

# BFO 2020 Specific Dependency Axioms

Inheres in and bearer of are inverse relations [dzz-1]

$$\forall a,b (\text{inheresIn}(a,b) \leftrightarrow \text{bearerOf}(b,a))$$

Realizes and has realization are inverse relations [pvk-1]

$$\forall a,b (\text{realizes}(a,b) \leftrightarrow \text{hasRealization}(b,a))$$

Has material basis and material basis of are inverse relations [tla-1]

$$\forall t,a,b (\text{hasMaterialBasis}(a,b,t) \leftrightarrow \text{materialBasisOf}(b,a,t))$$

Specifically depends on and specifically depended on by are inverse relations [yct-1]

$$\forall a,b (\text{specificallyDependsOn}(a,b) \leftrightarrow \text{specificallyDependedOnBy}(b,a))$$

When a role is realized the bearer of the role participates in the realization process [grx-1]

$$\forall r,p,b (\text{realizes}(p,r) \wedge \text{inheresIn}(r,b) \rightarrow \exists t \text{ participatesIn}(b,p,t))$$

Has material basis is disjunctive on third argument, a temporal region [hnl-1]

$$\forall p,q,r,s (\text{hasMaterialBasis}(p,q,r) \wedge \text{temporalPartOf}(s,r) \rightarrow \text{hasMaterialBasis}(p,q,s))$$

Realizes has domain process and range realizable entity [oot-1]

$$\forall a,b (\text{realizes}(a,b) \rightarrow \exists t \text{ instanceOf}(a,\text{process},t) \wedge \exists t \text{ instanceOf}(b,\text{realizableEntity},t))$$

Specifically depends on is transitive [myu-1]

$$\forall a,b,c (\text{specificallyDependsOn}(a,b) \wedge \text{specificallyDependsOn}(b,c) \wedge a \neq c \rightarrow \text{specificallyDependsOn}(a,c))$$

If s depends on c then s and c never share common parts (s,c continuants) [nfe-1]

$$\forall s,c (\text{specificallyDependsOn}(s,c) \rightarrow \neg (\exists w,t (\text{continuantPartOf}(w,s,t) \wedge \text{continuantPartOf}(w,c,t))))$$

A realizable entity exists at least at the beginning of the realization process [vhg-1]

$$\forall r,p (\text{realizes}(p,r) \rightarrow \exists \text{proct,first} (\text{occupiesTemporalRegion}(p,\text{proct}) \wedge \text{hasFirstInstant}(\text{proct,first}) \wedge \text{existsAt}(r,\text{first})))$$

Has material basis is time indexed and has domain: disposition and range: material entity [cfs-1]

$$\forall a,b,t (\text{hasMaterialBasis}(a,b,t) \rightarrow \text{instanceOf}(a,\text{disposition},t) \wedge \text{instanceOf}(b,\text{materialEntity},t) \wedge \text{instanceOf}(t,\text{temporalRegion},t))$$

If s depends on c then there's at least one time when they both exist and whenever s exists, c must also exist [iyu-1]

$$\forall s,c (\text{specificallyDependsOn}(s,c) \rightarrow (\exists t (\text{existsAt}(s,t) \wedge \text{existsAt}(c,t))) \wedge (\forall t (\text{existsAt}(s,t) \rightarrow \text{existsAt}(c,t))))$$

No role changes type during its existence [bks-1]

$$\forall o (\exists t \text{ instanceOf}(o,\text{role},t) \rightarrow \forall u (\exists t \text{ instanceOf}(o,u,t) \rightarrow \forall t (\text{instanceOf}(o,\text{role},t) \leftrightarrow \text{instanceOf}(o,u,t))))$$

DEFINITION: b is a relational quality = Def. b is a quality and there exists distinct c and d such that at all times t, b inheres in c if and only b specifically depends on. [dbp-1]

$$\forall b (\exists t \text{ instanceOf}(b,\text{relationalQuality},t) \leftrightarrow (\exists c,d (c \neq d \wedge \text{inheresIn}(b,c) \wedge \text{specificallyDependsOn}(b,d)) \wedge \exists t \text{ instanceOf}(b,\text{quality},t)))$$

A inheres\_in b = Def. a is a specifically dependent continuant and b is an independent continuant that is not a spatial region and a depends\_on b. [tht-1]

$$\forall a,b (\text{inheresIn}(a,b) \leftrightarrow \text{specificallyDependsOn}(a,b) \wedge (\exists t (\text{instanceOf}(a,\text{specificallyDependentContinuant},t) \wedge \text{instanceOf}(b,\text{independentContinuant},t) \wedge \neg \text{instanceOf}(b,\text{spatialRegion},t))))$$

Definition of specifically dependent continuant. [akq-1]

$$\begin{aligned} &\forall s (\exists t \text{instanceOf}(s, \text{specificallyDependentContinuant}, t) \\ &\quad \leftrightarrow \exists c, t (\text{instanceOf}(s, \text{continuant}, t) \wedge \text{instanceOf}(c, \text{independentContinuant}, t) \\ &\quad \wedge \neg \text{instanceOf}(c, \text{spatialRegion}, t) \wedge \text{specificallyDependsOn}(s, c))) \end{aligned}$$

The material basis of a disposition is part of the bearer of the disposition [uxo-1]

$$\begin{aligned} &\forall m, d, b (\exists t \text{instanceOf}(m, \text{materialEntity}, t) \wedge \exists t \text{instanceOf}(d, \text{disposition}, t) \\ &\quad \wedge \exists t \text{instanceOf}(b, \text{materialEntity}, t) \wedge \text{inheresIn}(d, b) \\ &\quad \rightarrow \forall t (\text{hasMaterialBasis}(d, m, t) \rightarrow \text{continuantPartOf}(m, b, t))) \end{aligned}$$

Specifically depends on has domain specifically dependent continuant and range specifically dependent continuant or independent continuant but not spatial region [kkl-1]

$$\begin{aligned} &\forall a, b (\text{specificallyDependsOn}(a, b) \\ &\quad \rightarrow \exists t \text{instanceOf}(a, \text{specificallyDependentContinuant}, t) \\ &\quad \wedge (\exists t (\text{instanceOf}(b, \text{specificallyDependentContinuant}, t) \\ &\quad \vee (\text{instanceOf}(b, \text{independentContinuant}, t) \\ &\quad \wedge \neg \text{instanceOf}(b, \text{spatialRegion}, t)))))) \end{aligned}$$

At every time a specific dependent s participates in a process p there's a part of that time, during which there's an independent continuant that s depends on, and that participates in p at that time [cgn-1]

$$\begin{aligned} &\forall sdc, p, t (\text{instanceOf}(sdc, \text{specificallyDependentContinuant}, t) \wedge \text{participatesIn}(sdc, p, t) \\ &\quad \rightarrow \exists tp, ic (\text{instanceOf}(tp, \text{temporalRegion}, tp) \wedge \text{temporalPartOf}(tp, t) \\ &\quad \wedge \text{instanceOf}(ic, \text{independentContinuant}, tp) \\ &\quad \wedge \neg \text{instanceOf}(ic, \text{spatialRegion}, tp) \wedge \text{specificallyDependsOn}(sdc, ic) \\ &\quad \wedge \text{participatesIn}(ic, p, tp))) \end{aligned}$$
