Chapter VII
Processes, Events, and Temporal Relationships

ABSTRACT

A process is a relationship that involves the flow of time. It is an irreducible fact about sequences in time. Processes are objects that cause change. Change involves time, and time involves events. Events have effects—effects that change states of objects and relationships. This is how processes are agents of change.

"The past not only contains, in its depths, the unrealized future, but in part the realized future itself"
- Tagore, Nobel laureate and Bengali Poet

In order to understand Process, we must understand the temporal nature of relationships and the properties that flow from the place where time and event meet relationships and objects.[1] The scope of our metamodel is restricted to discrete change; all relationships, temporal or not, must relate not just object instances to object instances, but also time slices of object instances to time slices of object instances. Figure 7.1 shows this concept and the distinction between temporal and nontemporal relationships.

The time slices in Figure 7.1 are identical to those in Figure 4.5. Relationships may not only exist between object instances but may also occur between time slices of object instances.

Figure 7.1 shows this fact. A temporal relationship is between time slices at different points in time; a nontemporal relationship is a relationship between contemporary time slices. Temporal and nontemporal relationships may be between the same or different object instances, and these object instances may belong to the same or different object classes.

The sweep of time makes temporal relationships special. Time cannot reverse itself. The direction of a temporal relationship carries more information than the nontemporal relationships of Chapter V. It carries information about the flow of time, about cause and effect. Temporal relationships are a subclass of relationships—a

Figure 7.1. Temporal and nontemporal relationships
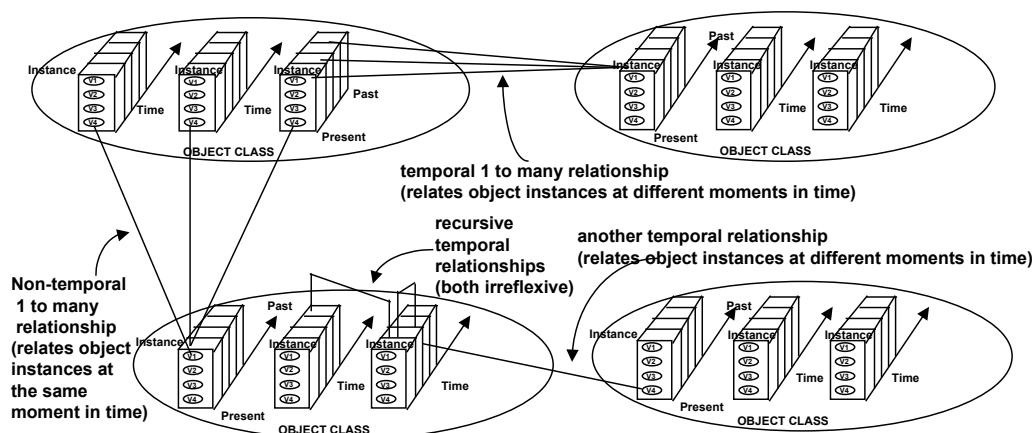
subclass that recognizes the flow of time and its irreversibility. They inherit the properties of nontemporal relationships and add temporal properties. They add the tide of time.

"Having written, the moving finger moves on"; no effect may change the past. States of time slices past are cast in stone, as are relationships between time slices in the past. However, the past can affect the present—and the future. Relationships between time slices present and past are mutable by events and effects, like any other relationship we have discussed thus far, but we must now consider their temporal dimensions as well. Taken together, they are properties of processes because temporal relationships are processes.

A temporal relationship is a process because it is a bridge across time built on causality.[2] Causality connects causes (objects) in the past to consequences (objects) in the present (or future); a process connects resources in the past to products in the present (or future). Processes are a polymorphism of causality. The meaning of Process conveys a little more information than cause and consequence. It also tells us that resources are used to produce products. Both resources and products are objects, but resources precede products, and processes are the causal link across time that

connect them—processes like Bake Cookie that turn dough into cookies.

RESOURCES AND WORK PRODUCTS

Bake Cookie is a temporal relationship between *Dough* and *Cookie* (ignoring the request for fresh cookies for the moment). *Dough* and *Cookie* are object classes. *Dough* comes first, and *Cookie* follows. *Bake Cookie* connects *Dough* in the past to *Cookie* in the present. *Dough* is a resource and *Cookie* is its work product. The objects that come before in temporal relationships are resources, and those that come later are products; they could be byproducts and waste products as well, which we will discuss later in this chapter.

Resources may be consumed by the process (as dough is) to make cookies or may only be needed for reference (or for other purposes that do not consume the resources). Resources that are not consumed are *catalysts* for the process. For example, the recipe for baking cookies is a resource (although it has not been shown in Figure 7.2a) that it is not consumed by the process, like the dough was. Similarly the cook is a resource

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