

Supplement 1 to

"Conceptual Modeling in Systems Biology Fosters Empirical Findings: The mRNA Lifecycle"

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Elements of the Object-Process Methodology Language

ENTITIES



STRUCTURAL LINKS & COMPLEXITY MANAGEMENT



ENABLING AND TRANSFORMING PROCEDURAL LINKS



EVENT, CONDITION, AND INVOCATION PROCEDURAL LINKS



ENTITIES		ENTITIES	
Name	Symbol	OPL	Definition
Things	<p>Object</p> <p>Object A</p> <p>Process D</p> <p>Process</p> <p>B</p> <p>E</p> <p>C</p> <p>F</p>	<p>B is physical. (shaded rectangle)</p> <p>C is physical and environmental. (shaded dashed rectangle)</p> <p>E is physical. (shaded ellipse)</p> <p>F is physical and environmental. (shaded dashed ellipse)</p>	<p>An object is a thing that exists.</p> <p>A process is a thing that transforms at least one object.</p> <p>Transformation is object generation or consumption, or effect—a change in the state of an object.</p>
	<p>State</p> <p>A</p> <p>s1</p> <p>B</p> <p>s1 s2</p> <p>C</p> <p>s1 s2 s3</p>	<p>A is s1.</p> <p>B can be s1 or s2.</p> <p>C can be s1, s2, or s3. s1 is initial. s3 is final.</p>	<p>A state is situation an object can be at or a value it can assume.</p> <p>States are always within an object.</p> <p>States can be initial or final.</p>

STRUCTURAL LINKS & COMPLEXITY MANAGEMENT



Name	Symbol	OPL	Semantics
Fundamental Structural Relations		A consists of B and C .	A is the whole, B and C are parts.
		A exhibits B , as well as C .	Object B is an attribute of A and process C is its operation (method). A can be an object or a process.
		B is an A . C is an A .	A specializes into B and C. A, B, and C can be either all objects or all processes.
	B is an instance of A . C is an instance of A .	Object A is the class, for which B and C are instances. Applicable to processes too.	
Unidirectional & bidirectional tagged structural links		A relates to B . (for unidirectional) A and C are related. (for bidirectional)	A user-defined textual tag describes any structural relation between two objects or between two processes.
In-zooming		A exhibits C . A consists of B . A zooms into B , as well as C .	Zooming into process A, B is its part and C is its attribute.
		A exhibits C . A consists of B . A zooms into B , as well as C .	Zooming into object A, B is its part and C is its operation.

ENABLING AND TRANSFORMING PROCEDURAL LINKS



Name		Symbol	OPL	Semantics
Enabling links	Agent Link		A handles B .	Denotes that the object is a human operator.
	Instrument Link		B requires A .	"Wait until" semantics: Process B cannot happen if object A does not exist.
	State-Specified Instrument Link		B requires s1 A .	"Wait until" semantics: Process B cannot happen if object A is not at state s1.
Transforming links	Consumption Link		B consumes A .	Process B consumes Object A.
	State-Specified Consumption Link		B consumes s1 A .	Process B consumes Object A when it is at State s1.
	Result Link		B yields A .	Process B creates Object A.
	State-Specified Result Link		B yields s1 A .	Process B creates Object A at State s1.
	Input-Output Link Pair		B changes A from s1 to s2 .	Process B changes the state of Object A from State s1 to State s2.
	Effect Link		B affects A .	Process B changes the state of Object A; the details of the effect may be added at a lower level.

EVENT, CONDITION, AND INVOCATION PROCEDURAL LINKS



Name	Symbol	OPL	Semantics
Instrument Event Link		A triggers B . B triggers A .	Existence or generation of object A will attempt to trigger process B once. Execution will proceed if the triggering failed.
State-Specified Instrument Event Link		A triggers B when it enters s1 . B requires s1 A .	Entering state s1 will attempt to trigger the process once. Execution will proceed if the triggering failed.
Consumption Event Link		A triggers B . B consumes A .	Existence or generation of object A will attempt to trigger process B once. If B is triggered, it will consume A. Execution will proceed if the triggering failed.
State-Specified Consumption Event Link		A triggers B when it enters s2 . B consumes s2 A .	Entering state s2 will attempt to trigger the process once. If B is triggered, it will consume A. Execution will proceed if the triggering failed.
Condition Link		B occurs if A exists.	Existence of object A is a condition to the execution of B. If object A does not exist, then process B is skipped and regular system flow continues.
State-Specified Condition Link		B occurs if A is s1 .	Existence of object A at state s2 is a condition to the execution of B. If object A does not exist, then process B is skipped and regular system flow continues.
Invocation Link		B invokes C .	Execution will proceed if the triggering failed (due to failure to fulfill one or more of the conditions in the precondition set).