Representing Value: Function, Capability and Role

Fumiaki TOYOSHIMA[a,1]
[a] *Graduate School of Advanced Science and Technology, JAIST, Japan*

Abstract. Value remains an elusive concept, notwithstanding its centrality to well-designed business processes, especially in the context of enterprise modeling. In this paper we contend based on ontology of function and capability that, insofar as it is economic resources (goods and services), the object of valuation is primarily a function which the agent believes can be manifested by some capability. We then extend this functional view of the value object to value (co-)creation with an emphasis on the relationship between function and role.

Keywords. value, value (co-)creation, function, capability, role

1. Introduction

The concept of value plays a crucial role in the contemporary economics. To develop an effective marketing strategy to sell their products, for instance, companies need to understand correctly what consumers really take to be valuable, e.g., through a statistical survey by questionnaire. It may be notoriously difficult to define value explicitly (i.e., to offer necessary and sufficient conditions for it), but a rigorous conceptualization of value would benefit considerably both the providers and the customers concerned.

This paper aims to offer close ontological investigation into value. We begin by disambiguating the term 'value' since it is highly polysemous. There are two general, economic meanings of value: exchange value and use value [1]. Exchange value roughly means what the consumer is willing to pay for something or the kind of worth of something which is representable in terms of the worth of another (typically by the market price): e.g., the exchange value of Mary's car is 30,000 dollars. The notion of exchange value is vital for economics and some value modeling approaches, including e3value [2]. The other kind of economic value, which we will bring for discussion below, is use value, namely the worth of something that is manifested in a close connection with the satisfaction of the user's desires or needs: e.g., the use value of this car is fairly high to Mary because it allows her to have only a short commute to work. There is a growing literature [1,3] on use value because of its relevance to business, management, and (service) marketing. For the sake of simplicity, we will henceforth use the term 'value' to refer to use value unless otherwise specified.

Following previous ontological investigations [4-8] into value, we presuppose the value ascription relationship between the value beholder [6] (an agent who ascribes value to something) and the value object [4,5] (the object of the value beholder's valuation).

[1] E-mail: toyo.fumming@gmail.com, fumiakit@buffalo.edu.

Our exploration has to be limited in scope, partly for space reasons. First, the value object is restricted to economic resources, i.e., the things that can be used to satisfy certain needs in a wide array of economic activities. Typical examples include goods (e.g., cars) and services (e.g., transportation services).[2] Second, we assume that the value beholder is a single individual (e.g., Mary) to avoid further complications added by the cases of collective agents (e.g., companies and organizations), which require extensive research into their relevant features such as group agency [9] and organizational identity [10], although they may be integral to highly developed, complex economic reality.

This paper is devoted to a careful ontological analysis of the value object. Our main claim is that the value object is *primarily* a function which the value beholder believes can be manifested by some capability. One corollary of this is that talk of the value object as another entity (e.g., events) than functions holds in virtue of its implicit but relevant connection with some function. The paper is structured as follows. Section 2 provides preliminary ontological knowledge, especially of ontology of function. Section 3 examines the ontological nature of the value object with a central focus on goods and services. Section 4 extends this functional perspective on the value object to an increasingly important topic in the modern service economy: value (co-)creation. Section 5 concludes the paper with some brief remarks on future work.

2. Preliminaries

For the sake of the anchoring of a general ontological background, we posit some basic categories and relations that are relatively widespread in upper ontologies. Entities fall into two kinds: universals (aka types, classes) and particulars (aka tokens, instances). Particulars (e.g., Mary) bear the instance-of relation to universals (e.g., Human). We speak mainly of particulars in this paper. Particulars fall into two categories: continuants (aka endurants) and occurrents (aka perdurants). Continuants can persist, that is to say, they can exist at one time and also exist at another different time; whereas occurrents (including events) extend through time (typically while having temporal parts). Continuants can be further divided into independent continuants (including objects) and dependent continuants (namely, properties in the broad sense of the term). Independent continuants, or especially objects (e.g., stones) can be bearers of dependent continuants (e.g., hardness) and can participate in occurrents (e.g., a fall of the stone).

Our whole investigation centers around ontology of function. Function remains a nebulous concept despite extensive research in philosophy and formal ontology (see [11] for a general survey). For our present purpose, however, it will suffice to spell out several distinctive features of function that are generally agreed upon in the discussion:

- *(Dependent) Continuant* [11,12]: A function should not be conflated with its manifestation (*functioning*). Functions are (dependent) continuants (contrary to e.g., [13]); whereas, their functionings are occurrents (events). Typically, objects can be bearers of functions. E.g., the heart bears the function to pump blood and its functioning is the event of blood pumping.[3]

[2] In this paper we postulate that there is no marked ontological difference between goods and products, thereby using those two terms interchangeably.

[3] Note that a function may not *inhere in* the entity that is the bearer of the function (see e.g., [14]).

- *Teleology* [15]: A function plays a vital role in explaining the existence of the function bearer. E.g., the function of the heart to pump blood conveys why the heart came into being (through evolutionary processes).
- *Normativity* [15]: The performance of a function bearer can be evaluated normatively (i.e., as good or bad) according to the criterion determined by the function. E.g., we speak of a 'good hammer' when it greatly helps to hit nails.
- *Malfunctioning* [16]: An entity can malfunction: that is to say, the entity can have a function, although it fails to perform according to that function occasionally or even permanently. Malfunctioning should be distinguished from non-functioning. E.g., a light bulb malfunctions when it does not emit light of the expected intensity or consumes more energy than expected.
- *Support* [16]: A function should be, in some sense, 'supported' by the physical structure of the function bearer. E.g., the function of chopsticks to serve as cutlery is supported by their thinness.

3. Value Object

3.1. Goods

Since our study of the value object is restricted to economic resources whose paradigmatic examples are goods and services, we will scrutinize goods and services from an ontological viewpoint and consider carefully what it means to see them as the value objects. First of all, goods fall naturally into the category of objects, as evidenced by their transferability [17,18]. Mary sold her car to her friend James, hence James's ownership of the car, for instance. In addition, goods are typically designed to have functions [18]: e.g., the function of Mary's car to carry a small number of passengers. It is therefore not unreasonable to think that goods count as the value objects in virtue of the value of their functions. James bought Mary's car mainly because its function to carry passengers, but not the appearance of her aging car, stroke him as valuable.

Moreover, the view of the value object as functions of goods meshes well with preceding ontological findings [4-8] on value. For one thing, value is directly affected by the qualities (intrinsic properties) of the value object. Given our hypothesis, this would be well explained by the *Support* feature of functions. For another, value is context-dependent: the same object may have different values to different agents in different scenarios or even according to different desires and goals of the same agent. This would be (partly) explicable in terms of the *Normativity* and *Malfunctioning* attributes of functions. The value of goods would depend heavily upon how well the goods perform their functions, thereby satisfying the value beholder's desires and preferences.

On closer examination it is found that an agent places a premium on functions of goods when she expects their functionings, or especially when she expects someone (her included) to be able to activate those functions. For instance, Mary's car would have no value for James when nobody around him holds a driving license; and he would not have bought it. For another example, Mary found a fire extinguisher valuable and bought it for herself because she thought that she would be able to use it in the case of fire. In ontological parlance, the value beholder assigns value to goods when she finds herself in the situation in which their functions can be manifested when combined with some agent's (e.g., her own) *capability* to activate them.

The ontological nature of a capability is a highly controversial topic, but one possible interpretation is that a capability is a subtype of disposition [19,20]. A disposition is a property that is linked to a realization, namely to a specific possible behavior of an independent continuant that is the bearer of the disposition [21,22]. Classical examples include fragility (the disposition to break when pressed with a certain force) and solubility (the disposition to dissolve when put in a certain solvent). Quite importantly, the term 'disposition' can be read either as a 'predicatory property' or as an 'ontic property' [23]. Predicatory properties are properties that are defined by almost any predicate (e.g., 'is disposed to break'), and the predicatory usage of the term 'property' is an ontologically uncommitted, mere *façon de parler*. Dispositions in their predicatory sense may be thus grounded in laws of nature [24]. Ontic properties are, in contrast, properties with a distinctive ontological role; and the ontic interpretation of the term 'disposition' means a property with dispositional essence (which may be preferably called a '(causal) power' [23]). In this paper we adopt the simpler view that a capability is a disposition in its predicatory (but non-ontic) sense, leaving aside its exact ontological nature.

Going back to the value object, some theorists maintain that the value object is ultimately a *value experience*: the kind of experience that the value beholder envisions with respect to the usage of economic resources (including goods) [5,6,8]. For instance, Mary's car is valuable to James because he imagines the situations in which its use fulfills his desires, e.g., the one where the car brings him to his workplace. In this way, the value of the car for James can be based on his value experiences that relate to his usage of the car. We may be giving a functional understanding of value experiences in the sense that the value beholder can imagine scenarios in which goods satisfy her desires when she recognizes possible manifestations of their functions, paradigmatically because she is herself capable of activating them (informally: of using the goods successfully).

3.2. Services

Let us move onto services. It is generally acknowledged that services are classified as events, as is supported by the fact that they are non-transferable and unownable: e.g., in enjoying transportation services, Mary is paying for non-repeatable events of moving from one place to another [17,18]. Further ontological analysis of services is nevertheless a debatable subject, despite a growing demand for their integrated conception which is expected to promote service marketing and improve public services with the advent of service sciences [25,26] and many attempts (e.g., [27]) to define them explicitly in the economic research. We will first look at some existing ontological accounts of services.

Ferrario and Guarino [17] argue that a "service is present at a time *t* and location *l* iff, at time *t*, an agent is explicitly committed to guarantee the execution of some type of action at location *l*, on the occurrence of a certain triggering event, in the interest of another agent and upon prior agreement, in a certain way." At the core of their conception of services is: "a *commitment* situation in which someone (...) guarantees the execution of some kind of *action(s)* (...) in the interest of somebody who agrees (...), at a certain cost and in a certain way", where "the commitment act can be seen as a *speech act* that most of the times is codified in a *document*, i.e. in an institutional object that can assume many different forms: a contract, an official declaration or deliberation, a service level agreement, etc." To take one of their examples, a fire-and-rescue service exists even though there are no lit fire. We pay for fire-and-rescue-services in order to enable fire fighters to be *prepared* to perform precise actions in case of fire.

While examining critically this commitment-based theory of services, Guarino, Longo and Guizzardi [28] define a (public) service as "an aggregation of all *activities* that realize a public authority's *commitment* to make *available* to individuals, businesses, or other public authorities some *capabilities* intended to answer their *needs*, giving them some possibilities to *control* how and when such capabilities are manifested." They say: "now the commitment does not concern directly the execution of core service actions, but rather the availability of certain capabilities. In this way we can see the actions done to make the service available to customers (…) as proper parts of the service."

In another direction, Sumita, Kitamura, Sasajima and Mizoguchi [29] define a service as "an execution-environmentally situated function (by which they mean "a function that is expected to be nicely executed in the predesigned environment") detached from the function performer from user (customer)'s point of view".[4] Their underlying assumption is that customers are "interested primarily in the quality of the function rather than the function performer." In one of their examples, massage services are typically offered in some massage salons and the customers enjoy them in virtue of their function to help them relax, but not of the masseurs themselves. By comparison, the use of a massage machine at the user's home is not a service (but a mere product function) because the home is not designed for maximizing the effect of the massage machine.

Finally, Smith [18] informally defines services as events for which production and consumption (must) coincide, thereby distinguishing services, which "exists only as it is being delivered," from commodities (or goods, in our terminology) as (manufactured) "things which can be stored, or rented". For instance, a musical performance in a concert hall is a service in virtue of a coincidence between the musical performance and the consumers' experience of it, whereas music in the form of CD is not owing to the temporal interval between its production and its consumption.

Those aforementioned definitions of services would be concordant with our thesis that the value object is primarily a function which the value beholder believes can be manifested by some capability. First, the eventness of services is well explicable in terms of functionings of goods, as is indicated by Sumita et al.'s [29] definition (but see Footnote 4) and Smith's [18] observation that services typically involve goods.[5] Additionally, Guarino et al. [28] state: "Such actual power [to execute the service actions] presupposes having access to the necessary *resources* and having the *freedom* to execute the actions." One of the most plausible candidates for resources deployed in services is arguably goods: e.g., fire extinguishers used in fire-and-rescue-services. Second, as compared to goods (whose functions are usually expected to be activated on the customer's part), services as functionings are paradigmatically enabled by the *provider's* capability to activate them. Guarino et al. [28] focus upon the availability of 'capabilities to honor the service commitment'. Sumita et al.'s [29] emphasis on the

[4] Sumita et al.'s [29] conception of function as "any goal-oriented effect-giving *operation* performed by any kind of agent" (emphasis added) could possibly contradict the *(Dependent) Continuant* feature of functions, but the core of their argument could be well understood on the auxiliary assumption that their term 'function' refers to function*ing* (occurrent) in our terminology.

[5] Guarino et al. [28] claim that "the idea of services as activities relies on the intuition that such activities are typically *ongoing*, and can genuinely change in time by acquiring new temporal parts" and Guarino [30] elaborates upon "a new approach to the ontology of processes" as 'ongoing events'. Their argument for an ontology of processes in the context of services is outside the scope of our exploration. See Toyoshima [31] for a general study of processes in formal ontology.

environment in services would be also clarified in light of the supplier's capability to ameliorate the performance of the function bearer.

One interesting consequence of our argument is that we describe services as valuable when both functions of goods and the provider's capability to activate them work well. and as valueless otherwise, i.e., either when goods malfunction (hence 'services as the malfunctionings') or when the supplier is incapable of utilizing the goods (or both). For instance, fire-and-rescue-services would be of poor quality when there are only broken fire extinguishers available and/or when firefighters are not well-trained enough to have mastery of extinguishers. It is only when excellent firefighters equip themselves with normal extinguishers that fire-and-rescue-services are of great use for us.

4. Value (Co-)Creation

We will finally extend this functional perspective on the value object to the concept of value (co-)creation [1,3] because it is nowadays one of the most important topics in value modeling. In the traditional 'goods-dominant logic' of economy, economic value is created exclusively through the provider's production process (e.g., design, manufacturing, and delivery). In the contemporary 'service-dominant logic', by contrast, economic value is co-created by the manufacturer and the customer: it is determined only when the consumer experiences use value by using goods actually in her own life, although the producer's creation of exchange value may be still an integral part of the process of value co-creation. Furthermore, value co-creation exhibits itself more perspicuously when the provider has a dialogical interaction with the customer, irrespective of whether it is direct or indirect [3].

To ontologize value (co-)creation, we introduce the distinction between design and use functions [14]. The design function is the function of an artifact that is produced with the plan to be used for its performance: e.g., the function of a screwdriver to turn screws. The use function is the function of an object that the user actually uses for its performance: e.g., the function of the screwdriver to open paint cans when Mary employ it for her use purpose. Thus, the design and use functions of an object are essential and accidental to the object in the sense that the object would cease and continue to exist if it *lacked* (rather than failing to perform) the design and use functions, respectively [15]. It should be admitted that the notion of use function is problematic from an ontological point of view. For one thing, it is highly contentious whether the use function can be taken with ontological seriousness because it would fail to meet the *Teleology* desideratum. For another, it may be difficult to draw clear lines of demarcation between design and use functions [32]. We will however exploit the concept of use function and the design-use distinction between functions for the sake of our argument.

It is generally agreed that use functions fall most suitably into the category of roles [11,14,33]. Roles are nonetheless so mysterious in formal ontology in general [34] that one may find multiple interpretations of the role concept even in upper ontologies [35,36]. We postulate in this paper only a few comparatively uncontroversial features of roles:

- *Playability*: A role can be played (in the predicatory sense of the term) by something ('player'). E.g., Mary can play a student role.
- *Temporariness/Contingency/Accidentality*: Role-playing is a temporary (time-relative), contingent, and accidental phenomenon. Compare Mary's playing of

a student role with, e.g., the fact that Mary is a human, the latter being a permanent (time-insensitive), necessary, and essential matter.[6]

- *Linkage with contexts*: A role is intimately connected to contexts (see e.g., [38,39] careful consideration of contexts). E.g., Mary plays a student role in the context of the ABC school.

For instance, the use function of a screwdriver to open Mary's paint cans is to be conceptualized as a role that is played by the screwdriver in her 'use context' [14], namely in a specific scenario in which she is accidentally using it to open pain cans. In ontology of value, we often speak of social roles [40] (e.g., consumers) because the value beholder's social roles influence greatly the value ascription relationship [5]; but note that the use function as a role is not social in this sense of the term.

Value (co-)creation would be well explained by the provider's design function and the customer's use functions. In the goods-centered society, the consumer's (and simultaneously the value beholder's) use functions of goods is basically identical with the supplier's design function of the goods, and the latter is the main value object. Contemporary service economy however sees a growing discrepancy between the design and use functions of goods. The purchaser (including the service provider) may be creative enough to invent a new usage of the same goods and she tends to assign value to their use functions rather than their original design function. This does not entail the devaluation of the manufacturer's design function of goods, however, because it constitutes the essential nature of the goods (recall the *Teleology* property of functions), which the consumer's use function of them depends entirely upon (just as, e.g., Mary can play a student role only in virtue of her humanity). In this respect, value in the service system is co-created, i.e., created both by the provider's design function (which determines the essence) of goods and by the customer's use function (namely, her value object) of the goods.

5. Conclusion

In summary, we submitted that, insofar as it is economic resources (goods and services), the value object is primarily a function which the value beholder believes can be manifested by some capability. More specifically, goods and services count as the value object typically because they are objects having functions that can be manifested by the consumer's capability to activate them and because they are functionings of goods that are enabled by the provider's capability to do so, respectively. We also extended this functional view of the value object to the concept of value (co-)creation, thereby arguing that value (co-)creation would be interpretable in terms of the goods supplier's design function and the customer's use function of the goods.

There are a number of directions of research in which our functional ontology of value can proceed. In particular, we will be able to develop an effective strategy for modeling value as we take more specific ontological assumptions, e.g., some established upper ontologies such as Basic Formal Ontology (BFO) [41], the Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE) [42], and the Unified Foundational Ontology (UFO) [43]. Since our ontology of the value object implies an inextricable link

[6] To keep things manageable, we are ignoring a conceptual discrepancy between necessity and essentiality [37].

between functions of goods and an agent's capability to activate them, for instance, one may formalize the value object in terms of reciprocal dispositions [44], assuming that a function is a special kind of disposition ([33]; but see [11,45] for criticism). Closer investigation is also warranted into the extension of our functional construal of value to ontology of risk because an intimate interrelationship between value and risk has been pointed out previously [8,46]. Finally, it is well worth examining the relationship between our functional approach to value and an existing model of services [47] that is based on the Resource-Event-Agent (REA) ontology [48] in which business processes are modeled upon the exchange of resources between agents. This task is expected to contribute to further development of the REA ontology (see e.g., [49]).

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