Value and goal modelling in healthcare

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In the healthcare sector, different healthcare providers, such as home care, primary care, and hospital clinics, collaborate in order to increase values for patients, such as better health state, increased knowledge on health conditions, and increased feeling of safety. To govern and evaluate such collaboration, we need a tool to understand how different patient values are related to each other, how values are related to goals, and how values and goals are related to actions planned and carried out among healthcare providers. Thereby, we can measure, analyse and redesign existing actions in order to better achieve desirable values. Furthermore, we also need a tool for finding new innovative goals and actions that better create desirable values. In this paper, we propose such a tool, in the form of a method based on value, goal and action models. Value models depict actors and the valuable resources they exchange as well as the purpose of the resources exchanged. Using these value models as a base, we are able to systematically identify high level goals and more detailed goals, as well as actions supporting these goals. Thereby, we will attain traceability from actions, via goals and values, which the actions realise. A case study from the Swedish healthcare sector is used to ground and apply our proposed method.

Keywords

value models, goal models, value for patient, enterprise modelling in healthcare

1. Introduction

The healthcare sector is a complex domain with many stakeholders having different interests and goals, which often are contradictory. For example, healthcare shall be equal, be of high quality, and at the same time be efficient. Mainly due to efficiency reasons, the healthcare sector is divided into different healthcare providers, such as home care, primary care, hospital clinics and private specialists. This results in an increased complexity, as different healthcare providers need to collaborate in order to fulfill their missions. There is an ever ongoing debate on how this collaboration shall be performed, and several different collaboration strategies are employed in healthcare all around the world.

One instrument for analysing and designing alternative ways of collaboration in healthcare is to use value models [1, 2, 3, 4]. A value model focuses on values and describes actors that collaborate, resources that are valuable for the actors, and the exchanges of these resources. Value models provide efficient instruments for comparing and evaluating alternative collaboration strategies, or optimising existing ones. Furthermore, value models are also capable of explicitly relating values for patients with values for other actors in a network of healthcare providers and other stakeholders. Especially, understanding the values for patients is essential for designing effective care cycles and measurement instruments, as argued in [5].

However, value models have their limitations. They do not explicitly show how values are related to existing actions in healthcare. This may be important since many problems in healthcare are caused by unsatisfactory structuring and distribution of healthcare actions

among healthcare providers [6, 7]. Neither can value models by themselves work as tools for suggesting new actions that improve the creation of values for patients and collaborating healthcare providers.

In order to overcome these limitations, value models need to be combined with goal and action models. The purpose of this paper is to propose a tool in the form of a method to identify goals and actions based on value models. Thus, we provide a link between high-level value models via goals to concrete actions. A major advantage of basing action analysis and design on value and goal models is that we ensure that the actions do realise the intended effects for patients and other actors in the network of healthcare providers.

The work in this paper is based on experiences of a project in the health care domain, the REMS project [8, 9]. The main aim of the project is to create a set of e-services that can be used to create, manage and transfer health care referrals between primary care units, an eye specialist hospital clinic, private eye specialist units, and opticians in the Stockholm area. Referrals are one of the key instruments when healthcare providers collaborate in a network in order to increase patient values. As the number of referrals and the number of actors involved in the referral process increase, manual routines between the healthcare providers become insufficient. A systematic approach, supported by an IT infrastructure, is thus required in order to design e-services that support the distribution and management of healthcare referrals. The approach used in the project is based on both enterprise models (value models, goal models, service models, action/process models) and IT models. In this paper, results and experiences from the project are used to ground and apply the proposed method.

The paper is structured as follows. In Section 2 and 3, value and goal models concepts are specified. In Section 4, a number of guidelines for identifying goals and actions are presented. Finally, in Section 5, concluding remarks are stated and further research is suggested.

2. Value Model

Many different kinds of models exist for representing and visualising the architecture, actions and environment of an enterprise. One recent type of model is the value model that focuses on actors, resources and resource exchanges [1, 2, 3, 4]. A value model, sometimes called a value-based business model, is different from other types of models used in enterprise analysis and design. In particular, a value model is different from action or process models. A value model gives a high level view of the actions taking place in and between organisations by identifying actors, resources and the exchange of resources between the actors. So, a value model focuses on the *what* in business. An action or process model, on the other hand, focuses on the *how*, as it deals with operational and procedural aspects of business communication, including control flow, data flow and message passing [1]. In other words, a value model takes a declarative view, while action or process models take a procedural view.

Our approach to value modeling is in line with the e3-value language, [1, 2]. However, to cater for the analysis needs of the health care domain we extend the e3-value language with the notion of internal resource, which makes it possible to capture softer values like knowledge and safety. In the rest of this section, we give an overview of important concepts in value models presented in this paper.

2.1 Actor

An *actor* is someone who is able to participate in resource transfers and conversions (see below). An actor is typically a legal entity, such as a person or a company.

2.2 Resource

A *resource* is an object that is viewed as being valuable by some actor. A resource is typically scarce; otherwise an actor would not consider it valuable. For example, ice would not count as a resource at the North Pole where it is abundant, neither would sand in Sahara. Some concrete examples of resources are books, cars, movies, hair cuts, and medical treatments. However, resources can also be of a more psychological and social nature, such as status, beauty, pleasure, health state, honour, and feeling of safety. To distinguish between these different kinds of resources, we identify two categories of resources, economic resources and internal resources.

Intuitively, an economic resource is a resource that can be transferred. More precisely, an *economic resource* is a resource that can be under the control of an actor, in the meaning that the actor may have legal rights on the resource. As a fundament for analyzing economic resources, we have identified the following categories:

- *Goods,* which are physical objects, like cars, refrigerators, and cell phones.
- *Information,* which is data in a certain context, like blueprints, referrals, and customer databases.
- *Services,* which are economic resources that encapsulate other resources and are used to increase the value of some other resource. Examples of services are hair cuts and eye treatments. A hair cut can increase the beauty and an eye treatment can give better health state.
- *Money*, which is a medium for exchange.
- *Voucher*, which is a certificate that can be exchanged for another specific economic resource, e.g. a good or a service. Usually, a voucher can be exchanged only at some pre-specified actor(s). Money can be viewed as the most general form of voucher without any restriction on economic resources and actors.

In addition to economic resources, there are also internal resources that cannot be directly transferred between actors. An *internal resource* is a resource that is not an economic resource. Some obvious examples of internal resources are beauty, health state, honour, and glory. It is not meaningful to talk about legal rights on these resources, neither is it possible to transfer any of these resources from one actor to another. Another example of an internal resource is knowledge. At first sight, it might seem that knowledge is possible to transfer from one actor to another. However, this cannot be done directly, but only through an intermediary economic resource, e.g. a book (goods) or a lecture (service). Internal resources are often desired by people for their own sake, e.g. someone might desire more knowledge without any intention to use it in a particular way. Someone else might desire knowledge in order to make money through lecturing or other knowledge services, i.e. she/he uses knowledge as an instrument for producing some other resource. Thus, internal resources can be seen both as ends in themselves or as instruments for other purposes. Economic resources, on the other hand, are only valuable as instruments for producing other resources.

2.3 Conversions

As mentioned in section 2.2, resources can be used as instruments to produce or modify other resources. An action that uses some input resources to produce new or modify existing resources is called a conversion. For example, water and flour can be used as input economic resources in a baking conversion to produce the output economic resource bread. Another example is an eye treatment (input economic resource) that is used to improve the health state (output internal resource) of a patient. In some cases, a conversion produces a brand new resource (bread), while in other cases the conversion modifies an existing resource (health state). In other words, a conversion can have two different results: a new resource or a modified resource.

2.4 Transfers

Transfers occur when actors want to acquire control of economic resources. Consider the question "What is transferred in a transfer?" This question may seem trivial, as the answer could just be "a economic resource". For example, if someone buys a book at a book store, then a book (goods, a resource) is transferred to him. Similarly, if someone borrows a book at a library, then again a book is transferred to him. However, these examples indicate that the simple answer may in fact be too simple. There is clearly a big difference between buying a book and borrowing a book. If you buy a book, you are entitled to read it or use it for any other purpose, give it to someone else, or even destroy it. In contrast, if you borrow a book, you are still entitled to read it, but neither to give it away nor destroy it. So, just saying that a book is transferred when you buy a book is not sufficient – we need to spell out how you are allowed to use the book. In other words, buying a book means to get certain rights on the book. In general, a transfer hands over these rights on economic resources from one actor to another.

2.5 Intended effect

It is often important to make explicit why an actor wants to get a resource in a transfer. To capture this, we introduce the notion of an *intended effect* of a value transfer, which is an increase or decrease of an internal resource that the receiving actor wants to achieve by using the transferred economic resource in one or more conversions. Examples of intended effects are: better health state (where "health state" is the internal resource), increased knowledge on health condition (where "knowledge on health condition" is the internal resource) and increased feeling of safety (where "feeling of safety" is the internal resource).

2.6 Graphical notation

Based on the above notions, we can now define a simple graphical form of value models. A value model is here shown by means of a directed graph representing actors, transfers and resources, see Figure 1:

- Actors. Actors are represented by the nodes of the graph and are shown as stick person icons.
- Transfers. Transfers are represented by labels on the directed edges of the graph.

The label for a transfer consists of three parts:

- The economic resource being transferred
- The category of the economic resource (put within square brackets)
- The intended effects of the use of the economic resource in one or more conversions (put within ordinary brackets)

An example of a label for a transfer is:

- eye treatment [service] (improved health state, increased feeling of safety)

If several conversions are needed in sequence in order to obtain the intended effect, we prefix it with "potentially".

2.7 Referral Case

The concepts presented above are applied on a real case from the REMS project. Figure 1 illustrates an excerpt of a value model defined in the scope of the REMS project. The figure is explained below, First, the transfers between the primary health care and patient are described, then the transfers between patient and primary health care, and so on.

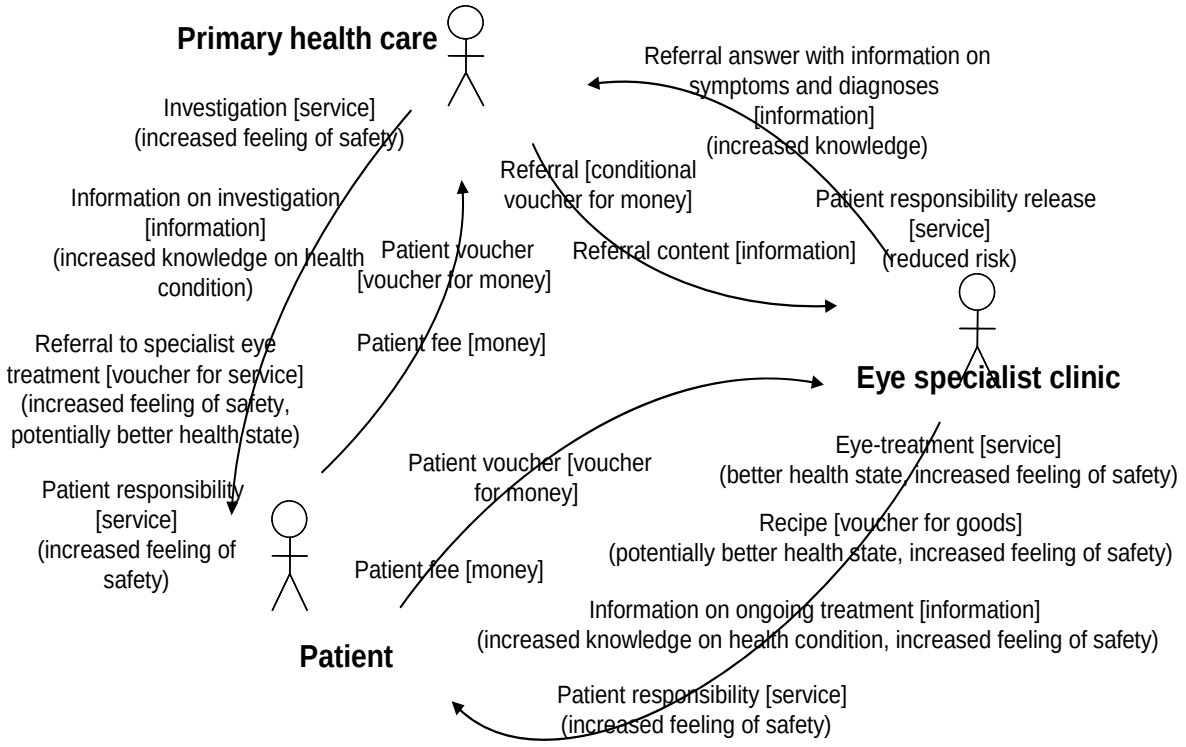

Figure 1 An excerpt of a value model defined in the scope of the REMS project..

From Primary Health Care to Patient

When a patient experiences an eye health problem, she/he will visit a primary health care provider. The basic/primary resource this provider offers is an *investigation* service. The intended effect of this investigation is that the patient gets an *increased feeling of safety*.

Note, as mentioned in Section 2.2, that a service can encapsulate other resources, such as information, vouchers and other services. In this example, the investigation provides a basis for an *information* transfer, where the provider informs the patient about her/his health status. This information has the intended effect that the patient will get an *increased knowledge of* her/his *health condition*. If the patient needs further treatment, either the primary care provider will carry out the treatment (a service, which is not shown in Figure 1) or the provider refers the patient to an eye care specialist at a hospital clinic that is able to provide advanced treatments. To do this, the provider offers a *referral to eye specialist treatment*, which is a *voucher* for an eye treatment (service). There are two intended effects as a result of the transfer of the referral. The first effect is direct: the patient will get an *increased feeling of safety,* since the patient knows that referral can be used for advanced treatment and this will reduce anxiety as the patient knows that she/he will get professional treatment. The other effect is indirect: if the patient uses the referral, the treatment at the hospital clinic may improve the health state of the patient, i.e. another effect of the referral is a *potentially better health state*. Furthermore, when the primary care provider starts investigating the patient, the primary care gets a *responsibility* for the patient's health, i.e. the provider is responsible to carry out required actions in order to maintain or improve the patient's health state (depending on the diagnosis). The intended effect of this responsibility transfer is that the patient gets an *increased feeling of safety*, since she/he knows that a professional health care provider has "promised" the health care system to carry out required actions for the patients. Note that the responsibility will remain on the primary care provider's shoulders until it explicitly hands over the responsibility to another health care provider, e.g. an eye care specialist at a hospital clinic.

Patient to Primary Health Care

When the patient visits the primary health care provider, the following resources are transferred from the patient to the provider: *patient fee* and *patient voucher*. The patient fee is the *money* that the patient pays when visiting the primary care, while the patient voucher is a *voucher for money* that enables further reimbursement for the expenses from the city council (not shown in Figure 1).

From Primary Health Care to Eye Specialist Clinic

The *referral* that the patient received is also sent from the primary health care to the eye specialist clinic. For the eye specialist clinic, the referral functions as a *conditional voucher for money* that gives the clinic a right to reimburse money from the city council. The voucher is conditional since the clinic can only reimburse the city council if the patient will visit the clinic for a treatment. Furthermore, the referral also contains *referral content* which is *information* that the eye specialist clinic uses to assess how urgent the patient's treatment is, as well as to plan and allocate resources at the clinic.

From Eye Specialist Clinic to Patient

When the patient visits the hospital clinic, she/he will receive *an eye treatment service* from the clinic. The intended effects of the treatment are two: *better health state* and an *increased feeling of safety*. Furthermore, the treatment encapsulates other resources. First, it encapsulates an information transfer, i.e. *information on ongoing treatment*, with the intended effect *increased knowledge on health condition*. Secondly, in some cases, the patient also needs certain medicine. The eye specialist clinic provider will then transfer a *recipe*, which is a *voucher for goods*; the patient can use the recipe at a pharmacy store and receive the needed medicine. There are two intended effects as a result of the transfer of the recipe. The first effect is direct: the patient will get an *increased feeling of safety,* since the patient knows that the recipe can be used as exchange for medicine, which may improve her/his health state. The other effect is indirect: if the patient exchanges the recipe for medicine and also

uses the medicine, the medicine actually may improve the health state of the patient, i.e. another effect of the recipe is a *potentially better health state*. Finally, when the eye specialist clinic starts the treatment, the clinic gets the *responsibility* for the patient's health, which gives the patient an *increased feeling of safety*.

From Patient to Eye Specialist Clinic

When the patient visits the eye specialist clinic, the clinic will receive patient fee and patient voucher. The patient fee is the *money* that the patient pays when visiting the primary care, while the patient voucher is a *voucher for money* that enables further reimbursement for the expenses from the city council.

From Eye Specialist Clinic to Primary Health Care Provider

When the eye specialist clinic starts treating the patient, the eye specialist clinic will explicitly hand over the responsibility for the patient's health state from the primary care. Therefore, the primary care provider will receive the resource *responsibility release,* with the intended effect: *reduced risk*. Furthermore, when the eye specialist clinic has treated the patient, the clinic sends a *referral answer* back to the primary care unit which is *information* on symptoms, diagnoses and carried out treatments. This information does not lead to any direct actions at the primary care unit. Instead, the referral answer is mainly used to *increase knowledge* about eye health care for the physicians and nurses at the primary care unit.

3. Goal Models

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 exchanges of resources among actors, goal models can be used to identify new actions or re-engineer existing ones in order to better fulfil these exchanges of resources. As a link between value models and concrete actions we thus employ goal models as a part of our method.

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*, [10], 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) [11]. 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 high 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 and means are commonly set on these goals. In this paper, we use the term "action" instead of "means".

BMM also makes a distinction between goal and objective. Goals are defined qualitatively. Each goal may have one or several objectives related to it. The objectives must have end date and criteria to determine whether the objectives have been reached or not. Thereby,

goal fulfilment can be measured. In this paper we also use objectives to determine whether a statement is a goal or an action, which is not always obvious, see section 4.3.

In the method presented in this paper, we use the BMM concepts of goal, means (but call them actions) and objectives. We also breakdown the goals using part-of relationships as the foundation.

4. From Value Model to Goal Model

In this section, we propose a number of guidelines for designing a goal model based on a value model. 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 resources that are under the control of the actor. In other words, the high level goals of an actor concern the actor's resources, i.e. economic resources as well as internal resources.

For a consumer, the most important resources are typically internal resources, while the economic resources are only of interest as far as they can be used as instruments to increase or improve the internal resources. However, for a company the economic resources are typically in focus, i.e. the company will focus on how to differentiate goods and services (i.e. the economic resources) from its competitors. Thus, there is a need for two guidelines in order to identify the high level goals of an actor:

- *The intended effect guideline* guides the creation of high level goals based on an internal resource. These goals are about the relationship between transfers and their effects; more precisely they specify that the acquisition of an economic resource in a transfer really shall result in the intended effects, i.e. that the economic resource can be used to increase some internal resource. An example is "The *eye treatment* shall give rise to an *increased feeling of safety".*
- *The resource enhancer guideline* focuses on the economic resources and guide the creation of high level goals based on a number of resource enhancers. A *resource enhancer* expresses either a desirable feature of an economic resource or a desirable feature of the way in which the economic resource is delivered to the recipient. By applying the resource enhancers we get a number of goals that concern the usefulness of an economic resource 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 high level goals for an actor, based on both economic resources and internal resources. 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. In Section 4.3, we suggest refinement guidelines that aid this decomposition.

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.

4.1 The Intended Effect Guideline

The intended effect guideline is specified as follows:

For each transfer of an economic resource ER with an intended effect IE, introduce the goal "ER should give rise to IE"

Examples of goals obtained by applying the intended effect guideline:

- The eye treatment (economic resource) shall give rise to a better health state (intended effect)
- The eye treatment (economic resource) shall give rise to an increased feeling of safety (intended effect)
- The information (economic resource) on the investigation shall give rise to increased knowledge on health condition (intended effect)

Figure 2 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 will result in introducing two high level goals as indicated. The rest of the goal model will be discussed in Section 4.3.

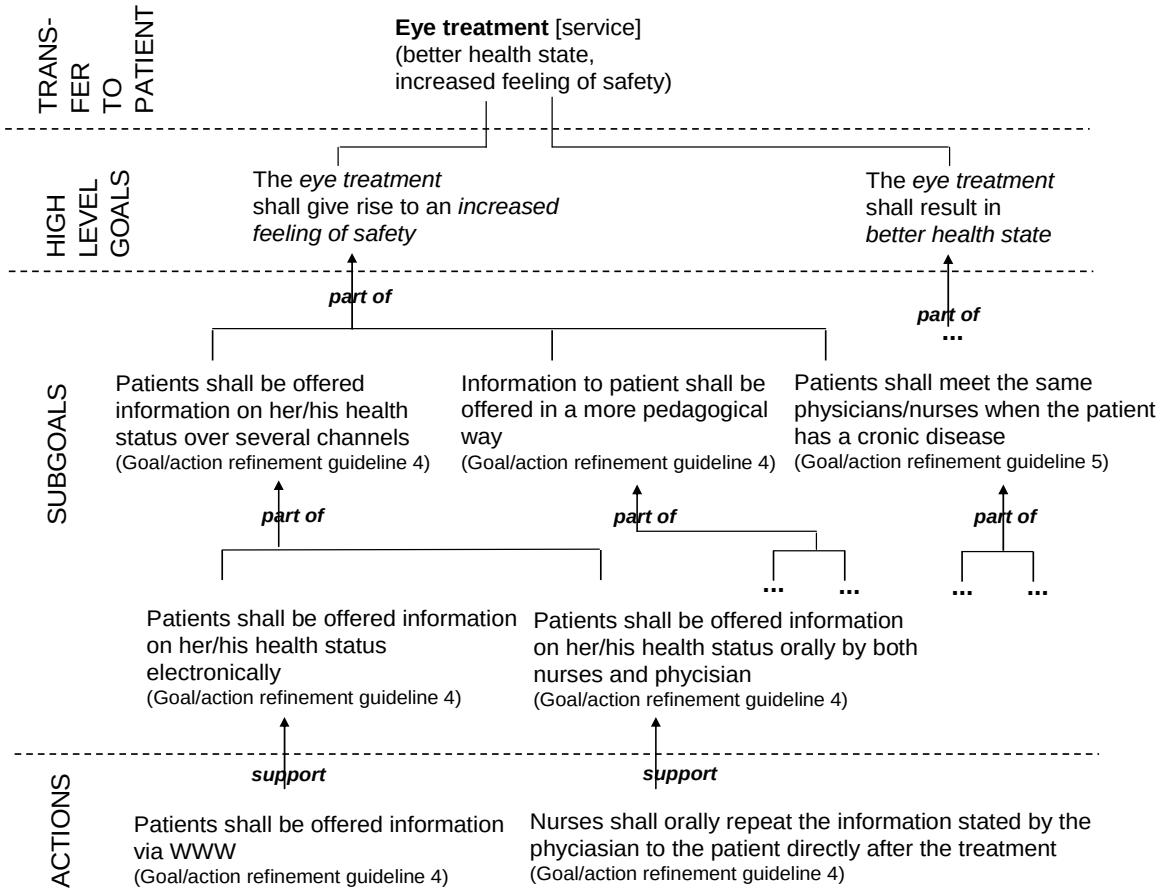

Figure 2 Goal model based on intended effect guidelines

4.2 The Resource Enhancer Guideline

The resource enhancer guideline is specified as follows:

For each transfer, introduce a number of goals based on the resource enhancers (fast, high quality, flexible, low cost, secure) according to table 1 below.

A resource enhancer expresses either:

- a desirable feature of *the way in which the economic resource is delivered* to the recipient
- a desirable feature of an *economic resource itself*, or

Table 1 A list of goals for different categories of economic resources as well as the delivery.

	Delivery of resource	***Resource***
Fast	•The delivery of the *information/goods/money/voucher* to the recipient shall be fast. •The delivery, i.e. the waiting time for the *service* shall be short.	•The enactment time of the *service* shall be short. •N/A for *information/goods/money/voucher.*
High quality	•The delivery of the *information/goods/money/voucher/ service* shall be reliable, i.e. the goods/information/money/voucher /service will always reach the recipient and the recipient will always be informed about delays.	•The *information* shall be correct, relevant, and up-to-date, and/or according to specifications. •The *goods* shall be fit for their use, and/or according to specifications. •The *service* shall be enacted fit for use and/or according to specifications. •N/A for *money/voucher*.
Flexible	•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 or digital file on CD sent via ordinary post. Further, the presentation of the information shall be adapted to the needs of the recipient. •The delivery of the *goods/voucher* 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.	•The i*nformation* shall be customizable to the needs of the recipient, e.g. an XML file will be more customizable than HTML (since the XML schemas can be changed). •The *goods* shall be customizable to the needs of the recipient, e.g. a chair is adjustable to fit the user. •The enactment of the *service* shall be customizable to the recipient. •N/A for *money and voucher*, but a voucher can have many different forms, such as a ticket or just information on a paper at the people that are responsible for exchanging the voucher for money or services.
Low cost	•The delivery of the *information/goods/money/voucher/service* shall be provided at a low cost.	•The *information/goods/service* shall be provided at a low cost. •N/A for *money and voucher.*
Secure	•The delivery of the *information/goods/money/voucher/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 i*nformation, money and voucher and services.*

The list of resource enhancers is open ended, but in a number of case studies we have found that *fast, high quality, flexible, low cost,* and *secure* to be the most fundamental ones. This list also matches the critical success factors of business process as suggested in [12], with the exception of secure.

Examples of goals obtained by applying the resource enhancer guideline:

- The information (information) shall be correct and up to date (high quality)
- The waiting time for the eye operation (delivery of service) shall be short (fast)
- The medicine (goods) shall be provided at a low cost (low cost)

Figure 3 shows a goal model that is derived from transfer of an eye treatment from the hospital clinic to the patient. Applying the guideline above results in introducing high level goals as indicated. The rest of the goal model will be discussed in Section 4.3.

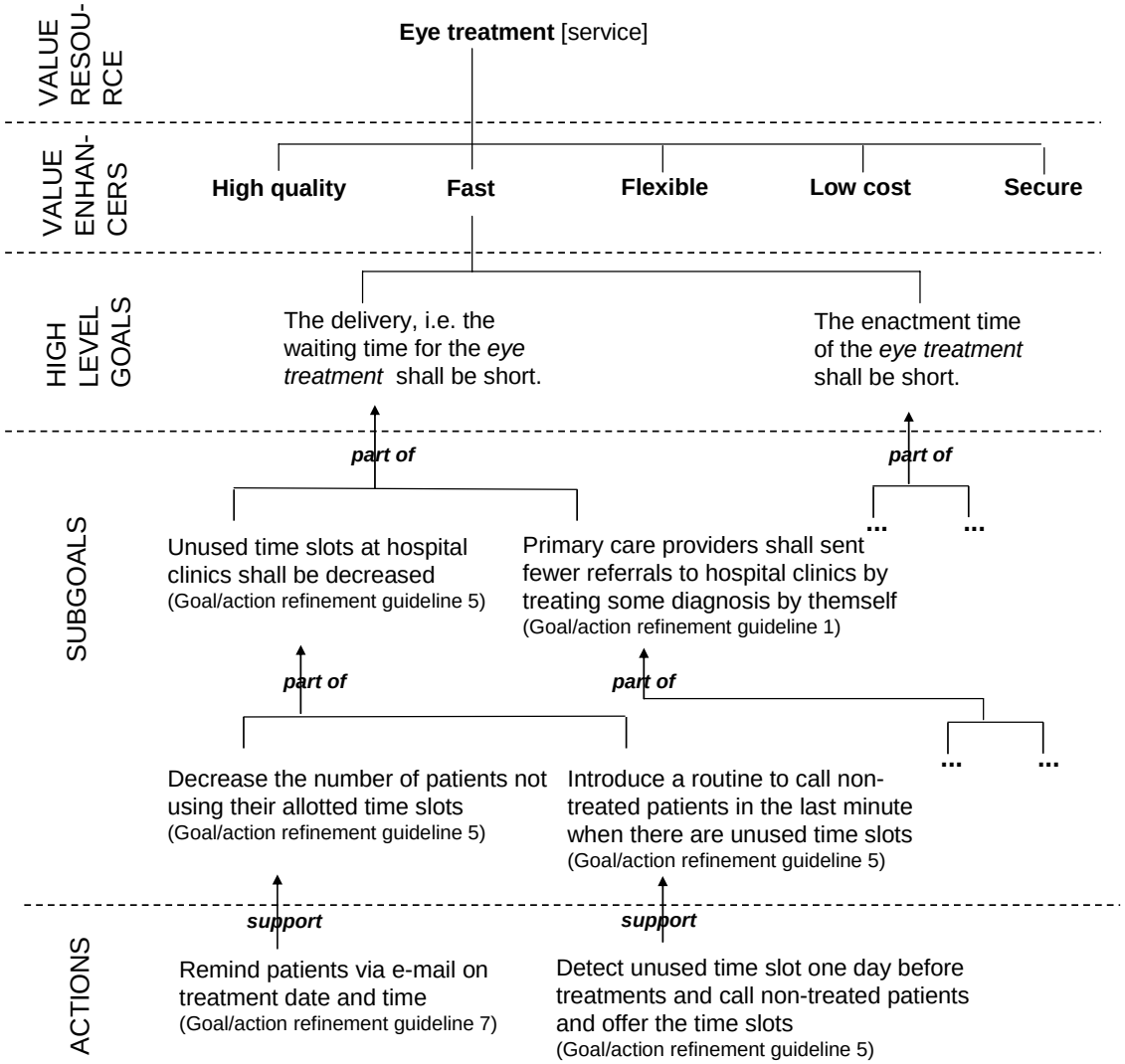

Figure 3 Goal model based on resource enhancer guidelines.

4.3 Goal and Action Refinement Guidelines

After having identified high level goals by means of the intended effect and resource enhancer guidelines, there is a need to decompose these goals until concrete actions are identified. A set of guidelines, presented in this section, suggests how to carry out this decomposition.

An overall goal and action refinement guideline is specified as follows::

For each high level goal, identify lower level goals using the guidelines below. This decomposition stops when actions are reached.

Goal and action refinement guidelines are listed below, and for each guideline some examples are given. Each example is labelled whether the statement is a goal or an action. The goals and actions that are identified can be categorised as:

a) transfer of resources or relationships between two actors
b) internal actions of one single actor, or
c) architecture and information provision within the entire value net.

a) Transfer of resources or relationships between two actors

Guideline 1: Introduce a goal concerning the volume of resources being transferred between two actors

- More referrals shall be sent to private health care providers and less to hospital clinics (goal)
- Primary care providers shall send fewer referrals to hospital clinics by treating some diagnoses by themselves (goal)

Guideline 2: Introduce a goal concerning the inconvenience costs of transferring resources between two actors

- It shall be possible to send referrals electronically (goal)
- It shall be easy and fast to select the most appropriate hospital clinic for a particular patient case (goal)

Guideline 3: Introduce a goal concerning the responsibility relationship between two actors

- Hand over of patient responsibility shall be explicit (goal)

Guideline 4: Introduce a goal concerning the exchange of information between actors

- Electronic referral shall include relevant parts of the patient history (goal)
- Patients shall be offered information on their health status over several channels (goal)
- Information to patients shall be offered in a more pedagogical way (goal)
- Patients shall be offered information via WWW (action)

b) Internal actions of one single actor

Guideline 5: Introduce a goal concerning the planning of actions of an actor

- Unused time slots at hospital clinics shall be decreased (goal)
- Introduce a routine to call non-treated patient in the last minute when there are unused time slots (goal)
- Detect unused time slot one day before treatment and call non-treated patients and offer the time slots (action)

Guideline 6: Introduce a goal concerning the execution of actions of an actor

- Increase the speed of referral administration at hospital clinics (goal)

Guideline 7: Introduce a goal concerning the control and monitoring of actions of an actor

- Decrease the number of patients not using their allotted time slots (goal)
- Introduce penalty fees on patients not using their allotted time slots (action)
- Remind patients via e-mail on treatment date and time (action)

Guideline 8: Introduce a goal concerning the capabilities of an actor

- Competence of primary health care in eye health care shall be increased (goal)

c) Architecture and information provision within the entire value net

Guideline 9: Introduce a goal concerning the transparency of the value net

- Private health care providers shall be able to announce their free time slots (goal)
- Patients shall be able to view the status of their referrals (goal)

Guideline 10: Introduce a goal concerning the culture of the value net

- Introduce a common standard (action)

Guideline 11: Introduce a goal concerning the actors and resources of the value net

- Introduce actors that distribute risks in the value net (action)

To determine whether a statement is a goal or an action, we use the BMM concept objective, introduced in Section 3. For each statement one or several objectives are specified. When there is only one objective related to a statement, and the criterion to determine whether the objective has been reached or not is a simple "yes" or "no" answer, the statement in the goal model is an action. For example, the statement "Patients shall be offered information via WWW" is an action, since an objective related to the statement can be formulated: "Are patients offered information via WWW?", and the answer to that question will be a simple "yes" or "no" answer.

Figures 2 and 3 provide further examples of the application of these guidelines and illustrate how a goal model can be generated starting from a value transfer, moving to high level goals by means of the intended effect guideline or the resource enhancer guideline, and then decomposing these goals by means of the goal and action refinement guidelines until actions are reached.

5. Concluding Remarks

In this paper we have proposed a method that combines the use of value and goal models. While value models capture values and high-level resource exchanges, goal models enable a structured approach for defining concrete actions. Our main contributions consist of the following:

1. An *enhanced value model* depicting actors, their transfers of resources, and the intended effects of these transfers. This value model enables us to represent, explore and relate traditional economic resources, such as goods and services, as well as internal resources such as safety and knowledge. Internal resources are important in the health care sector to capture and refine the notion of values for patients [5].

2. A set of *high level goal derivation guidelines* that assist in the derivation of high level goals from a value model. To capture business goals pertaining to improvements on both economic and internal resources we defined two sets of guidelines, *intended effect guideline* and *resource enhancer guideline*. Applying these guidelines will result in a set of high level

goals that are grounded in the value model, thereby linking goals to resource transfers in the value model.

3. A set of *goal and action refinement guidelines* that guide the refinement of the high level goals into concrete actions. The refinement guidelines work as a tool that enables the definition of actions that the actors can take to improve production, transfer and use of resources.

The proposed method can be used in two ways. First, it can be used to systematically suggest and identify new innovative actions that improve the overall performance of a network of actors in the healthcare sector. The method will thereby assist designers in generating new ideas and helps to ensure that all potential improvements are explored. Secondly, it enables traceability of planned and carried out actions to the high level goals and resource transfers that they improve. Thus, the method enables designers to validate existing actions in the context of resource transfers and the effect they have on participating actors.

Finally, some subjects of further work are:

- analysing and comparing different collaboration strategies in healthcare, such as consumer-driven healthcare, pay-for-performance, value-based competition, by using value, goal, and actions models
- understanding the purpose of existing actions in healthcare processes by identifying, in a "reverse engineering" style, values and goals related to existing actions
- evaluating existing actions and healthcare processes (consisting of a set of existing actions) by relate the actions and processes to specified objectives of the goals

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