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Matching Complex Consumer Needs with *e*-Service Bundles

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Abstract

e-Services are commercial services that can be ordered and provisioned via the Internet, satisfying a consumer need. Sometimes, such services are provisioned by a constellation of enterprises, and consist of multiple elementary services. A problem is then how to configure such a constellation, satisfying a complex consumer need. To this end, we extend the notion of consumer need in the e^3value methodology, as originally intended for designing value constellations. We also show how needs can be (automatically) matched with services provisioned by suppliers. As such, our contribution can be seen as a first step towards on-demand dynamic value constellations, provisioning e-services.

1. Introduction

So far, e-business scenarios have been mainly concentrating on producing, trading, and consuming physical goods. Success stories include Dell and Cisco systems. However, commercial *services* are at least equally important from an economic perspective [9]. A specific kind of services is so-called *e*-services. These are deeds and performances of mostly an intangible nature [9], which, to a large extent, can be ordered *and* provisioned via the Internet. Examples include relatively simple services such as Internet access and an email box, or more complex services such as domestic computer networks - as a managed service -, Internet radio, and home comfort control [2]. For all these services, consumers are charged; in other words, they can be seen as *commercial* services.

An e-service can be an *elementary* service, which is an e-service that needs to be performed and provisioned by one enterprise (for commercial or technical reasons). In other words: an elementary service can not be split up and divided over multiple enterprises. However, consumer needs may sometimes be complex and thus require a *package* of *elementary* e-services, rather than just one single elementary e-service. A package of such services, we call a *service-bundle*. If services are provisioned as a bundle of elementary e-services, it is often possible to use a *same* resource in *multiple* elementary e-services the bundle consists of (e.g. in case of infrastructural components), thus enabling cost reductions (see for more information [16]).

As an example, consider a triple play strategy currently employed by most telecommunication operators (telcos). In a true triple play scenario, telcos offer television, internet and telephony (elementary services) as a *bundle* over *one shared* infrastructure (resource) –namely a cable or fiber - to the consumer. This satisfies (partly) a complex consumer need for 'communication'.

While the example is about e-service bundling in a *single* company, offering e-services in bundles is also advantageous in case *multiple* companies involved, because these companies then *jointly* fulfill a complex consumer need that they would not have been able to satisfy *individually*, given their capabilities.

Our long-term research goal is to arrive at so-called *dynamic value constellations* for *e-services*. These are configurations of enterprises and consumers (see e.g. [5]) that are created *on demand* to *satisfy* a *complex need* by offering a *bundled*, *multi-enterprise e-service*. With 'on demand' we mean that a value constellation is formed based upon the specific need of a consumer; the idea is *not* to have a pre-assembled value constellation. Building such constellations should be supported by information technology for a number of reasons. First, since e-services can be ordered and provisioned *online*, building the offering constellation *itself* should also be done online and therefore be supported by information technology. This is an obvious requirement from the consumer. Second, given the *complexity* of such constellations (many enterprises, many services, many consumer needs) automated tool support is required to build such a constellation within reasonable time. Note that building dynamic value constellations for *commercial e-services* contrasts to recent work in the field of Computer Science on web-*services* [10], which focuses on the *technical interoperability* of software of various enterprises, rather than on operability on the business level.

Information technology support for dynamic e-service value constellations requires formal *models* (that can ultimately be implemented in software) that allow understanding and reasoning on constellations of enterprises and consumers, their needs, offered services, potential service bundles, resource allocations, delivery schedules, and more. In the recent past, we have developed such models (*e^3value, serviguration*) to conceptualize and analyze value constellations, needs, and services. Using software tool support, such constellations can be analyzed for profitability [3,4], and bundles of services can be automatically generated satisfying explicitly stated consumer needs [1].

The goal of this paper is to explore if previous work on value modeling (*e^3value*) & service modeling (*serviguration*) [1 3,4, 16] is also of use for understanding a value constellation creating, distributing, and consuming *e*-services. We explore the potential use of the *e^3value* methodology for e-service modeling using a case study on digital television. Since we have already shown in earlier work that *e^3value* is of use for profitability assessment [3] and that *serviguration* is capable of reasoning about various service bundles [16], we are now in particular interested in the questions (1) *whether the e^3value modeling methodology is helpful to understand consumer* needs *that potentially can be satisfied by an e-service bundle,* and (2) *whether serviguration is helpful in deciding which e-service bundle to* choose *to satisfy such a need.*

The structure of this paper is as follows: first, we introduce our case study using the *e^3value* technique. Then we concentrate on modeling the consumer need. The results from this are then used in trying to match the consumer perspective with the supplier perspective. We conclude with our findings and directions for further research.

2. Digital Television

Suppose that someone has just moved into a new house, has a need to watch television and therefore has to choose a service providing television channels. This consumer now faces a rather complex task, already only as a result of the currently fast changing telecommunication landscape.

The number of providers from which one can acquire television channels is increasing, as are the options adhering to the infrastructure over which the television services are provided (which is important, as each infrastructure has its own possibilities/limitations). To make the situation even more complex, there currently is an observable trend of moving away from offering a standardized package of TV-channels to offering different packages that satisfy different consumer preferences.

In this case study, we explore consumer demands in order to find a television provisioning service that satisfies these demands. We consider the following two target audiences:

- Students with a "higher education": we assume that such students do not have that much financial resources but at the same time are relatively familiar with the possibilities that digital television could provide to them;
- Average 2.4 household: we assume that such a household will probably need a broad offering of television content/services (considering that each member has his/her own tastes). Also, most households have multiple televisions, meaning that there might be some difficulties with the infrastructure (in the current situation, each television set would need its own set top box) and finally, most households are not that familiar with the possibilities/constraints concerning digital television(i.e. looking at the benefits/constraints rather than merely at the resources that a service provides).

Furthermore, we assume that the target audience is located at one city. This is because the content offered by a cable company depends on the area you live in (in the Netherlands, specific agreements are made between cable companies and the local government)

We limit the number of (digital) television service offerings to three: two of them provide a digital television service offering, but the choice for analogue television has also been modeled. Analogue television can act as a substitute for digital television as the consumer just has a need to watch television, whether it is digital or not does not really matter.

Digital television can be seen as an e-service because it can be fully ordered and provisioned via Internet (or closely related) technology. The only physical step involves placement of a set top box at home. Our case study data comes from two large (digital) television providers in The Netherlands, namely Casema (www.casema.nl) and Digitenne (www.digitenne.nl) [11,12].

3. The e^3*value* Methodology

We first model the television value constellation and service bundles as they currently exist using the e^3*value* methodology. To make the paper self-contained, we briefly explain e^3*value* below (for detailed information, see [3]). The e^3*value* methodology models a network of enterprises creating, distributing, and consuming things of *economic value*. One of the strength of an e^3*value* model is that it can be graphically depicted (see Figure 1 for an example), thus enabling easy communication of the model between the stakeholders involved. The e^3*value* modeling constructs are:

Actor. An actor is perceived by his/her environment as an economically independent entity.

Value Object. Actors exchange value objects. A value object is a service, a good, money, or even an experience, which is of economic value for at least one of the actors.

Value Port. An actor uses a value port to provide or request value objects to or from other actors.

Value Interface. Actors have one or more value interfaces, grouping value ports, and showing economic reciprocity. Actors are only willing to offer objects to someone else, if they receive adequate compensation in return. Either all ports in a value interface each precisely exchange one value object, or none at all.

Value Exchange. A value exchange is used to connect two value ports with each other. It represents one or more potential trades of value objects.

Market Segment. A market segment breaks actors into segments of actors that assign economic value to objects equally. This construct is often used to model that there is a large group of end-consumers who value objects equally.

Value Activity. A actor performs one or more value activities. These are assumed to yield a profit.

Dependency path. A dependency path is used to reason about the number of value exchanges in an *e^{3}value* model. A path consists of consumer needs, connections, dependency elements and dependency boundaries. A *consumer need* is satisfied by exchanging value objects (via one or more interfaces). A *connection* relates a consumer need to an interface, or relates various interfaces of a same actor. A path can take complex forms, using *AND/OR dependency* elements taken from UCM scenarios [8]. A *dependency boundary* represents that we do not consider any more value exchanges on the path.

Given an *e^{3}value* model, attributed with numbers (e.g. the number of consumer needs per timeframe and the valuation of objects exchanged), profitability sheets can be generated (for a software tool see http://www.cs.vu.nl/~gordijn/tools.htm). Profitability sheets show the net cash flow for each actor involved and are a first indication whether the model at hand can be commercially successful for each actor.

4. An e^{3}value Model for Digital Television

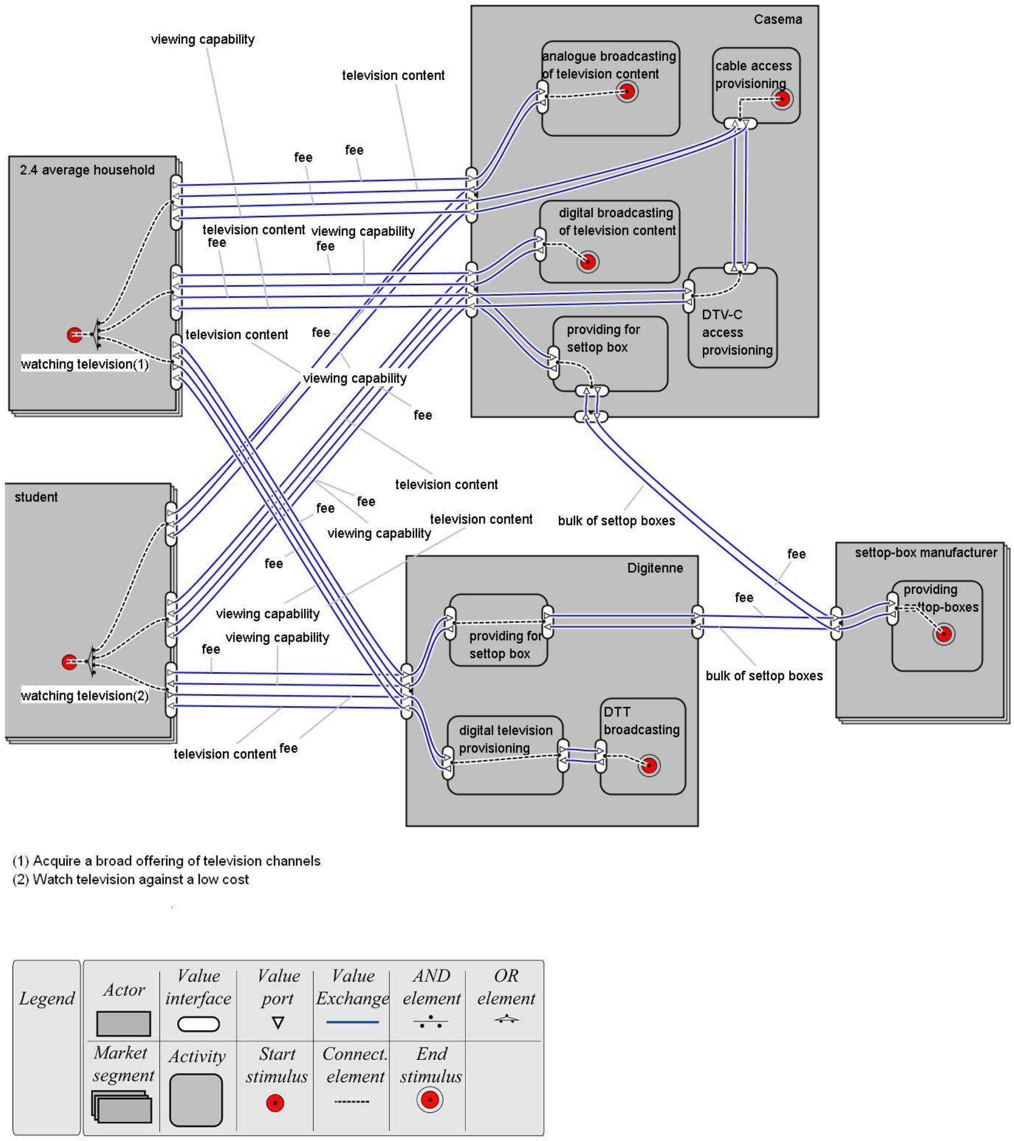

Figure 1: An e^{3}value model for the television case study

Figure 1 presents an *e³value* model for the television case. At the left, the two target audiences considered in this case study are modeled. They are modeled separately as each has a different stated need concerning the television service offering. The 'OR-element' drawn into the interior of the market segment shows that the viewer can choose from three alternatives to satisfy his need. First, he can choose from two different suppliers: A 'cable' provider, and a provider broadcasting digital television via the ether. Second the 'cable' provider itself provides two alternatives: Analogue TV or digital TV.

The cable company is modeled as a single actor and not as a market segment; the reason for this is that in the Netherlands, you still are dependent on a single cable company (which one that is, depends on your geographical location). In addition the providers of the set top-boxes are also modeled, as their products determine what services are possible.

The service offerings that are modeled in the *e^{3}value* model are:

- *Casema* (the cable company) offers the following packages:
  - Analogue service offering: The channels that a consumer can receive via this service offering are broadcasted with an analogue signal. The standard subscription package consists of 34 channels
  - Digital plus package: This package can be acquired on top of the analogue service offering, which means that the channels from the analogue service offering are maintained and that additionally a package of extra digital channels is offered.

    Offering digital television on top of analogue television is possible because of reuse of the infrastructure; in the *e³value* model this can be observed by the fact that *both* the analogue and digital television service offerings rely on the *same* cable access provisioning service. This can be seen by the fact that they both acquire the same resource (in the form of a value object) from the cable access provisioning service.
- *Digitenne* provides digital television through the ether. Digitenne has one type of television service offering for watching at home, comprising of 27 channels. This is collectively referred to as 'television content'. In addition, to view television, a subscriber needs to obtain a 'viewing' capability service. This is an infrastructural service, and is currently implemented as a set top box at the consumer's home. It receives and decodes the digital television signal, and displays the signal on a television. As opposed to Casema, Digitenne does not provide an analogue television service offering to its consumers.

For digital television, additional equipment is necessary to receive digital television because there needs to be some sort of on-site infrastructure (in the form of a set-top box) that can interpret the digital signal and display it on the television. We chose to also model the provisioning of these set top-boxes, as the functionality offered by the set top-box itself also has an influence on the services that can be offered to the consumer (e.g. a set top-box with a hard disk could give the consumer the possibility to digitally record videos for delayed watching). The set-top boxes can be quite expensive, with prices ranging from €149,- to €679,- (this can be seen on the website of the service providers). This means that the initial expenses are actually quite high, even though this is not made clear in the advertisements; these just emphasize how low the subscription prices are. This will be further discussed later on in this paper; first we will take a look at the needs adhering to digital television from a consumer perspective.

5. Digital Television: The Consumer Viewpoint

5.1 Clarifying the Consumer Needs

As said, one of our questions is whether the *e³value* modeling methodology is helpful to understand *consumer needs* that potentially can be satisfied by an e-service bundle. However, when we look at the model, the only needs we have are "watching television against a low cost" and "acquire a broad offering of television channels", which is a too high level to make an adequate matching to the existing resources of the different television service offerings. In general, truly understanding a consumer need requires analyzing different aspects of the need instead of just focusing on a high level stated need of the consumer (which is also stated by Kotler in [6]). For instance, when just focusing on this high-level stated need, the qualitative aspect of the service offering might be overlooked (e.g. the consumer might expect that a digital tv-service offering has at most the same amount of failures as an analogue service offering).

It is important to stress that to enrich the current way of *needs* modeling, we want to rely on *existing* theory. It is explicitly not our goal to add theory on marketing and related sciences *itself*; rather we want to *model* and *conceptualize* such theory, with the aim to ultimately provide *software support* for matching needs with available e-services.

Understanding the Different Aspects of a Need

When trying to understand a complex consumer need, a reasonable starting point in existing research can be found in the framework provided by Holbrook [7]. He states that consumer value can be interpreted as the result of the interplay between a number of factors, of which he defined eight in total. In the framework from Holbrook, these factors are arranged according three main properties, each consisting of two opposing categorizations. These are:

- Active versus reactive use: with active it is meant that the consumer does things to or with the product/service as part of the consumption process; reactive on the other hand means that the product/service acts upon the consumer.
    - Example of active use: ice skating
    - Example of reactive use: watching figure skating
- Intrinsic versus extrinsic value: extrinsic use of a product/service means that there is a means-end relationship present, so the product/service is consumed in order to achieve a goal other than acquiring the product/service in itself. Intrinsic value, on the other hand, means that the product/service has value contained within itself
    - Example of extrinsic value: a roman emperor that uses a nicely decorated cup to drink wine
    - Example of intrinsic value: that same cup, on display in a museum
- Self-oriented versus other-oriented value: Here the question is of whether a product/service is consumed for ones own sake(“how do I benefit from it?”) or if it is beneficial for others
    - Example of self-oriented value: buying a Porsche to impress the neighbors
    - Example of other-oriented value: selling the Porsche at a charity auction

In understanding a consumer need further, we will use two factors from Holbrook, namely the *efficiency-factor* which is defined to be self-oriented, extrinsic and active and the *excellence-factor*, which is also self-oriented and extrinsic but reactive rather than active.

The efficiency-factor as defined by Holbrook indicates the presence of a means-end relationship between the consumer and the product/service used. This is useful when elicitating consumer needs as it automatically leads to inquiries concerning the *goal* of the acquired product/service. In this case study for instance, watching television is not really a goal, but a means to achieve the goal of being entertained. Because we feel that the term ‘efficiency’ is a bit too abstract and does not cover fully the purposes for which we use this Holbrook-factor, we coined the term *means-end need.*

Also, we specialized the generic term ‘excellence’ into ‘quality’, which has the same properties as a need adhering to excellence but is more related to what we intend to use it for. If we analyze the needs from the value model further using the specialized factors from Holbrook, we get the results as modeled in table 1.

Table 1: Distinctive needs with respect to digital television

	Stated needs	Means-end needs	Quality needs
Student	-Watching television *against as low a cost as possible	-Keeping up with current affairs -Being entertained -knowing what is on television -Learning about new subjects -Monthly fee should be low, not too much initial expenses	-Few failures -Adequate support -easy self-installation
Average 2.4 household	- Watching television - Acquire a television offering that offers a broad range of channels	-Keeping up with current affairs -Being entertained -Learning about new subjects	-Few failures -Adequate support -easy self-installation -support for multiple television sets

Table 1 is still too generic to be of real use for matching needs with available services. As an example, consider the need of ‘being entertained’; this is far too general to reason about in the matching process later on, one of the main reasons being that the satisfaction of that need largely depends on the target audience (e.g. children are entertained by different programs/subjects than adults).

Concretizing Needs

As has been concluded in the previous paragraph, we need to specify needs further in order to be able to reason about specific demands and how they can be satisfied by the available services. To detail the needs into demands we will use AND-OR goal trees [13], as has been suggested in [16]. We will do this for both the means-end needs and the quality needs.

In short, an AND-OR goal tree shows a top-level goal, which is decomposed into sub-goals that need to be achieved in order to achieve the top-level goal. These sub-goals could again be perceived as top-level goals which need other sub-goals in order to be achieved. This specification of goals into sub-goals then continues until one arrives at a point where it is felt that the goals to be achieved are specific enough (meaning; until the goals are operationalized into measurable, observable properties that can be matched to certain resources). These specific goals then form the leafs of the tree.

The vectors connecting the different levels (meaning: goals that have the same amount of granularity, e.g. in figure 2 *being entertained* and *keeping up with current affairs* are on the same level) of the tree can be annotated with either an AND or an OR construct. When annotated with AND, *all* sub-goals must be achieved in order to achieve the top-level goal, while an OR-construct indicates that achieving *one or more* sub-goals (and not necessarily all goals!) will mean that the top-level goal is also achieved. The AND-OR goal tree of the means-end needs belonging to the 2.4 average household can be found below (the goal trees belonging to the student are not shown in this paper due to space limitations).

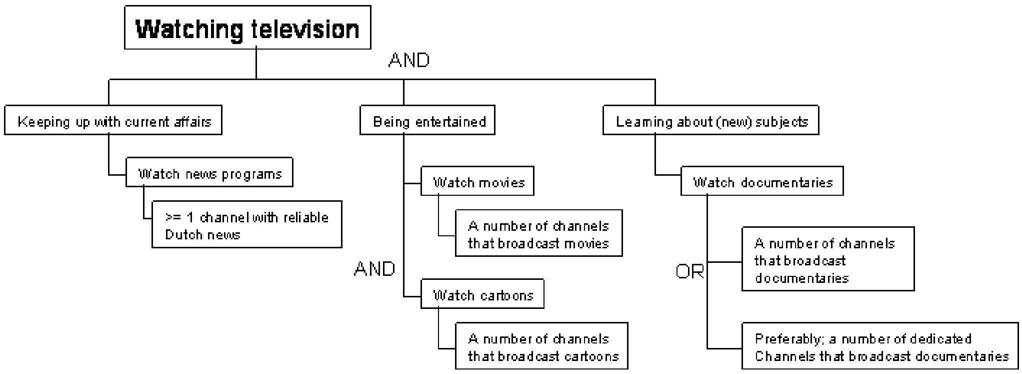

Figure 2: Goal tree of means-end needs from average household

The *quality* needs are still too generic to reason about; this can for instance be concluded from the fact that we do not yet know what the consumer expects when he/she states that there should only be *few failures*. "Few" is still subjective and can not be matched onto observable properties of resources delivered by a service provider. In the end, we need to specify the quality needs further until we have a demand that is specific enough to be matched to a resource from the service provider or that can be easily measured(e.g. in figure 3, the demand *"same availability as analogue television"* can be objectively measured) The quality needs are specified in figure 3.

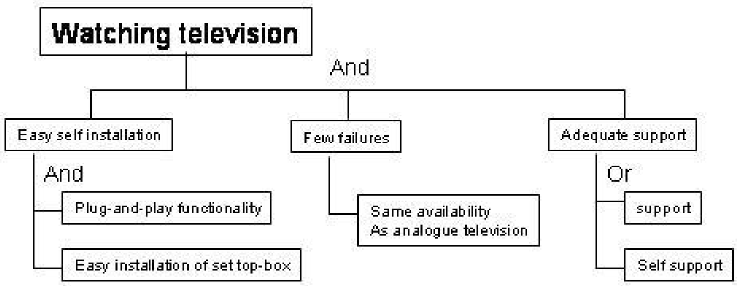

Figure 3: Unstated needs of the 2.4 average household that need to be satisfied for the top-level goal of watching television

Prioritizing Consumer Needs

So far, we have provided constructs to conceptualize needs into more concrete demands. However, yet another dimension is that a consumer usually has a *preference* ordering in demands that must be satisfied (hence, the added "preferably" that can sometimes be found in the goal trees). So, it should be possible to make a distinction between demands that *must* be satisfied and those who would be *nice to have*.

A tool already exists that expresses a preference ordering between different requirements (actually demands), in the form of a list. This list distinguishes four requirements: *Must have* requirements, *Should have* requirements, *Could have* requirements, *Won't have* requirements and, as an acronym, is called a MoSCoW-list [15]. If we assume that demands are actually specific requirements, it should be possible to apply this preference ordering to the demands stated earlier. The *quality needs* are also included into the list, and are perceived to be must-have requirements. The MoSCoW list, based on a summary of the specified demands and the delight needs mentioned earlier, can be found in table 2.

Table 2: MoSCoW-list of needs

	Student	**Average household**
Must have	-at least one channel with reliable Dutch news -a number of channels that broadcast movies -initial fee should be at most ½ of monthly scholarship -monthly fee should be at most 1/10th of monthly scholarship - availability of all necessary equipment -same availability as analogue television -support/self-support	-at least one channel with reliable Dutch news -a number of channels that broadcast movies/cartoons/documentaries -availability of all necessary equipment -easy installation of set top box -same availability as analogue television -support/self-support
Should have	-dedicated channels for watching movies/documentaries/cartoons	-dedicated channels for watching movies/documentaries/cartoons
Could have	-control a movie like with a dvd player (start/stop/rewind) -see a movie when you want to -discount	-discount -monthly magazine

The way in which we intend to use this, is to test whether the service offerings satisfy the 'must have' demands first, and to move to the 'should have' demands and 'could have' demands after that. This means that a service offering is discarded if it does not meet *all* of the 'must-have' requirements. Also, if service offering A satisfies more 'should have' requirements than service offering B, A will be preferred over B independent of the number of 'could have' requirements satisfied by B.

It is worth noting that alternative techniques exist that enable the creation of a preference ordering, such as AHP [17]. The reason that MoSCoW has been chosen however, is that it is fairly simple and yet has proven to be effective in creating a preference ordering in (software) requirements. Since e-service needs come relatively close to requirements for software (most e-services *are* essentially software), MoSCoW is a first candidate to try. It might be interesting to look further into AHP in the course of further research, and evaluate whether the heavier workload inherent to AHP- due to the pairwise comparison that has to be made between any two objectives that are to be ranked – weighs up to the added value AHP has with respect to MoSCoW.

6. Digital Television: Translate Consumer Demands to Available Service Offerings

Now that we have expressed consumer needs and demands using need/demand hierarchies and goal trees, we will try to match these needs to the different resources provided by the service offerings of suppliers. In [16], this matching is done by means of a Feature-solution graph, or FS-graph in short [14]. A FS-graph is a lightweight modeling technique which aims at matching requirements to feasible solutions. This matching occurs with information ordered within three spaces in the graph, namely (1) the context space, which contains context specific information (eg. target audience, geographic location) (2) the feature space, which contains the requirements, or in this case the specific consumer demands and (3) the solution space, which contains the resources provided by the supplier (or suppliers in this case).

Additionally, a FS-graph employs a number of constructs to enable the matching process, namely:

- The *selection/rejection* and *positively/negatively influenced by* relationships between elements of the feature space (needs and demands) and solution space (services). The *selection/rejection* indicates a 1:1 relationship between the demand and service, while the *positively/negatively influenced by* indicates a 1:N relationship. The 1:N relationship means that a demand can be satisfied/negatively influenced by several resources, while the 1:1 relationship means that there is a one to one mapping between demand and resource.
- The context switch, which enables the usage of context-sensitive information within the matching process.

Figure 4 presents the (partial) FS-graph which is used to match the needs/demands to the available resources. Using this partially depicted graph, we can make a series of observations. First, the demand ‘availability of necessary equipment’ holds for both target audiences and this demand is satisfied through the availability of a set top box. However, when trying to find a match between this demand and resource, we found that a set top-box is actually expensive. Even more so, we found that the cost of a set top-box exceeds ½ of the monthly scholarship of an average student, with the cheapest boxes ranging around €149, while the average student receives about €250,- a month. For the student target audience, this would mean that it would be better to select the analogue package rather than the digital television package. The set top-box is a compulsory part of a digital television service offering, which can be seen by the AND-annotation in Figure 4 (stating that *all* resources are acquired that are connected to the service offering by an arrow).

Also, it can be seen that the resource ‘set top box provisioning’ negatively influences the demand satisfaction of ‘equipment availability’ for the average household. This means that they can afford it and the advice for them would be to acquire a digital television-service offering, but that they should only acquire one set top box and not buy one for every television set in the house. This implies that the average household should go for the Casema digital plus package, as this service offering is provided on top of the analogue package. The reason for this is that the digital television service offering inherits all the resources from the analogue package-including the analogue signal, meaning that television sets without a set top box can still be used to watch the channels from the analogue package. Another reason to choose Casema over Digitenne (the other digital television service offering) is that it offers a broader range of channels, although this is not directly clear from the graph (given the fact that it is only partial).

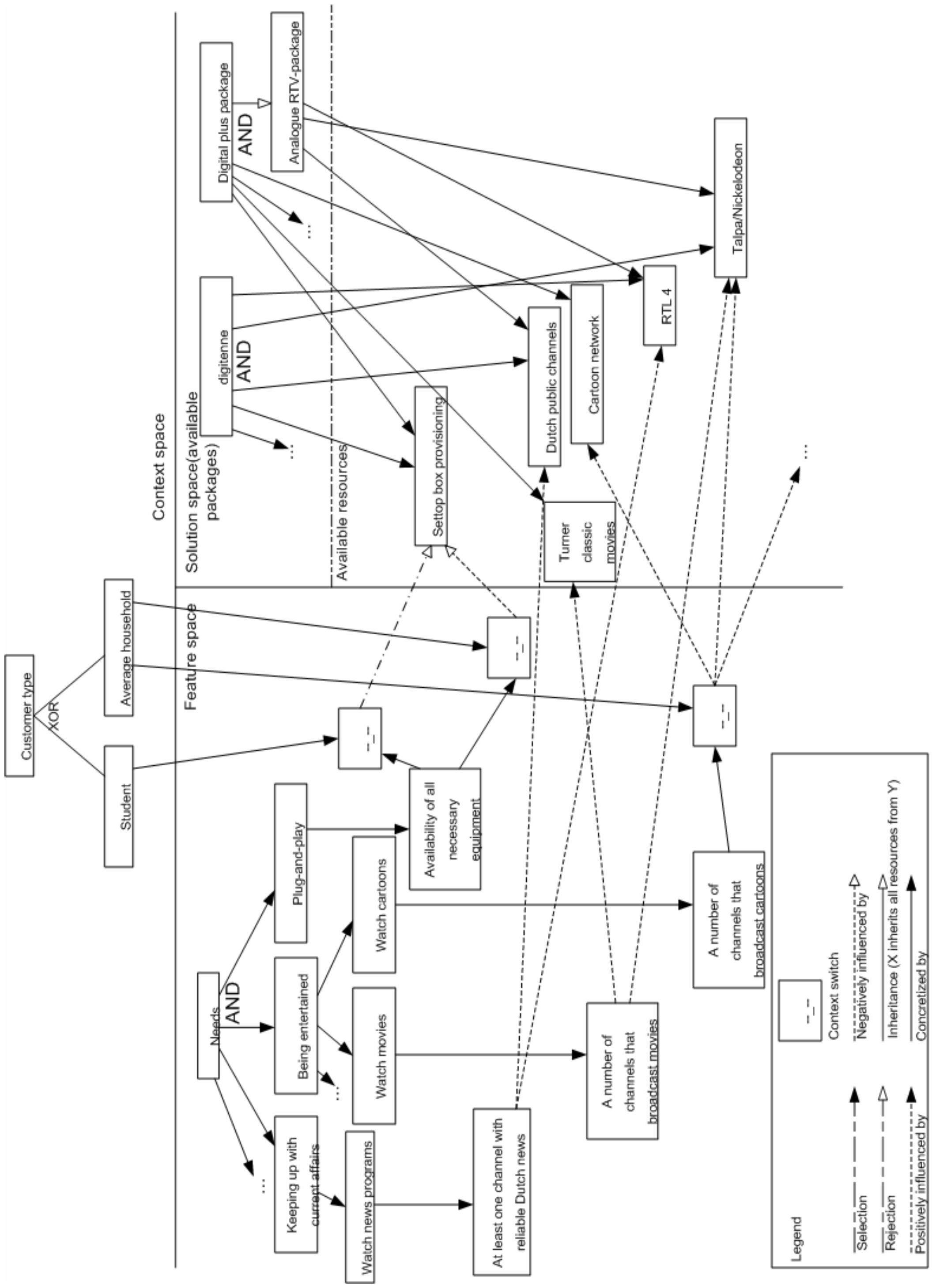

Figure 4: FS-graph adhering to digital television

7. Discussion

We started this case study with the question whether the *e³value* methodology is useful for modeling needs. As a result of the presented case study, we found that the 'consumer need' concept in *e³value* can be extended in order to provide an in-depth analysis and understanding of a consumer need. Using the framework Holbrook for the analysis of a need has been an adequate starting point in analyzing a need, but in the course of further research, elements of other frameworks for the analysis of consumer needs might also be included. The reason for this is that, while the factors that we used were useful to consider, the framework from Holbrook also contains less effective elements that would not really be useful when trying to understand needs concerning e-services. Consider for example the aesthetics-factor, which is defined to be intrinsic, reactive and self-oriented. This factor might explain how a work of art is valued, but it is not of much use when considering e-services. (although there are exceptions that one can think of, but overall it is expected that the aestetics-factor does not play an important role when analyzing IT-services)

Additionally, we added to the *e^3value* methodology the *prioritization* of needs by using a MoSCoW-list; besides it being fitting, it also helps in creating an FS-graph as one does not have to model all demands at the same time. Also, it might help in reducing the modeling workload as in some cases, the necessary conclusions can already be drawn by only modeling the *must have* demands.

As a second question, why have tried to what extent service bundles can be (automatically) selected using an expression of consumer needs by employing an FS-graph. While creating this graph, we encountered a number of problems. First, creating an FS-graph is very time-consuming, as one has to model every possible connection between the consumer side and supply side. Second, it is not very illuminating or practical. This can be can seen in the graph depicted above, which is already quite elaborate but still only depicts a fragment of the *must-have demands* from a simple case study. When one thinks about it, creating such a graph for all demands in an industry-strength case study is not really practical. Furthermore, it does not really clarify the matching process. For instance, if one would show such a graph to a client to show how you arrived at a certain service bundle, one could imagine that this person would not really receive any insight into your results. We plan to test an another approach for the matching process, namely by enriching the expression (and thus conceptualization) of needs, such that the process of matching needs with resource outcomes of services can be done using (1) a more explicit and formal expression of needs, and (2) a explicit statement of the resource outcomes. By doing this, the FS-graph hopefully can be simpler or even disappear.

8. Conclusions

In this paper, we showed how a complex consumer need can be analyzed using a model-based approach (*e^3value*) and how to use the results of this analysis to create a preference ordering on preexisting service offerings that could satisfy this need. It was found that the needs elicitation in the *e^3value* service ontology could use more elaboration if one truly wants to understand a consumer need, as there are many facets to consider that the consumer might not state as a need (e.g. quality attributes).

What needs to be researched further is how the results presented in this paper can be used to on-demand *generate* bundles of IT-services satisfying a complex *need*, instead of differentiating between predefined service packages. A more practical question related to this is *which party* will actually *compose* the IT-service bundle. This is an important question as that party will be the linking pin with the consumer, a position that many companies want to take as seen from a commercial perspective.

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