Modelling Value-based Inter-Organizational Controls in Healthcare Regulations

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Abstract. Products and services are increasingly offered by value webs, rather than by a single enterprise. Typically, value webs need inter-organizational controls to prevent fraudulent behaviour of actors. To design and analyze controls, we developed the economic value-based methodology *e³-control*, which so far has been applied mainly in commercial environments, which are regulated by contractual arrangements. In this paper, we use *e³control* in a highly regulated environment, which contains public-private partnerships, namely the healthcare sector in The Netherlands. Lessons learned include that the notion of economic reciprocity – as present in a commercial setting – is not always apparent in highly regulated environments; and that a highly regulated environment requires artefacts like evidence objects, which can be dealt with as if they were value objects.

1 Introduction

Products and services are increasingly offered by *value webs* [17] rather than by a single enterprise, partly due to increasingly complex consumer needs. For understanding, modelling and analysing value webs, a few value modelling techniques are available (e.g. [11, 17], see [10] for an overview). One of these is the *e³-value* methodology [5], which is used in this paper. The *e³-value* methodology focuses on understanding how economic value is created, distributed, and consumed in a network of enterprises. In a way, an *e³-value* model supposes an *ideal* or *normative* world, in the sense that it prescribes what happens when all actors perform their duties as agreed. Once we understand which valuable things should be exchanged, the next step is to relax the assumption of an ideal world, by supposing that some actors may perform *opportunistic actions*: commit fraud, or

unintentionally do not keep their promises. To this end, we use *e³-control* [6], a method that takes a value web as a starting point to analyze possibilities for opportunistic action, and proposes solutions to prevent these. Such solutions take the form of *inter-organizational controls*: procedures and guidelines for redesign, that aim to prevent, detect or correct opportunistic action.

Both the *e³-value* methodology and the *e³-control* methodology use the notion of *economic value*. Adopting an economic value perspective is reasonable when designing inter-organizational controls, because: (1) the business relationships that need to be controlled have to be understood first; (these are typically expressed as economic value exchanges in *e³-value*); (2) many control mechanisms are themselves services, that have to be paid for (e.g. notary or escrow services); and (3) documentary controls can have an intrinsic economic value (e.g. tickets, Bill of lading). The value perspective is conceptually close to Transaction Cost Economics, which studies contractual safeguards against opportunistic action [18].

Related research is quite extensive in the security domain [15], but this does not provide insights into control issues for business models. In business modelling, there have been a few other conceptual modelling approaches, such as the Business Modelling Ontology [11], and value webs [17], but these hardly address control. Accounting literature [13,14] generally tackles control at the business process level, and mostly focuses on internal control.

The *e³-value* and *e³-control* methodologies have been successfully applied in a series of case studies in different industries, such as news, entertainment, Internet service provisioning, banking, and international trade procedures, see e.g. [7, 8]. These industries are commercial environments, regulated mainly by contractual arrangements. In addition *e³-value* and *e³-control* have been applied in the electricity sector, which was government regulated, but is becoming de-regulated right now [6]. Although an economic value-oriented approach works well in purely commercial settings, one could question whether such an approach is suitable for highly regulated environments. Such environments have a large number of procedures and regulations that are imposed on the execution of business processes by one dominant actor in the network, which is often a governmental agency. Often these environments involve public-private partnerships.

In this paper we discuss whether controls in highly regulated environments should be modelled as value-based controls or not. To investigate this question we have carried out a case study in the healthcare sector, specifically on recent changes to the governance and control of the Dutch public insurance system for exceptional healthcare (AWBZ). The emphasis in the paper lies on the case study, which is quite complex. The theory section must therefore remain relatively short.

The main contribution of this paper is to elicit issues for discussion, regarding the applicability of a value perspective in highly regulated environments which involve public-private partnerships, such as healthcare. In response to these issues, we present a number of lessons learned. The remainder of the paper is structured as follows. In section 2, we explain the basic concepts of our methodology for designing value-based inter-organizational controls. In section 3, we describe the AWBZ healthcare system, and the introduction of a “Social Chart”, and analyse it using *e³-control*. Along the way, we present lessons learned. Finally section 4 contains our conclusions.

2 Design of inter-organisational control mechanisms

The *e³-control* methodology consists of the *e³-control design framework* and the *e³-control ontology*. Since *e³-control* is an extension of the *e³-value* methodology, we first briefly explain the *e³-value* methodology.

2.1 The *e³-value* methodology

The *e³-value* methodology supports the conceptualisation of a business network by constructing a value model [5], representing it graphically in a rigorous and structured way, and performing an economic sensitivity analysis for all organisations involved. In particular, the *e³-value* methodology provides for showing which parties exchange things of *economic value* with whom, and expect what in return. The methodology has been validated in a series of case studies in several domains, such as news, banking and insurance, electricity power, and telecommunications [5].
We briefly describe the concepts of the *e³-value* methodology. For a detailed description, see [5]. Figure 1 shows a buyer who obtains goods from a seller and offers money in return. According to the law, the seller is obliged to pay value-added tax (VAT). This can be conceptualized with the following *e³-value* constructs (in bold). **Actors**, such as the buyer, seller, and the tax office are economically independent entities. Actors transfer **value objects** (payment, goods, VAT) by means of **value exchanges**. For value objects, someone should be willing to pay, which is shown by a **value interface** being part of an actor. An interface models the principle of *economic reciprocity:* only if you pay, you can obtain the goods and vice versa. A value interface consists of **value ports**, which represent that value objects are offered to and requested from the actor's environment. Actors may have a **consumer need**, which, following a path of **dependencies,** will either result in another exchange of objects through a value interface, or end in a **boundary element**. The latter means that we do not consider additional value exchanges. A dependency path indicates that there is a direct link between the occurrence of one value exchange, and another.

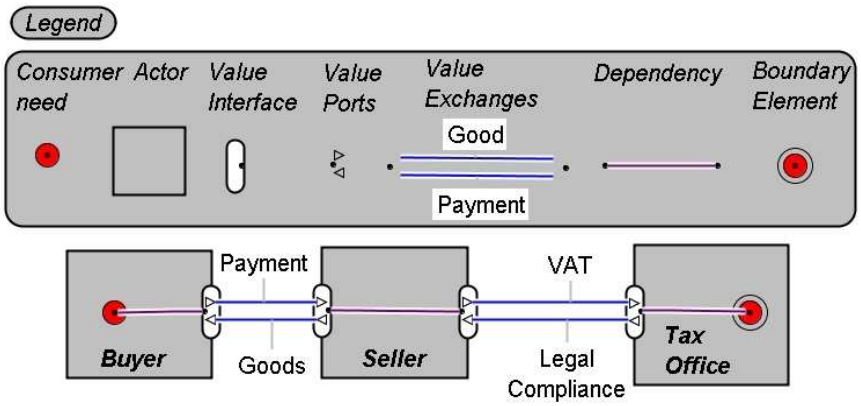

Fig. 1. An *e³-value* model of a purchase with tax payment

2.2 The *e³-control* methodology

In *e³-value*, we assume that actors behave in an *ideal* way, meaning that all value exchanges occur as prescribed. This implies, amongst other things, that actors respect the earlier mentioned principle of economic reciprocity. In *e³-control* [6,7] the economic reciprocity constraint is relaxed, to model **sub-ideal value exchanges**, represented in the diagrams by dashed lines. These represent the possibility that actors will for example not pay for a good, or not obtain a good while paying for it, or even obtain the wrong goods. These mishaps may occur intentionally (fraud) or unintentionally (errors). Scenarios of sub-ideal behaviour are often elicited by an analysis of the weaknesses in the business processes and organizations that implement a value exchange. Such an analysis makes use of risk indicators and principles of the auditing field [13], such as the principle of *segregation of duties*.

Thus, *e³-control* can account for sub-ideal behaviour, whereas *e³-value* typically models ideal or normative behaviour. Using *e³-control*, we can reveal potential weaknesses in an *e³-value* model, and suggest inter-organizational controls as a remedy. Application of the *e³-control* methodology involves the following steps:

Step 1: Elicit an *ideal e³-value* model with the actors involved and what they exchange of value;
Step 2: Analyse control problems, by a risk analysis of the underlying business processes and organizational structure, stating potential *sub-ideal* behaviour;
Step 3: Design *inter-organization controls*, stated as an *e³-value* model or, if sub-ideal behaviour cannot be completely removed, stated as an *e³-control* model.

3 Case study: Exceptional health care

In the Netherlands, the *Act on Extraordinary Medical Expenses* (AWBZ[1]) regulates the provision of care for chronic diseases, such as protracted illness, invalidity, learning disabilities, mental disorders and geriatric diseases. Because this kind of care is too expensive to insure in a private way, the system is arranged as a public health care service. A patient only pays a small part of the costs; the largest part is reimbursed by a government fund, filled by collecting a percentage of the income tax of each citizen. Clearly, the AWBZ system qualifies as a highly regulated environment. Patients need to apply for care through a tedious bureaucratic process. Various semi-independent governmental agencies perform tasks in the system, in return for funding. Although the government retains political control over the system, increasingly also private care providers are allowed to enter.

Currently, the exceptional health care system is undergoing major changes in terms of services, actors, financing and control. In this case study, we use *e³-control* to explain some of these changes, and to analyse and design controls for the new situation. The underlying research question is whether *e³-control* is applicable in such a highly regulated environment, and what we can learn from it.

[1] In Dutch: Algemene Wet Bijzondere Ziektekosten (AWBZ)

The data for the case study was collected from a series of semi-structured interviews with five experts from different health care organisations. The resulting *e³-control* models were verified by these domain-experts. In addition, data was collected from publicly available documents [3, 9] and government web sites.

3.1 The Exceptional Care System

To understand the case study at hand, we first provide an *e³-value* model of the current Exceptional Health Care system in Figure 2. In principle, every Dutch citizen is entitled to exceptional care. Every citizen could fall ill, which is represented by the choice fork (triangle). Both healthy citizens (on the left) and patients (on the right) pay taxes. In order to obtain AWBZ funding, a patient needs to be assessed by a national organisation called Indication Centre[2]. Based on the medical condition of the patient, as evidenced for example by medical reports, the Indication Centre issues a needs document[3], which states to what type of care the patient is entitled to. Needs are formulated in terms of standardised functions*:* domestic care, personal care, nursing, supportive assistance, activating assistance, treatment and institutional care. For each function, there are different classes, which specify the intensity of the treatment. In Figure 3 this needs document is modelled as "Right for Functions". A local Administration Office[4] allocates to each patient specific care providers, who provide the care services that correspond to the needs functions. This is modelled as a value object called "Right for Care". Both the "Right for Care" and a "Personal Contribution" are needed to obtain the "AWBZ Care" from the care provider. This scenario already reflects some of the recent changes. Before April 2003, needs assessment and product allocation were performed by the same institutions, which resulted in a biased allocation of health care services.

The Administration Office is responsible for distributing funds to care providers, represented by the "Budget" object. To be accountable, the care provider needs to provide evidence about delivered AWBZ care to the Administration Office. On the basis of such evidence, the budget for the next period is determined. The budget is provided by the Ministry of Health, Welfare and Sport. The Administration Office is responsible for reducing health care queues. The Administration Office therefore receives "Funding" in return for "Administration Services and Queue Management".

The ministry receives its funding as a percentage of the income "Taxes" of each citizen. In return, one could say that the government guarantees "Access to Quality Healthcare". As a minimal quality measure, the government requires care providers to have an accreditation from the Health Care Insurance Board[5]. The accreditation is only issued, when care providers can prove that they have adequate facilities to provide care that corresponds to the AWBZ functions. In Figure 4, this is represented by the exchange of "Evidence of Ability to Deliver Care" for "Accreditation". This is only a limited check. Please note that proper health care quality controls were only established from 2004 onwards (see below).

[2] In Dutch: Centrum indicatiestelling zorg (CIZ)
[3] In Dutch: Indicatiestelling
[4] In Dutch: Zorgkantoor
[5] In Dutch: College voor zorgverzekeringen (CVZ)

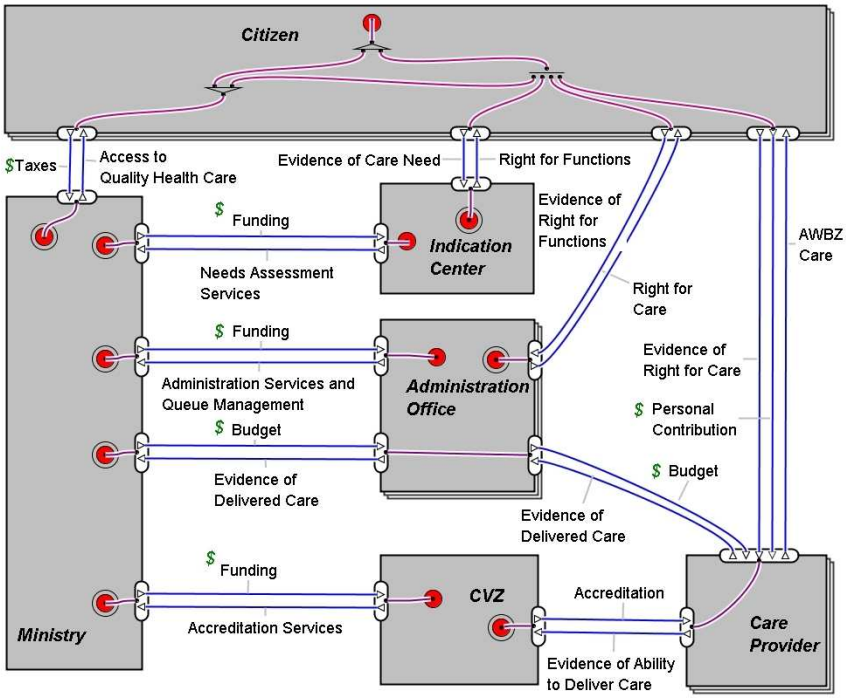

Fig. 2. Value network for exceptional health care system in The Netherlands

Discussion

We have made an *e*^{3}*-value* model of the Exceptional Health Care System, which exemplifies a highly regulated network. The model identifies actors, and value exchanges between those actors. As always, modelling decisions can be subject to debate. We identify the following issues for discussion, and present the lessons we have learned.

Issue 1: Highly regulated settings contain *indirect reciprocities*.
Observation: In the private sector, in which cases are often regulated by contracts, we mostly see direct reciprocities: a customer obtains a good or service and pays for it accordingly. But in this case, the economic reciprocal relation is at most indirect. For example, the Indication Centre receives a sum for its task of needs assessment. It does not receive proportionally more funding, when it issues more rights for functions. In the AWBZ, the provision of care is largely paid for by the tax-payer. For most people, namely for those who are not suffering from a disease and are not using the AWBZ system, the reciprocal relationship between care and taxes is even further removed. In a way, citizens pay for the guarantee that they will have access to health care of a certain quality, in case they would need it.

Lessons: First, we observe that in case of an indirect reciprocity, the dependency path (purple line) between a customer need (red dot), and the source of funding (big red dot), is often broken. Second, indirect reciprocities are modelled by guaranteed access to a service, in case citizens do not actually use the service at the moment. At a choice point (triangle) *e³-value* can represent the relative proportion of cases in which one dependency path is followed, rather than another. This would make it possible to model insurance settings by a kind of probabilistic reciprocity, in which the total of insurance premiums collected (here from taxes) should at least cover the expected disbursements to patients. Third, in case of indirect reciprocity, access to a service can be restricted by other means, such as a system of *rights*, and *evidence documents* (see issue 2 and 3 below).

Issue 2: *Regulatory rights* are modelled as value objects.
Observation: A public-private partnership is often characterized by extensive regulations. This was also observed in the energy sector [6] and now in healthcare. Regulation can take the form of a system of rights, to restrict access to a service. Examples in the case study are "Right for Functions" and "Right for Care".
Lesson: In general, legal rights can be seen as a value object in *e³-value* and so have to be modelled accordingly. This corresponds to case studies on international trade procedures [8], and copyright law for internet radio [7]. As a consequence, regulatory rights should also be seen as value objects. Because they guarantee access to a product or service, such rights are of real economic value to actors.

Issue 3: *Evidence documents* are modelled as value objects.
Observation: This case shows various requirements for evidence. Examples in the case study are "Evidence of Care Need", "Evidence of Right for Functions", and "Evidence of Delivered Care". Evidence often takes the form of a *document*, that has to be shown to an official, to obtain a product or service.
Lesson: Although usually the collection and interpretation of evidence is seen as a regular business process, in this case evidence documents can also be seen as value objects in *e³-value*. Evidence documents are required to obtain other objects (rights, AWBZ care) and are thus of economic value for the actors. This reconfirms intuitions from case studies in international trade, in which evidence documents like the Bill of Lading, are also modelled as value objects [8].

3.2 Personal Budget and Social Chart

The exceptional health care system described above has a number of problems. The right to health care, through needs assessment, is disconnected from the care that is actually available. Care providers cannot always deliver the needed services, because their budget from the government has a limit. Because care providers do not have an incentive to provide services above their budget, the model in Figure 5 resulted in a *supply-driven* system, with queues of patients waiting for treatment. Therefore the Dutch government is moving towards a more *demand-driven* system. The new situation, the resulting control problems, and a possible solution are analysed with the three steps of *e³-control*.

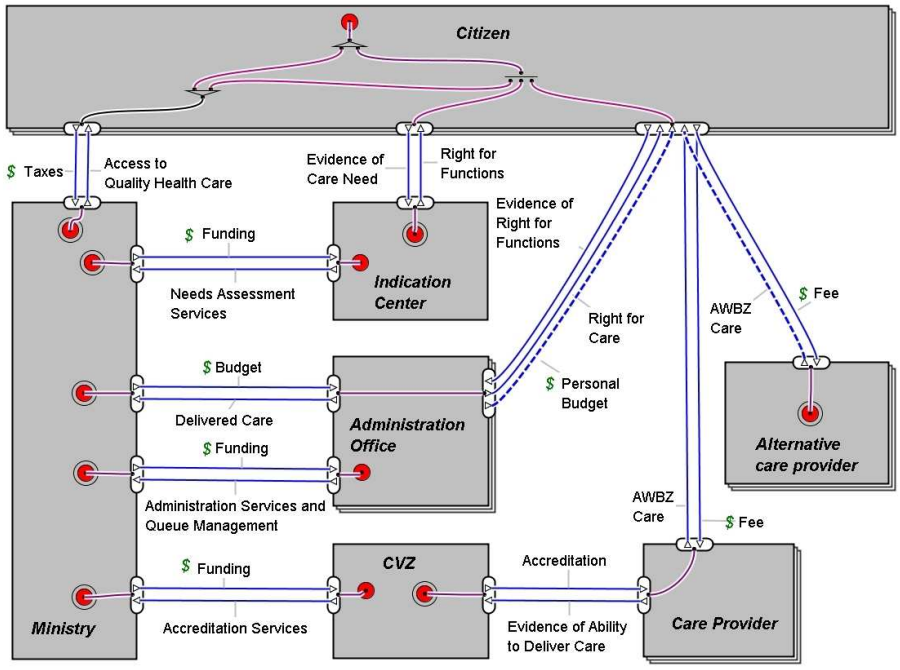

Fig. 3. Control problems with the Personal Budget system

Step 1: Introduction of a Personal Budget
Now, the patient can apply for a *Personal Budget* to spend on care services, provided either by traditional care providers, like a hospital or day care centre, or by *alternative care providers*. This may be any company or person, even a family member, who delivers (non-medical) services, such as cleaning, transport, or day care. This liberalization has led to more choice and an increased ability for patients to organize heir own lives. The system has some control problems, see Figure 3.

Step 2: Control Problems of the Personal Budget
Control problem 1*: Information about alternative care providers.*
Patients and relatives are not adequately informed about the available care, and the care providers in a region. Information about care providers is available from the Administration Office, but this only concerns accredited care providers. Based on interviews with domain experts, we observe that patients tend to select traditional care providers, rather than alternative care providers. This may stifle the development of the market for alternative care providers.

This observation corresponds to the general idea that *information asymmetry*, a situation in which the customer has less information about a product than the provider, has a negative effect on the emergence of new markets [1]. In Figure 3, this control problem is represented by a sub-ideal exchange (dashed line), labelled “Right for Care”.

Control problem 2*: Quality of alternative care providers.*
Traditional care providers have to be accredited. Because of the large number of alternative care providers, the CVZ can not accredit all of them. So, alternative providers are not required to have an accreditation, which results in a quality risk. This problem is modelled by marking the exchange of "AWBZ Care" between the citizen and the alternative care provider as a sub-ideal value exchange (dashed line).

Step 3: Future Scenario - the Social Chart
To solve control problems 1 and 2 we suggest a possible future scenario, presented in Figure 4: a so called Social Chart. The Social Chart is an interactive website that provides an overview of the care services in a region, *and* provides facilities for community-based quality control. The concept of such a *dynamic interactive social chart*, focused on the care takers of patients with *dementia*, (DEMDISC) is currently being developed in the FRUX project [2].

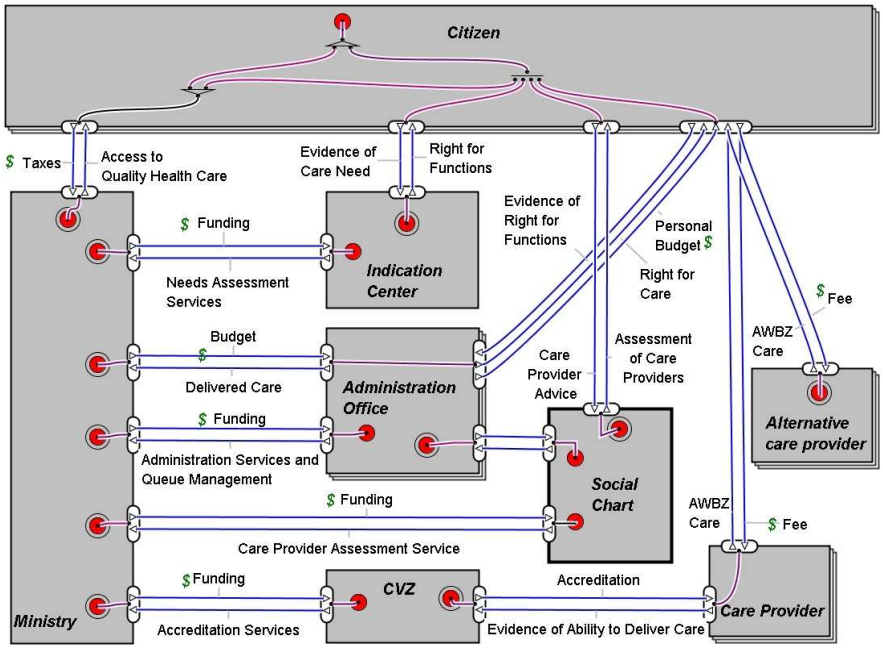

Fig. 4. Role of the Social Chart: informal quality control and care provider advice

Considering control problem 1*: Care Provider Advice.*
The purpose of the Social Chart is to provide information about alternative care providers, and help users select a care provider that satisfies their individual needs. In Figure 4 the Social Chart delivers a service called "Care Provider Advice". In one possible scenario, the Social Chart could be funded by the Administration Office. An increased usage of alternative care providers as a result of the "Care Provider Advice" offered by the Social Chart would reduce the queue problem, which is the Administration Office's responsibility.

Considering control problem 2*: Informal Quality Control.*
Quality control is a general concern in Dutch healthcare. Since 2004, an independent health inspectorate, Inspectie Gezondheidszorg, (not in the model) supervises the quality of care providers [2]. Given the expected explosion of new care providers, this organization cannot feasibly control the quality of all care providers. We therefore propose that the Social Chart should enable a kind of informal quality control. The Social Chart could provide, for example, a web-forum with testimonials, an online community peer review, a reputation mechanism, or collaborative filtering techniques [16]. In this manner, knowledge about the quality of care providers can be shared throughout the community of patients and relatives.

Such *community-based quality control* only works when users contribute to the community. That is why in one possible scenario, depicted in Figure 4, the Social Chart receives "Assessment of Care Providers" from patients. Since this informal assessment would reduce the administrative burden of assessing alternative care providers, one could argue that the Ministry of Health should subsidise the Social Chart, to stimulate the development of an effective virtual community of patients. So, in Figure 5, a value exchange "Care Provider Assessment Service" is drawn between the Social Chart and the Ministry of Health in return for "Funding".

Note that this is only one of many possible scenarios. A social chart could be set up for example by the patients association, by commercial parties like an insurance company or information broker, or by local or central governmental bodies. Members of virtual communities in healthcare are generally willing to contribute to the community [3]. We do realize that setting up a reliable system for online feedback is a research topic by itself. For example, testimonials tend to be biased. More quantitative comparisons also exist. For example a Dutch information broker, independer.nl, is using a large number of general practitioners to get statistically valid feedback on the healthcare services of various hospitals in the Netherlands.

Discussion.
Issue 4: Services can be *community-based*
Observation: A community-based quality control, like a feedback or recommender system, only works when sufficient members actually contribute to it.
Lesson: Sharing and exchanging valuable information, like experiences about care providers, can be based on solidarity and membership of a community. In *e^3-value*, this can be modelled by a value exchange between different instances of a so called *market segment* (stack of actors), aggregated over a longer period of time. One patient benefits from the contributions of other patients
Issue 5: Control services are often *commercial* services
Observation: A highly regulated environment requires many control services. Examples in the case study include needs assessment (Indication Centre), allocation of actual care services, and the allocation of personal budgets (Administration Office), and providing information about care providers, and care provider assessment (Social Chart).
Lesson: Control services can be seen as commercial services, which can in principle be outsourced. This is clearly modelled: all controlling parties, whether they are government agencies or not, need to be funded or paid. Control services may even spawn off new business opportunities, as in the case of the Social Chart.

4 Conclusions

In this paper we have analysed governance and control issues in the Dutch Exceptional Healthcare system (AWBZ), using the *e³-control* methodology, which is meant for the design and analysis of inter-organisational control mechanisms. The AWBZ case is interesting, because it shows the complexity of a highly regulated environment, which involves public-private partnerships. Since *e³-control* is based on an economic value perspective, it is reasonable to question whether such an approach is applicable in a sector like healthcare. The *e³-valuel* and *e³-control* approaches force us to model all actors as separate organisations with their own economic sustainability objectives, and, due to this network aspect, hidden interactions become visible. In particular, the *e³-control* analysis of the AWBZ case demonstrates

(1) that rights, evidence and regulations can in fact be fruitfully analysed from a value-based perspective, and
(2) that *e³-control* can reveal the existence of a business opportunity, because many regulative controls have inherent economic value aspects.

Hence, we conclude that value-based approaches like *e³-valuel* and *e³-control* are not only applicable in commercial settings, but also in the public domain. In particular, regulatory rights and evidential documents, two mechanisms that are often used by public institutions to regulate private businesses, can be seen as value objects.

Another contribution of this research is the distinction between *direct* and *indirect reciprocity*. In the contractual arrangements of many commercial relationships, economic reciprocity is typically *direct*: e.g. payment is required for each good or service, and vice versa. In this case study we found that economic reciprocity in public-private partnerships is often *indirect*. In particular, funding of a governmental agency may not depend on the number of cases dealt with.

We also learned that it makes sense to model the AWBZ as a kind of insurance: citizens get guaranteed access to the healthcare system, in return for their AWBZ contributions through taxes. In future research we will try to find out whether this model is also applicable to other insurance settings. Both insurance and community-based services rely on a notion of solidarity: some members benefit, from the contributions of all. As a final lesson, we have seen that also in the public domain, many control services should actually be seen as *commercial* services, which should be adequately funded. For our health care domain experts, this was actually the most important result: understanding and analyzing inter-organizational controls, spawned off a new business opportunity: the Social Chart.

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