# Issue 643: P156 occupies & P7 took place at –inverse shortcuts

CEO walked the SIG through the HW he prepared –an exploration of the inferences that can be drawn from instances of P156 occupies and P7 took place at. The details of the HW (graphical representation that matches the FOL statements) can be found [here](https://cidoc-crm.org/Resources/p7-p156-as-inverse-shortcuts).

**Discussion points**:

## In general:

* The SIG needs to determine if any unidirectional implication expressed in some property’s FOL can be called a “shortcut”, irrespective of its complexity, or if the term can only be applied to straightforward paths. To be discussed in [issue 655](https://cidoc-crm.org/Issue/ID-655-what-kind-of-inferences-count-as-instances-of-shortcut-properties) and to be brought at the next SIG meeting for discussion.
**HW**: CEO, WS, MD

## Wrt. P7 took place at:

* The complexity of the axiom wrt. the instance of E18 that provides the reference space of an instance of E4 Period makes people reluctant to call it a shortcut (which to everyone’s understanding should form a straightforward path). Maybe it’s an implication after all and not a shortcut.
* The relation between any two instances of E53 Place, entails that the places in question need to have been defined in the same reference space.
* Any given place can be defined wrt to more than one reference space (f.i., in the case of nested reference spaces)
* The inference that one can draw from *P7 took place at* can be summed as follows:
IF it has been documented that an instance of E4(x) Period *took place at* an instance of E53(y) Place (i.e: E4(x).P7:E53(y)),
THEN (based on the *spatial projection* of E4(x) to an E53(z) Place –P161(z,x)) one can deduce that the instance of E53(z) Place *P89 falls within* the instance of E53 (y) (i.e., E53(z).P189(z,y):E53(y).
	+ This calls for enhancing the scope note of P89 falls within, but it should be done in [issue 656](https://cidoc-crm.org/Issue/ID-656-reformulate-the-scope-note-of-p89-falls-within).

**Decisions:**

* leave the scope note for P7 took place at as is, do not declare it an inverse shortcut.
* Enhance the scope note and FOL of P89 (new issue [656](https://cidoc-crm.org/Issue/ID-656-reformulate-the-scope-note-of-p89-falls-within))
* Start a new issue (see: [655](https://cidoc-crm.org/Issue/ID-655-what-kind-of-inferences-count-as-instances-of-shortcut-properties)) on the complexity of axioms that constitute shortcuts

## Wrt P156 occupies

**Decisions**:

* Do not make P156 an inverse shortcut either (especially seeing as the inference is bidirectional)
* Change the scope note to make sure that either side of the axiom implies the other (“is equivalent to”). The details of the decision can be found [below](#_P156_scope_note).

### P156 scope note adjustment

#### (NEW)

**P156 occupies (is occupied by)**

Domain:

[E18](#_toc7650) Physical Thing

Range:

[E53](#_toc8104) Place

Subproperty of:

[E18](#_toc7650) Physical Thing. [P53](#_toc9768) has former or current location (is former or current location of): [E53](#_toc8104) Place

[E18](#_toc7650) Physical Thing. [P157](#_toc11276)i provides reference space for: [E53](#_toc8104) Place

Quantification:

many to one (0,1:0,n)

Scope note:

This property describes the largest volume in space, an instance of E53 Place, that an instance of E18 Physical Thing has occupied at any time during its existence, with respect to the reference space relative to the physical thing itself. This allows for describing the thing itself as a place that may contain other things, such as a box that may contain coins. In other words, it is the volume that contains all the points which the thing has covered at some time during its existence. The reference space for the associated place must be the one that is permanently at rest (*P157 is at rest relative to)* relative to the physical thing. For instances of E19 Physical Objects it is the one which is at rest relative to the object itself, i.e., which moves together with the object. For instances of E26 Physical Feature it is one which is at rest relative to the physical feature itself and the surrounding matter immediately connected to it. Therefore, there is a 1:1 relation between the instance E18 Physical Thing and the instance of E53 Place it occupies. We include in the occupied space the space filled by the matter of the physical thing and all its inner spaces.

This property is equivalent to the fully developed path from E18 Physical Thing through *P196 defines,* E92 Spacetime Volume, *P161 has spatial projection* to E53 Place. However, in contrast to *P156 occupies,* the property *P161 has spatial projection* does not constrain the reference space of the referred instance of E53 Place.

In contrast to *P156 occupies*, for the property *P53 has former or current location* the following holds:

It does not constrain the reference space of the referred instance of E53 Place.

It identifies a possibly wider instance of E53 Place at which a thing is or has been for some unspecified time-span.

If the reference space of the referred instance of E53 Place is not at rest with respect to the physical thing found there, the physical thing may move away after some time to another place and/or may have been at some other place before. The same holds for the fully developed path from E18 Physical Thing through *P196 defines*, E92 Spacetime Volume, *P161 has spatial projection* to E53 Place.

Examples:

* The Saint Titus reliquary(E22) *occupies* the space of the Saint Titus reliquary (E53). [The reliquary is currently kept in the Saint Titus Church in Heraklion, Crete since 1966 and contains the skull of Saint Titus.] (Fisher & Garvey, 2010)
* Burg Eltz near Koblenz, Germany (E24) *occupies* the space within the 1661AD outer walls of Burg Eltz (E53). [The castle (English name: Eltz Castle) underwent a series of expansions starting in the 12th century until it reached its current extent in 1661AD and contains buildings from various periods.]

In first-order logic:

P156(x,y) ⇒ E53(y)

P156(x,y) ⇒ E18(x)

P156(x,y) ⇔ (∃z) [E18(x) ∧ E53(y) ∧ P196(x,z) ∧ P161(z,y) ∧ P157(y,x)]

#### (OLD)

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Domain:

[E18](#_toc7650) Physical Thing

Range:

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Subproperty of:

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This property describes the largest volume in space, an instance of E53 Place, that an instance of E18 Physical Thing has occupied at any time during its existence, with respect to the reference space relative to the physical thing itself. This allows for describing the thing itself as a place that may contain other things, such as a box that may contain coins. In other words, it is the volume that contains all the points which the thing has covered at some time during its existence. The reference space for the associated place must be the one that is permanently at rest (*P157 is at rest relative to)* relative to the physical thing. For instances of E19 Physical Objects it is the one which is at rest relative to the object itself, i.e., which moves together with the object. For instances of E26 Physical Feature it is one which is at rest relative to the physical feature itself and the surrounding matter immediately connected to it. Therefore, there is a 1:1 relation between the instance E18 Physical Thing and the instance of E53 Place it occupies. We include in the occupied space the space filled by the matter of the physical thing and all its inner spaces.

This property implies the fully developed path from E18 Physical Thing through *P196 defines,* E92 Spacetime Volume, *P161 has spatial projection* to E53 Place. However, in contrast to *P156 occupies,* the property *P161 has spatial projection* does not constrain the reference space of the referred instance of E53 Place.

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In first-order logic:

P156(x,y) ⇒ E53(y)

P156(x,y) ⇒ E18(x)

P156(x,y) ⇔ (∃z) [E18(x) ∧ E53(y) ∧ P196(x,z) ∧ P161(z,y) ∧ P157(y,x)]