.

1. INTRODUCTION

The use of e-services [1] is evolving from a point-wise use towards large-scale use across enterprise boundaries. E-services that are used within an organization or that only involve a few external actors may be designed without the need to explicitly motivate the service in terms of gained business value. Such use of e-services can be handled by using traditional software development approaches. However, shifting the focus to large scale design of external e-services, stresses the need to analyze, identify and design e-services within the context of value exchanges on the business level. Besides the need to handle the increased complexity in the form of numerous business actors and their value exchanges, there is also a need for a structured approach for software service design that merges the IT and business perspectives. Having a well-defined alignment of software and business values provides benefits for service requirement gathering, service design and service validation.

In this paper, we propose a structured approach for e-service design based on value and goal models. As a first step we apply value models to capture high-level business requirements in the form of value transfers between actors. Using a set of guidelines we then define top-levels goals derived from the value models. These top-level goals are then used as input for deriving a set of candidate e-services.

The work in this paper is based on experiences of a project in the health care domain, the REMS project [2]. The main aim of the REMS project is to create a set of e-services that can be used to create, manage and transfer health care referrals between S:t Erik’s eye hospital (an eye specialist clinic) and primary care and private eye specialists in the Stockholm area. Referrals are one of the key instruments when health care providers collaborate in the treatment of patients. As the number of referrals and the number of parties involved in the referral process increase, manual routines become insufficient. Management of health care referrals spans geographical, organizational and IT system boundaries; thus, the project contains ample examples of complex business as well as IT interactions. A systematic approach, supported by an IT infrastructure, is thus required in order to design e-services that support the distribution and management of health care referrals.

The paper is structured as follows. In Section 2 and 3 we give an overview of related research and our approach. The use of, and extension of, value models are described in Section 4. In Section 5 the approach for linking value with goal models are described. The goal models are further refined into e-services, as described in Section 6 and 7. In Section 8 we discuss the applicability of the approach within the REMS project. Finally, in Section 9 we summarize our contribution and discuss subjects of further work.

2. RELATED RESEARCH

In recent years, the problem of integration between business and information systems has been extensively studied in the research community. The approach presented here relates to and builds on research that relates business processes, business models and goal models to services.

Many studies have considered the business process perspective as a starting point for designing service-based systems [3], [4], [5]. However, being focused solely on processes, that is, on an operational perspective, the aforementioned studies have omitted the economic viability and value of services that we address in this paper.
Recent research [6], [7], [8], [9] elicits that when addressing business-to-IT integration, constructive results are obtained by starting to analyze the business models of enterprises. A business model describes what is offered by an actor to another actor [9], rather than how these offerings are negotiated, contracted and fulfilled among the actors, as explained by a process model. In [10], and [11] a business model is taken as a starting point for aligning business requirements with executable processes, that is, service coordination. The approach emphasizes that IT solutions need to be derived from business models, validated with particular value propositions and exchanges, and accepted by all participating actors. We utilize this approach in our study; however, the value model that we propose, in addition to the exchange of economic resources, captures the concept of actors’ internal values of receiving an economic resources, see also discussion in [12]. This means that we make a difference between the resource transferred between actors and the internal value experienced by an actor. Furthermore we set a focus on the identification of e-services capable of supporting such value models. Thus, in our approach, value models are more general than business models, including both the exchange of economic resources and the internal values that actors experience by receiving economic resources. Examples of internal values are increased knowledge and increased feeling of safety.

Several recent studies [13], [14] consider goal-oriented analysis as a starting point for the design of IT-enabled business models. These studies set the focus on identifying strategic goals and aligning them with business models. Our approach differs in the way that we utilize a goal modeling approach as a mediator between value models at one side and e-services at another side. Thereby, we are able to explore alternatives for provisioning the values in the form of e-services.

3. OVERVIEW OF THE APPROACH

The main aim of the approach presented in this paper is to drive the design of e-services from a business value perspective. In order to do this, we utilize four distinct steps: value modelling, top-goal identification, goal driven identification of e-services and e-service refinement (Figure 1).

1. Value modeling: A value model [11] is first used to capture high-level economic resource transfers between actors. We here extend this model by also capturing internal values, such as knowledge and safety.
2. Definition of top goals: A goal model is used to further refine transfers in the value model. As a starting point for the goal model we use a set of guidelines to derive top-level goals from the value model.
3. Goal driven identification of e-services: The goal model is refined, leading to e-services as means to fulfill sub-goals. As an extension to the goal model we introduce a service-level in the goal model, specifically enabling the identification of e-services that supports goal fulfillment.
4. E-service refinement: To aid the service analyst to select and structure e-services based on the outcome of the goal model we provide a granularity guideline. This guideline aid the service analyst to aggregate e-services to the desired granularity level.

The approach presented in this paper both add concepts to existing models (in the form of internal values, top-level value goals and a service-level in goal models), as well as providing methodical support for linking values, goal and e-services together. The advantage of basing service analysis on value models and goal models in this way is that we gain alignment of business and IT levels, thereby ensuring that the services support the desired business values.

4. VALUE MODELLING

According to the REA Enterprise Ontology [15], a business model, in its basis, describes the transfer of economic resources between involved actors. Economic resources are things that have utility and are under control of a business actor. Examples of economic resources are products, services or money. Every resource may be associated with a price, which is established on an economic market basis.

In our approach we strive to capture the transfer of economic resources as well as the values that indicate why a particular resource is desired. Actor-external resources are modelled as value objects, while actor-internal motivation for the transfer are modelled using the notion of value:

- A value object is a domain specific economic resource transferred between actors. Value objects are commonly exchanged in the form of dualities. This means that in a business context, an actor that provides something of value to another actor always gets compensation [16]. In the health domain, an example of duality is when a patient gets treatment from a primary heath care physician, who in return obtains a patient fee. As a fundament for analyzing value object we have defined four types of value objects goods, information, money, and services (the use of these value object types are discussed further in Section 5.2).
- An actor is a business role that a legal entity, such as an organization or a person, takes when providing or

![Fig. 1. Overview of the approach](image-url)
consuming value objects. Some examples of actors are patients, physicians, primary care units, etc.

− A **value** is a intended effect of the use of a value object. More precisely, a **value** is a desired improvement of an actor internal resource\(^1\), which specifically describes resources that cannot be transferred directly. Examples of values to an actor are increased knowledge, higher status and better health state. Internal values can be achieved by an actor by consuming value objects. For example, an eye treatment (a value object in the form of a service) can give improved eye-sight (a internal value) of a patient. Not only services can be used to achieve values for actors, but also other value objects, i.e. goods, information, and money. For example, glasses (goods) will yield improved eye-sight (a internal value) for a patient. Note that some internal values are of a psychological nature and are wanted for their own sake. Examples are increasing the status, beauty, pleasure or an increased feeling of safety. Even though it is out of the scope for this paper, internal values can be classified according to value categories, such as the typology of consumer values presented by Holbrook \[18\].

In summary, there are four different types of value objects: goods, information, money, and services. These value objects can be used to create values for the actors. Note that some value objects mean the **right** to a value objects in the future. For example, a ticket to a music performance gives the owner of the ticket the right to visit a certain music performance. This also means that the value is a **potential** value, e.g., a potential increase of pleasure. Another example from the health care domain is a referral, which gives the patient a **right** to a health care service, which provides a **potential** better health state. A common term when transferring rights to resources is vouchers, for example a ticket can represent a voucher for a music performance.

In Figure 2 we illustrate an excerpt of the value model defined in the scope of the REMS project. The figure depicts:

- the transfers of value objects among the actors
- which types of value objects that are transferred (in brackets)
- values that are based on the value objects as input (in parenthesis)

Note that we in this model take a limited provider perspective, as in this study we set the focus on modeling the values as perceived by the consumer of the health care services, and not the values perceived by the service provider (the primary health care and eye specialist clinic in Figure 2).

The value model in Figure 2 is based on the following process: Having a problem with the eye(s), the patient first contacts the local primary care unit, in order to get investigated, and if necessary, sent to an eye specialist clinic for investigation or treatment. As Figure 2 depicts, the value objects that the patient needs to obtain are the initial investigation, and the referral. The values are discovered by asking “why is a value object desired?”. For the patient, the investigation (service value object) provides increased knowledge on his or her health condition (value). The referral to a specialist eye treatment gives the patient the right to an eye treatment in the future (right to a service value object), which provides a potentially better health state (a value). Note that the patient may not receive any referral document, only oral information about the referral. In relation to this, the primary care unit gets the following value objects: patient fee and patient voucher. The patient fee is something that the patient pays when visiting the primary care, while the patient voucher enables further reimbursement for the expenses from the county council. (The patient voucher could also be named patient registration, because it is the patient registration information that is sent to the city council for reimbursement.)

Further, an exchange of value objects occurs between the primary care and the eye specialist clinic. The referral that the patient received is also sent to the eye specialist clinic. For the specialist clinic, the referral gives the clinic a potential right to reimbursement from the city council (if the patient will visit the clinic for treatment). When the eye specialist clinic has treated the patient, the clinic sends a referral answer back to the primary care unit with information on symptoms, diagnoses and carried out treatments. This information does not lead to any direct actions at the primary care unit (note, if the specialist clinic wants the primary care to carry out some treatment, a new referral has to be sent to the primary care). The referral answer is mainly used to increase the knowledge about eye health care for the physicians and nurses at the primary care unit. Further, when the patient visits the eye specialist clinic, the clinic receives patient fee and patient voucher (money value objects and right to money value object), and the patient receives eye treatment (service value object) and information about ongoing treatment (information value object). The former value object received by the patient aims to increase the health status (internal value) and the latter to increase the patient’s knowledge on his or her health condition (internal value), as well as the patient’s feeling of safety (internal value).

The value model as shown in Figure 2 is used as a starting point for designing the e-services capable of supporting the established values. In the next section we describe a novel goal-based modeling approach that we apply in order to identify the electronic assets (that is, e-services) that may provision the utilized value objects, giving thus an assurance of fulfilling the associated values.

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\(^1\) Note here that we apply the notion of resource as defined in Reference Ontology \[17\], which is not restricted to only describe in/output of businesses.
5. **Defining Top-Level Goals Using Value Enhancers**

A goal is generally a description of a desirable state, something that is worth pursuing. While value models are used to analyse the high-level transfers of resources among actors, goal models can be used to analyse instruments that improve these exchanges. As a link between value models and concrete improvement instruments, in the form of e-services, we thus employ goal models as a part of our approach.

Goal models have been used in requirements engineering to understand a problem domain and to map out the interests of different stakeholders. One of the most widely known languages for goal modelling is i* [19], which provides constructs for modelling goals, tasks, resources, and dependencies between actors. While i* holds a strong position in the academic community, there are also goal modelling languages with a more practical orientation. One of these languages is the Business Motivation Model, BMM [20]. A basic notion in BMM is that of a goal, which expresses something a business seeks to accomplish, a desired future state of affairs or condition. Examples of goals are being the market leader in an industry or having a profit of more than 1 million euros. Goals can be decomposed, i.e. one goal can be a part of another goal. Generally, the decomposition forms a hierarchy where top-level goals are broken down into sub-goals.

Furthermore, BMM includes the notion of means, i.e. something that can be used to achieve a goal. Means can take different forms, as they can be instruments, devices, capabilities, techniques or methods. A means states what an organisation will do or use to achieve a goal, while a goal tells what the organisation views as desirable. Thus means represent concrete actions that an organisation can take to reach a goal. When breaking down goal into a goal hierarchy, the goals will be more concrete further down in the hierarchy; means are commonly set on these goals.

In the approach presented in this paper, we use the BMM concepts of goal, means and the breakdown of goals using part-of relationships. We use a goal hierarchy to identify potential e-services, the e-services that we model are aligned with the concept of means in BMM as they are identified as the IT instruments of the enterprise for achieving low-level goals.

Besides the goal hierarchy (denoted as “subgoals” in Figure 3), we have added the following novel layers to the goal model:

- A starting value object layer, describes the starting point for the goal model.
- A layer with top-level goals, derived from the value object layer.
- A bottom level e-service layer, describing e-services that can aid in the fulfilment of bottom-level sub-goals.

The first layer, the value object layer, is directly taken from the value model. The remainder of this section will describe guidelines for creating the second layer, the top-level goal layer. The breakdown of goals into the bottom e-service layer is briefly described in Section 6 while the guidelines for the refinement of e-services at the bottom layer of the goal model are described in Section 7.

The starting point for the goal model is one of the actors in the value model and the interests of that actor. It is envisaged that these interests can be expressed in terms of the transferred value objects and the perceived internal values, as expressed in the value model. In other words, the top level goals of an actor concern both the actor’s exchange of value objects and the
intended effects (internal values) of those exchanges. Thus, there is a need for two guidelines in order to identify the top level goals of an actor:

- **Intended effect guideline** guides the creation of top level goals based on a internal value. These goals are about the relationship between transfers and their intended effects; more precisely they specify that the acquisition of a value object in a transfer really shall result in the internal value, i.e. that the value object can be used to increase some internal resource. An example is "The eye treatment shall give rise to an increased feeling of safety".

- **Value object enhancer guideline** focuses on the value object and guide the creation of top level goals based on a number of value enhancers. A value enhancer expresses either a desirable feature of a value object or a desirable feature of the way in which the value object is delivered to the recipient. By applying the value enhancers we get a number of goals that concern the properties of a value object as well as the adequacy of its delivery. Examples are "The delivery of the eye treatment shall be fast" and "The information shall be correct and up to date".

Applying both these guidelines will result in a number of top level goals for an actor, based on value objects and internal values. These goals will be on a very generic level, and they will not directly suggest any actions to take. Therefore, there is a need to decompose these goals until concrete means are identified.

It should be emphasized that all guidelines are to be used by the discretion of the designer, i.e. the designer decides whether to include a goal or action suggested by a guideline into the goal model.

5.1 Intended Effect Guideline

The intended effect guideline is as follows:

*For each transfer of an value object VO with an intended internal value, introduce the goal "VO should give rise to IV"*

Examples of goals obtained by applying the intended effect guidelines:

- The eye treatment shall give rise to a better health state
- The eye treatment shall give rise to an increased feeling of safety
- The investigation shall give rise to increased knowledge on health condition

Figure 3 shows a goal model that is derived from the transfer of an eye treatment from the hospital clinic to the patient. Applying the guideline above results in introducing two top level goals as indicated.

5.2 Value Object Enhancer Guideline

The value object enhancer guideline is as follows:

![Goal model based on intended effect guideline](image-url)
For each value object transfer, introduce a number of top-goals based on the value enhancers according to the table below.

A value object enhancer expresses either a desirable feature of an economic resource itself or a desirable feature of the way in which the economic resource is delivered to the recipient. The list of value enhancers is open ended, but in a number of case studies we have found the following to be the most fundamental ones: fast, high quality, flexible, low cost, and secure. This list also matches the critical success factors of business process as suggested in [21], with the exception of secure.

Table 1 below spells out how the value object enhancers will give rise to goals concerning value objects and their delivery in transfers. It can be noted that the goals generated through one value object enhancer may vary depending on the type of the value object it is applied to.

| Table 1, Value Enhancers and Derived Top-goals for Different Types of Value Objects |
|--------------------------------------|--------------------------------------|
| **Delivery of value object types**   | **Properties of the value object types** |
| **Fast**                             | **The enactment time of the service** shall be short. |
| - The delivery of the information/goods/money to the recipient shall be fast. |
| - The delivery, i.e. the waiting time for the service shall be short. |
| **High quality**                     | **The information** shall be correct, relevant, and up-to-date, and/or according to specifications. |
| - The delivery of the information/goods/money/service shall be reliable, i.e. the goods/information/money/service will always reach the recipient and the recipient will always be informed about delays. |
| **Flexible**                         | **The goods** shall be fit for their use, and/or according to specifications. |
| - The delivery of the information shall be customizable, i.e. information shall be delivered in different forms, e.g. paper, digital file sent via Internet. Further, the presentation of the information shall be adapted to the needs of the recipient. |
| - The delivery of the goods to the recipient shall be customizable, i.e. different forms of delivery shall be provided, e.g. home delivery, delivery to the nearest post office. |
| - The delivery of the money can be in form of cash, a check, or sent to an account. Further, the cash can also be delivered in different currencies. |
| - The delivery of the service to the recipient shall be customizable in space and time, i.e. different forms of delivery shall be provided, e.g. heath care services at home, at health care units close to home, as well as the waiting time shall be adaptable depending on needs and demand. |
| **Low cost**                         | **The enactment of the service** shall be customizable to the recipient. |
| - The delivery of the information/goods/money/service shall be provided at a low cost. |
| **Secure**                           | **N/A for money.** |
| - The delivery of the information/goods/money/service shall be provided with high confidentiality, high integrity, and accountability. |
| - The goods shall be safe in intended as well as unintended use. |
| - N/A for information, money and voucher and services.
Examples of goals obtained by applying the value object enhancer guideline:

- The information shall be correct and up to date
- The waiting time for the eye operation shall be short

Figure 4 shows a goal model that is derived from transfer of an eye treatment from the hospital clinic to the patient. Applying the guideline above result in introducing two top level goals as indicated.

6. GOAL DRIVEN IDENTIFICATION OF E-SERVICES

The top goals identified through the analysis of value objects and internal values serve as a starting point in the goal analysis, carried out in a participative manner including different stakeholders. A top goal is further refined to create a goal hierarchy, which forms a basis for the identification of e-services. When low-level goals have been identified, it is usually straight-forward for the stakeholders to determine candidate e-services that might support these goals, see Figure 3 and 4. A key question to drive the identification of candidate e-services from low-level goals is “Can this goal be achieved using an e-service?”.

An example of goal refinement in this manner can be found in figure 4, where the top-level goal “the waiting time for the eye treatment shall be short” are refined. The first sub goal (see figure 4) is that unused time slots in the hospital shall be decreased, a part of this goal is to minimize the number of patients that does not use their allotted time slots. During the goal modelling session it was discussed how this low-level sub goal could be achieved. One possible way, as seen in Figure 4, is to introduce an e-service that reminds the patients via e-mail. Goal refinement leads to a set of e-services that can aid in fulfilling the top-level goals. After the goal refinement there is a need to structure the identified e-services, this is discussed in the next section.

7. E-SERVICE REFINEMENT

Depending on how the goal modeling sessions were carried out, the e-services will be specified on different granularity levels. There will simply be e-service candidates ranging from quite small features (such as “document the patient symptoms“) to larger services (such as “prioritize and route the referral to a clinic“). Therefore, a discussion among business and systems developers about a preferred granularity level needs to be performed. This discussion will be similar to identifying the granularity of UML Use Cases, which are important modeling artifacts in the Rational Unified Process. For example, Cockburn [23] distinguishes between, and also presents guidelines for identifying Use Cases on different granularity levels, i.e., kite, sea and fish level.

During the discussion about the granularity level of the e-

Fig. 4. Goal model based on value enhancer guideline
services, we recommend specifying which criteria the choice of granularity level will be based on. We have identified the following guiding criterias:

- **Sell/Buy** – e-services may be designed for being a product sold on the market, and therefore they need to be adapted for that market or for different market segments.
- **Legacy system** – e-services may need to be adapted to the existing system that will provide the e-services. Thereby, an e-service works as wrapper for an existing legacy system [24].
- **Reuse** – e-services may be used by other e-services. In that case the least common denominator of the requirement from other e-services’ use may direct the level of granularity.
- **Process descriptions** – the granularity level of the e-services may be adapted to predefined process descriptions of an organization or standardized process models presented by a standardization body. For example, the services identified by the European health care standard Healthcare Information Service Architecture (HISA) [25] are based on the process standard SAMBA [26]. In [27] the use of pre-specified workflow transactions from the Integrating the Healthcare Enterprise (IHE) framework is recommended as identification of e-services.
- **Work assignment** (task) – a specification of a work assignment may be the base for the choice of granularity level, i.e., an e-service is something that fulfills all steps in a specified work assignment, see guidelines discussed in [23].

The above guidelines can be used to single out e-services that are to be implemented. Services being on a finer granularity level might be implemented as features (or functions) of other (larger) e-services.

8. **Applying Value and Goal Models in the REMS Project**

The described approach on using value and goal models are applied in the health care project REMS [28] as an instrument for identifying and refining e-services, and as a general approach for conducting iterative and participative project work. As described in the introduction, the aim of the REMS project is to support the eye health care in the Stockholm region, with an IT asset for health care referrals. Since a referral works as a “communication tool” between primary health care units, hospital (eye specialist clinic) and private specialists, the project work includes all of these actors in the e-service analysis. The following steps outline how the described approach is applied in the REMS project:

1. **Value model creation.** As a starting point a value model was developed by the key stakeholders, that is, the representatives from the management at S:t Eriks Eye hospital and eye specialists at the clinic. At the outset, an initial value model depicting the exchanged value objects between the patients, the primary health care and eye specialist was designed. Furthermore, the internal values that motivated each value object flow where modeled. Initially there where a mix of internal values and value objects in the model. The value model was later on structured by assigning (at least) one internal value to each value object, and by checking that exchanged value objects where a part of dualities as described in section 3.

2. **Scoping the value model and iterative application of the value object-to-services approach.** Transformation of value models into e-services using goal models, was performed together with user representatives of the involved actors. The modeling group was in this case larger than in the first step, also including representatives from another hospital, primary care, opticians and private eye specialist (in total 6-8 persons). Before commencing the first modeling session, the scope of the goal model was limited to the interactions of key actors that are depicted in Figure 2, as this was the planned scope for the first release of e-services. The starting point for the goal modelling session where the top-goal generated as described in Section 5. The goal models were refined in several iterations during a 6-month period. Each iteration added more details, and thus more e-services at the “bottom” level of the goal model.

3. **Validating e-services prototypes.** When the first version of a prototype for referral management was built, the goal model was used to track the goal fulfilment. For example, from the capability to “Search for referrals” (Figure 3), it is possible to track the top-level goal, as well as its enhancement for the value object flows in the value model.

In this special settings the main focus for iterations where thus the goal models, combined with prototypes at the later iterations. Upcoming releases, covering a larger domain scope, demand a re-visit of the value models for further design of e-services.

9. **Conclusion**

In this paper, we have proposed an approach for the identification of e-services based on value models. The approach includes extension to both value and goal models. Furthermore, by using explorative goal modeling, we have bridged the gap between value-based models and e-services. We believe that our approach has successfully revealed the following aspects:

- **Business orientation in service modeling:** using a value-based model as a starting point in identification of e-services, we have enabled propagation of business logic to the technology level. In particular, by defining an actor-oriented notion of business value, we have made it possible to discern alternatives of value object provisioning providing thus a basis for a customer-based service analysis.
- **Goal orientation in service identification:** determining goals by setting the actor-oriented enhancers on the value objects has enabled identification of customized services that may be further grouped to offer economic alternatives in provisioning of value objects.
- Traceability: in our approach e-services are derived from a goal model, which in turn is based on a value model. This means that the features and capabilities of the identified e-services can be explained from both goal and value perspectives.

- Method support: in order to identify e-services in a problem domain, first a value model is designed, including in the final step only the exchanges of the value objects that are associated by at least one actor-assured value. As second, enhancing the value objects with adequate properties, top-level actor goals are defined. These goals are further refined in a goal hierarchy, until concrete course of actions are obtained, focused on the form of e-services.

As we explained in Section 3, a subject of further work is ontological structuring of values, possibly starting from a general to a domain-related level. Furthermore, an important aspect is the identification of possible dependencies among the identified e-services, that may be used as a basis for creation of service compositions, that is, processes. Finally, if the goal models will be utilized as a basis for management or validation of the business and supporting IT, there may be a need for categorizing the goals in the goal model, as well as specifying the types of relation between the goals, see for example [29] and [30].

ACKNOWLEDGEMENTS

The REMS project is funded by the Swedish agency for innovation systems (VINNOVA), the Stockholm county council and S:t Eriks eye hospital. The authors would like to thank the representatives participating in the modeling sessions, and the IT specialists at OOPix AB, Sweden.

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