

From artefacts to products

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FOMI 2006

Trento, 15 Dec. 2006

Goal

To propose ontologically founded formalizations of the notions

▷ **artefact**

▷ **product**

(This means to deal with related notions as well,
e.g., *capacity* of an object and *residue* of an intentional process)

Perspective

- ▷ We focus on ontological aspects and, after making some basic choices, we elaborate a proposal.

The aim is not to provide a definitive (or comprehensive) definition, nor to claim that one view is better than others. It is to show how to capture basic intuition in a precise way.

[There are *possible (and valuable)* alternatives but we need the right level of precision to begin a consistent comparison and to relate them.]

- ▷ In particular, we

- 1) *limit* our work to a specific class of entities
- 2) explicitly adopt a specific *ontological framework*.

Is this work really needed? (1)

- ▷ well... ontology, interoperability, semantic clearness...
- ▷ what is a product?
 - ▷ *Oxford Dictionary*: product = “a thing that is grown or produced, usually for sale” and “a thing produced during a natural, chemical or industrial process.”
 - ▷ *Wikipedia*: “in marketing, a product is anything that can be offered to a market that might satisfy a want or need” and “it is the complete bundle of benefits or satisfactions that buyers perceive they will obtain if they purchase the product. It is the sum of all physical, psychological, symbolic, and service attributes.”

Is this work really needed? (2)

- ▷ *WordNet*: “commodities offered for sale” and “an artifact that has been created by someone or some process.”
- ▷ *Enterprise Ontology*: “the *ROLE* of the good, service, or quantity of money that is: offered *FOR SALE* by the *VEN-DOR* –or– agreed to be exchanged [...]” with a proviso: “[...] possible confusion with the use of the term ‘product’ when referring to something produced/manufactured but which is not sold[...]”
- ▷ *SUMO*: (documentation Product ”An Artifact that is produced by Manufacture.”)

Is this work really needed? (3)

- ▷ *OpenCyc*: “Each instance of Product is a TemporalThing that is, or was at one time, offered for sale or performed as a commercial service, or was produced with the intent of being offered for sale. Positive examples of Product: [excerpt]
- a barrel of crude oil being shipped to a customer;
 - a purchased automobile after it has been driven for years;
 - a professional plumber installing a new sink.
- Negative examples of Product include:
- some natural crude oil lying in the ground;
 - an automobile prototype developed by a car company for testing purposes;
 - a do-it-yourselfer installing a new sink in his or her house.”

Framework

- ▷ We work within the foundational ontology DOLCE
- ▷ and assume that an ontology of *social reality* and *mental states* is given (as an extension of DOLCE, today, this is true only in part).

In particular, this work depends on an ontology that can formalize groups of agents and their social relationships, actions and social entities like contracts and organizations.

Restriction of the topic

- ▷ At this time we limit our work to *single physical objects* (concrete entities, *PED*) like, for instance, pieces of glass or plastic (*M*), pens and chairs (*POB*) and similar objects. More precisely, we do not deal with:
- non-physical objects: *concepts, judgments, laws, melodies*;
 - abstract entities like *sets* and *numbers*;
 - agentive entities like *organizations, intended babies, bred animals, genetically modified organisms*;
 - features like *corners* of a table, *bumps* on the road;
 - and events in general (*order executions, wars, performances*)

Plan

We start from **A**rtefact and use this notion to define **P**roduct.

Further Basic Assumptions

- ▷ Artefacts are here seen as objects *essentially* based on intentionality
 - *bare artefact*: only based on the (private) intention of its creator
 - *social artefact*: bare artefact which is socially recognized as such [Dipert]
- ▷ Intention to obtain an entity for some purpose
 - Not necessarily intention to modify or process some existing entity, or produce something materially new:
 - artefact $\not\equiv$ artificial
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- ▷ Mental attitudes play a role indirectly (“creation” event)

Intentional Selection

- ▷ Suppose that, at the sea, I spot a pebble, thinking “that’s going to make a nice paper weight for my office”, and I pick it up.
- There are not thousands of paper-weights at the sea. The paper-weight is not the pebble, it is (specifically) *constituted* by the pebble.
 - The paper-weight is *created* when I form the intention to use the pebble as a paper-weight which, in this approach, means that I *select* the pebble for some paper-weight capacity.

Intentional Selection (2)

- ▷ The distinction between the pebble and the paper-weight via a (set of) selected capacity gives room to define:
- malfunctioning artefacts
e.g., pumice paper-weight: the selected capacity/ies is not among the object capacities
 - broken artefacts
when the entity evolves loosing some of those capacities which are part of the selected capacity

Capacity

- ▷ Capacity is here seen as an objective (individual) property
- ▷ A regularity in behaviour: under such and such circumstances, the entity behaves in such and such a way
 - Related to the notion of *behaviour*
 - Also called *disposition* in the literature
- ▷ Individual, dependent on its bearer: a *quality* in DOLCE terms
- ▷ *The* capacity of an entity is actually the set all capacities/dispositions the entity has.
 - At any given time, it is related to a position (valuation or quale) in the *capacity space*. This position (a *region*) is the fusion of all atomic capacity-quale the entity has.

Selected capacity

- ▷ The selected capacity of an entity is a quality that does *not* change in time:
it is fixed once for all by the creator when the artefact is created.
 - If there is a new selection, another artefact is born.
- ▷ Generally it corresponds to a *set* of regions in the capacity space as the selected capacity is usually not fully specified
 - The pebble I have picked up for a paper-weight is chosen for the weight, shape and size which fit within a certain *range*, not for the exact weight, shape and size it has.
- ▷ It is typically a *sub-region* of the actual capacity quale
 - The creator of a pen has not selected the pen disposition to make a certain noise when crashed with a hammer
(*Typically*, because the pen might be flawed)

Social Recognition

- ▷ The paper-weight becomes a *proper* or *social* artefact when one can tell, e.g., from the fact that it is sitting on my desk on top of a pile of papers, that someone *must* have intentionally selected it as a paper-weight.
 - *Intrinsic Social Artefacts*: Structure- and material-based recognition (knives, cars)
 - *Contextual Social Artefacts*: Context- or use-based recognition (pebble / paper weight)
- ▷ Recognition is not a kind of intentional selection; the intention is attributed to someone else, possibly unknown
 - Recognition can be *erroneous*.

Bare Artefacts - definition

$$BareArt(x) =_{def} \exists e, p, y, q \textit{IntentionalSel}(e, p, x, y, q)$$

e: creation event

p: creator

x: material entity constituting the artefact

y: artefact

q: selected capacity

p is a single agent or a group (a society); e is an instantaneous event or an achievement event; y is matter or a physical non-agentive physical object; x is constantly and specifically constituted by y ; furthermore x , y , and p are participants of e .

Social Artefacts

- ▷ Selected capacity q of artefact x is recognizable by society s at time t

$$Recognizable(q, x, s, t) \rightarrow (BareArt(x) \wedge SelectedCap(q) \wedge qt(q, x) \wedge SC(s) \wedge PRE(x, t))$$

- ▷ Defining Recognizable...

▷ $SocialArt(x, s) =_{def}$
 $BareArt(x) \wedge \exists q \forall t (PRE(x, t) \rightarrow Recognizable(q, x, s, t))$

Product: a definition

The key element that distinguishes products from simple artefacts is the ‘exchange purpose’.

Given a society s , a physical endurant x and a time t , we define x to be a product at t when:

$$\begin{aligned} &Product(x, s, t) =_{def} \\ &\exists e, a, b, t' (SocialArt(x, s) \wedge PRE(x, t) \wedge Creation(e, x) \wedge \\ &ql_T(t', e) \wedge Creator(a, x) \wedge Int_{a,t'} \exists e' b' t'' (Exchange(e', a, b', x) \wedge \\ &ql_T(t'', e') \wedge t' < t'') \wedge Int_{b,t} \exists e' b' t'' (Exchange(e', b, b', x) \wedge \\ &ql_T(t'', e') \wedge t < t'')) \end{aligned}$$

Manufactured Product: a definition

Given a predicate $IntentionalProc(e, a, x, y)$ for
“event e is the intentional processing by agent a of entity y to
obtain entity x ”

A manufactured product is then:

$$\begin{aligned} ManProduct(x, s, t) =_{def} \\ Product(x, s, t) \wedge \exists e, e', a, y, z, q, t', t'' (ql_T(t', e) \wedge ql_T(t'', e') \\ \wedge IntentionalSel(e, a, x, y, q) \wedge IntentionalProc(e', a, y, z) \wedge \\ \neg t' < t'') \end{aligned}$$

Malfunctioning products

This notion of product (and already that of artefact) includes malfunctioning or even failed products. A product is malfunctioning at some time t if at that time the entity does not possess all the capacities selected for it.

$$\begin{aligned} MalFunctioningProduct(x, s, t) =_{def} & Product(x, s, t) \wedge \forall q, q', v, v', t \\ & qt(q', x) \wedge SelectedCap(q) \wedge Capacity(q') \wedge ql(v, q, t) \wedge \\ & ql(v', q', t) \wedge IN(w, v)) \rightarrow \neg P(w, v') \end{aligned}$$

- ▷ Note: the product inherits the capacities of the constituent
- ▷ The artefact may have *more* capacities than the constituting entity

Residues vs Products

- ▷ The (intentional) creation of a product comes often together with an event of physically creating the product (and the underlying entity).

However, not all intentionally processed entities yield artefacts (sawdust).

- ▷ A *residue* is an entity that has been processed and that does not constitute a product (nor an artefact).

$$\begin{aligned} \textit{Residue}(x) &=_{\textit{def}} \\ \neg \textit{BareArt}(x) \wedge \exists e, y, a \textit{IntentionalProc}(e, a, x, y) \end{aligned}$$

Product Types

- ▷ Here product types are defined to be concepts (endurants) based on a *prototype*. All products classified by p have a selected capacity matching that of the prototype.

the products themselves can exist at different times; the type is time-independent.

$CF(x, y, t)$ stands for “at t , x satisfies all the constraints stated in the description defining concept y ”.

$$\begin{aligned} ProductType(p, s) =_{def} \\ \forall x, t (CF(x, p, t) \rightarrow Product(x, s, t)) \wedge \exists x, t, q_x, v_x (CF(x, p, t) \\ \wedge SelectedCap(q_x) \wedge qt(q_x, x) \wedge ql(v_x, q_x, t) \wedge \forall y, t' (CF(y, p, t') \\ \leftrightarrow \exists q_y, v_y (qt(q_y, y) \wedge Product(y, s, t') \wedge SelectedCap(q_y) \wedge \\ ql(v_y, q_y, t') \wedge \forall w_y (IN(w_y, v_y) \rightarrow \exists w_x (IN(w_x, v_x) \wedge \\ P(w_x, w_y)))))) \end{aligned}$$

Open issues

This is work in progress...

and there are many issues to discuss further.

In the future, we will concentrate our attention to:

- ▷ ontological description of what ‘capacities’ are and how capacity spaces are organized
- ▷ death of artefacts (when does an artefact cease to exist?)

Basic references for this approach

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