

# Business Process Modeling with EPC and UML Transformation or Integration?

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**Abstract:** *Process and object-orientation are basic concepts of modeling, implementing and customizing information systems. In this paper we present two approaches of combining those concepts into a coherent way. In the first approach we discuss how to transform business process models (Event-driven Process Chain (EPC) diagrams) into object-oriented models (Unified Modeling Language (UML) diagrams). The main focus is to support the co-existence of both modeling methods focusing on the modeling context. The second approach deals with the integration of both modeling methods extending the EPC-model by business object classes.*

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# 1 Business Modeling

Today, analysis and design of *business processes* are the major tasks of *business engineering* [Scheer (1994), Österle (1997), Hammer et al. (1993), Davenport (1993)]. In research as well as in practice, the *Architecture of integrated Information Systems (ARIS)* [Scheer (1992)] is accepted as a standard framework for business process (re-)engineering. It supports the whole process management life cycle consisting of *process design*, *process management*, *process workflow* and *process application implementation* [Scheer (1996)]. The *Unified Modeling Language (UML)* [Rational Software (editor) (1997)] is a common standard for object-oriented modeling. The *UML* is derived of a shared set of commonly accepted concepts which have successfully been proven in the modeling of large and complex systems, especially software systems. With the *UML extension for business modeling*, a first object-oriented *UML* terminology has been defined for the domain of *business modeling*. *ARIS* as well as *UML* are based on integrated meta models supported by several modeling tools. The core business modeling concepts of both methodologies will first be introduced and compared afterwards.

## 1.1 Event-driven Process Chain (EPC)

The method of *Event-driven Process Chains (EPC)* [Keller et al. (1992), Nüttgens (1997)] has been developed within the framework of *ARIS* in order to model business processes. In the *EPC model*, a process consists of sequences of events triggering business functions, which are themselves the results of other functions apart from initial events triggering the whole process. By introducing boolean operators ("and", "or", "exclusive or"), the event-driven control structure can be expanded to a complex *control flow* illustrating business relevant decisions.

This basic model of the *EPC* can be extended by further semantic components of description. The illustration of *data flows*, responsibility of *organization units* and the use of *IT systems* are examples for such an extension (see figure 1). Furthermore, on the basis of formal descriptions of the *EPC method*, tool-supported concepts for analysis and simulation are being developed. The approach of Langner/Schneider/Wehler [Langner et al. (1997)] aims at the translation of *EPC models* into *petri networks* and at the algorithmic verification of the resulting networks. In contrast to this, the approaches of Rump [Rump (1997)] and of Keller/Teufel [Keller and Teufel (1997)] are based on a formal description of the *EPC*.

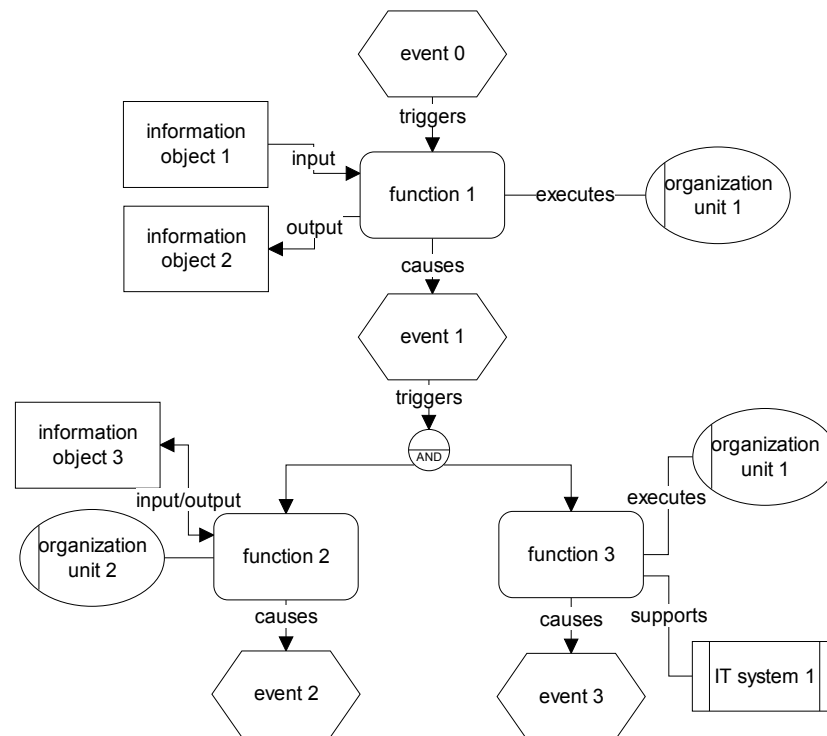


Figure 1: Event-driven process chain (EPC)

## 1.2 UML Extension for Business Modeling.

The *UML extension for business modeling* [Rational Software (editor) (1997)] consists of several *stereotypes* and introduces an *object-oriented* terminology for *business modeling*. The extension does not currently introduce any explicit *tagged values* or *constraints* and is not meant to be a complete business modeling language at all.

On the top level, there is the *use case model* and the *object model* based on the *UML meta class model*. Models are partitioned into constructs, based on the *UML* meta classes *subsystem* and *package*.

The *use case model* describes the behavior and relationships between services and participants outside the focused information system, e.g. customers and suppliers. The *object model* focuses on the internal *business processes*. It consists of *object systems*, containing *organization units*, *work units*, *workers* and *entities*. Figure 2 illustrates the entity *trade* in two states [*requested*] and [*processed*], where the *trade* is processed by the *trade document work unit*. *Client trading* is an action. The icons are designed to be meaningful in the particular problem domain. Nevertheless, the diagram is based on *UML elements*, using other symbols and another terminology.

Hence, we do not go further in detail concerning the *UML extension for business modeling*, but compare the *EPC* directly with *class* and *behavior diagrams* of the *UML* in order to show contradictions and synergy.

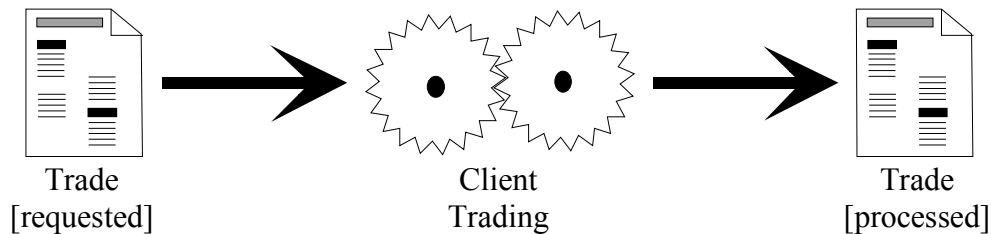


Figure 2: Example of special icons for entities and actions [Rational Software editor) (1997)]

## 2 Transformation Approach: From the Event-driven Process Chain to the Unified Modeling Language

As we have mentioned above, the *EPC* method and *UML* have different scopes of business modeling. Hence, it is not clear whether the results of the *EPC* method substitute the *UML* results or whether the methods are compatible at all. In this section, we describe an transformation approach which shows exemplary relationships between the *EPC* and the basic *UML* diagrams *use case*, *activity diagram*, *class diagram* and the *UML application architecture* at all. We give a short description of the *UML* diagram, followed by the comparison with the *EPC* and a rough transformation from *EPC* to *UML*.

### 2.1 UML Use Case Diagrams

*Use case diagrams* primarily define the behavior of a system or subsystem. Instances of the *actors* can use services of the system in any chronological order. The internal structure of the system, which makes the services available, can be regarded as a black box.

The relationship and interaction of *organization units* and *business functions* can also be illustrated using an *EPC*-diagram. Moreover, the *control flow* is illustrated and scenarios can be linked to complex process models in *EPC*.

*Use cases* can be regarded as a representation of small and less structured business functions on a very detailed level, where is no need to define a control flow.

Furthermore, collecting all references from an *application system* to all *functions* and *organizational units* concerned, a *use case diagram* for the *application system* can be made up. An example for the transformation is shown in figure 3.

## 2.2 UML Activity Diagram

An *activity diagram* is a combination of the *control flow* and *object flow* among its constituent *actions*, similar to the *control flow* and the *data flow* among the *functions* in the *EPC*. Thus, most of the *EPC diagram* constructs can be more or less easily transformed into *activity diagrams*. *EPC functions* provoke *activities*, *EPC events* cause *object flow states* and *EPC link operators* lead to *synchronized* or *splitted transitions*. Figure 4 illustrates those relationships. Because of the illustrative design of *control flow* and *data flow*, both models can also be applied in the context of *workflow modeling*.

## 2.3 UML Class Diagram

Although *class diagrams* describe the static structure of an information system, processes give a lot of information on objects, their structure and their relationships. Classes can be derived from *information objects* and *business functions* of *EPC-diagrams* by detailing them. Within *ARIS*, the *Entity- Relationship Model (ERM)* or *function decomposition diagrams* can be used to describe the static structure. As shown in Figure 5, classes are not necessarily developed in a top down approach but can be derived in parallel to a business process model.

## 2.4 UML Application Architecture

A general grouping mechanism of the *UML application architecture* is provided by the *subsystem* and the *package* constructs. An *application system* can be modularized in *subsystems* and *packages*.

In an *EPC diagram*, the existing applications are described as an *IT-resource*, related to other kinds of resources like organization units and *information objects*.

The relationship between *applications* and *business functions* and their support of complex business processes are also illustrated in the *EPC diagram*. *Application systems* defined in an *EPC model* are the basis for describing their interaction. Furthermore, in an *application architecture diagram*, application components can be represented by several *UML packages*. Each *package* can be specified in greater detail with the help of further *UML diagrams*, as it is indicated in figure 6.

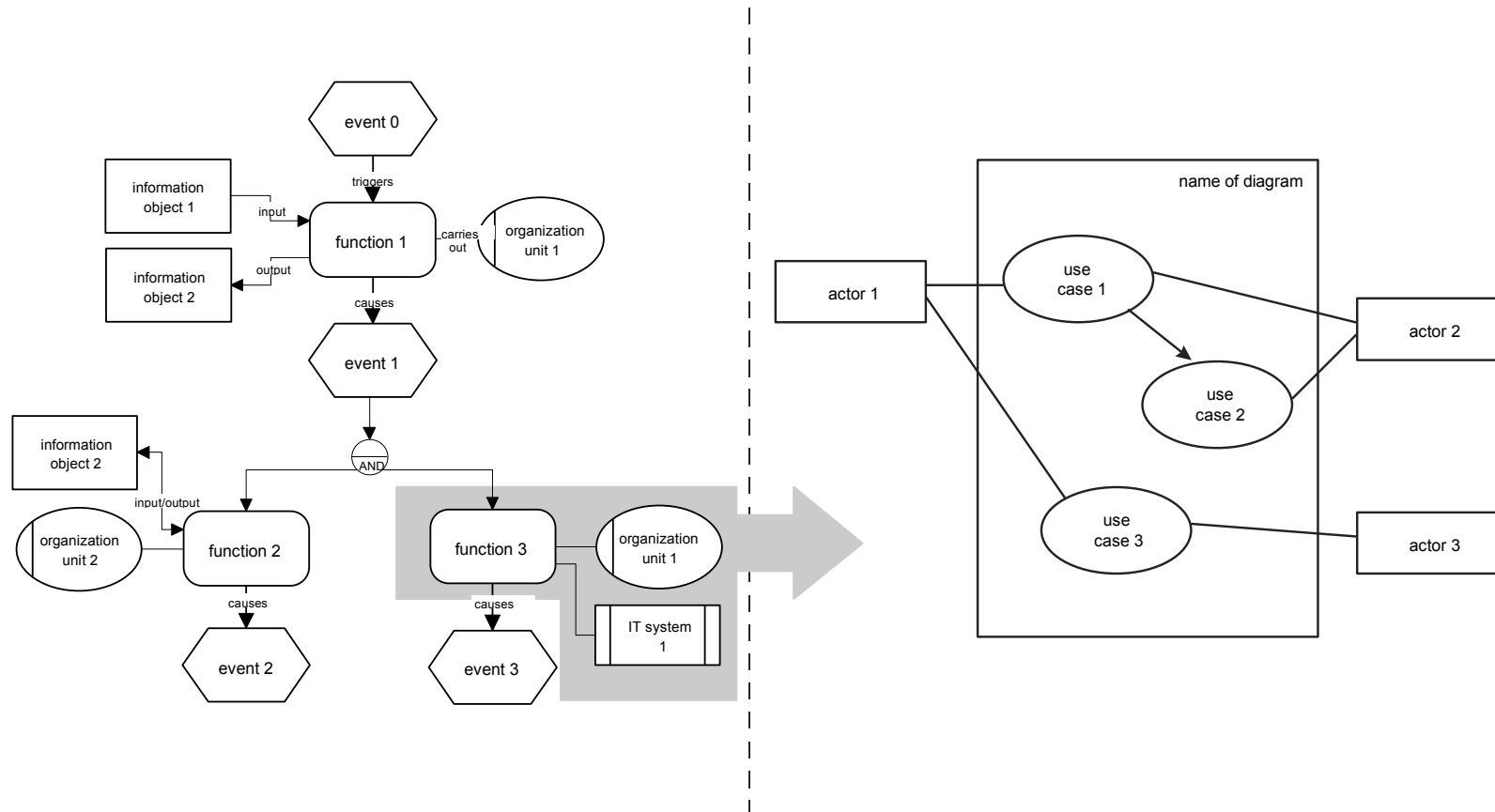


Figure 3: EPC - UML Use Case Diagram transformation, see [Oestereich(1997)]

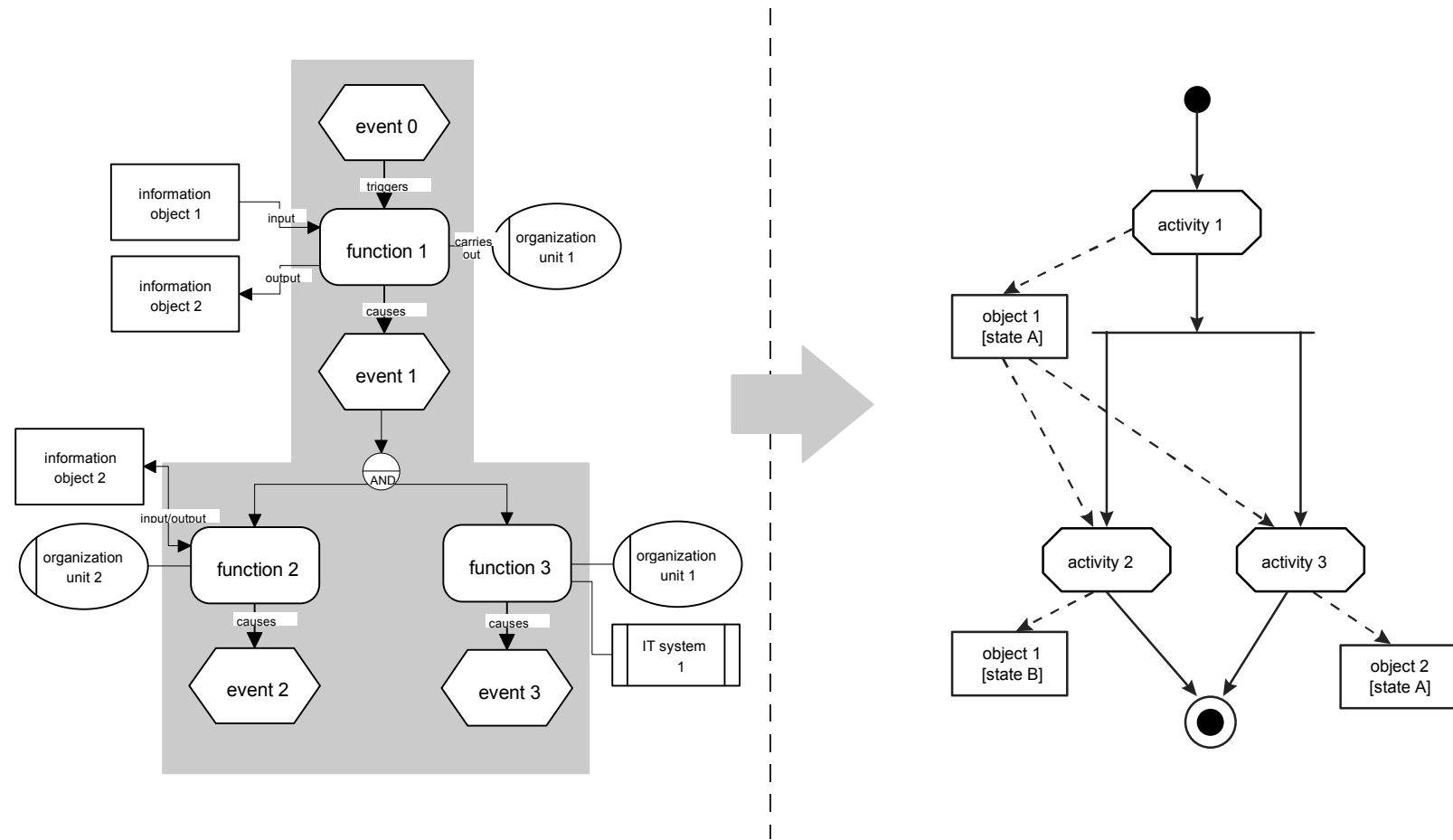


Figure 4: EPC - UML activity diagram transformation

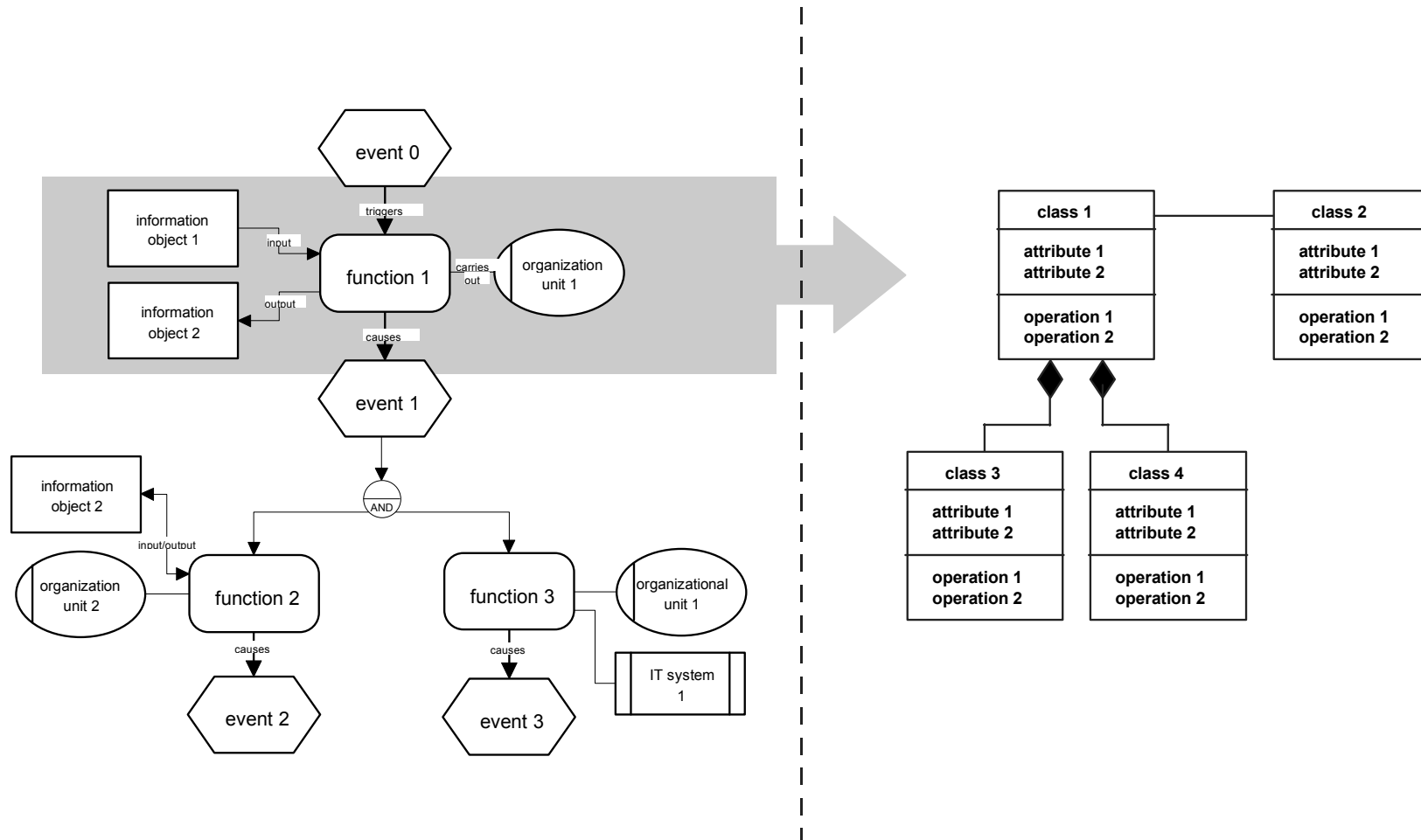


Figure 5: EPC - UML class diagram transformation

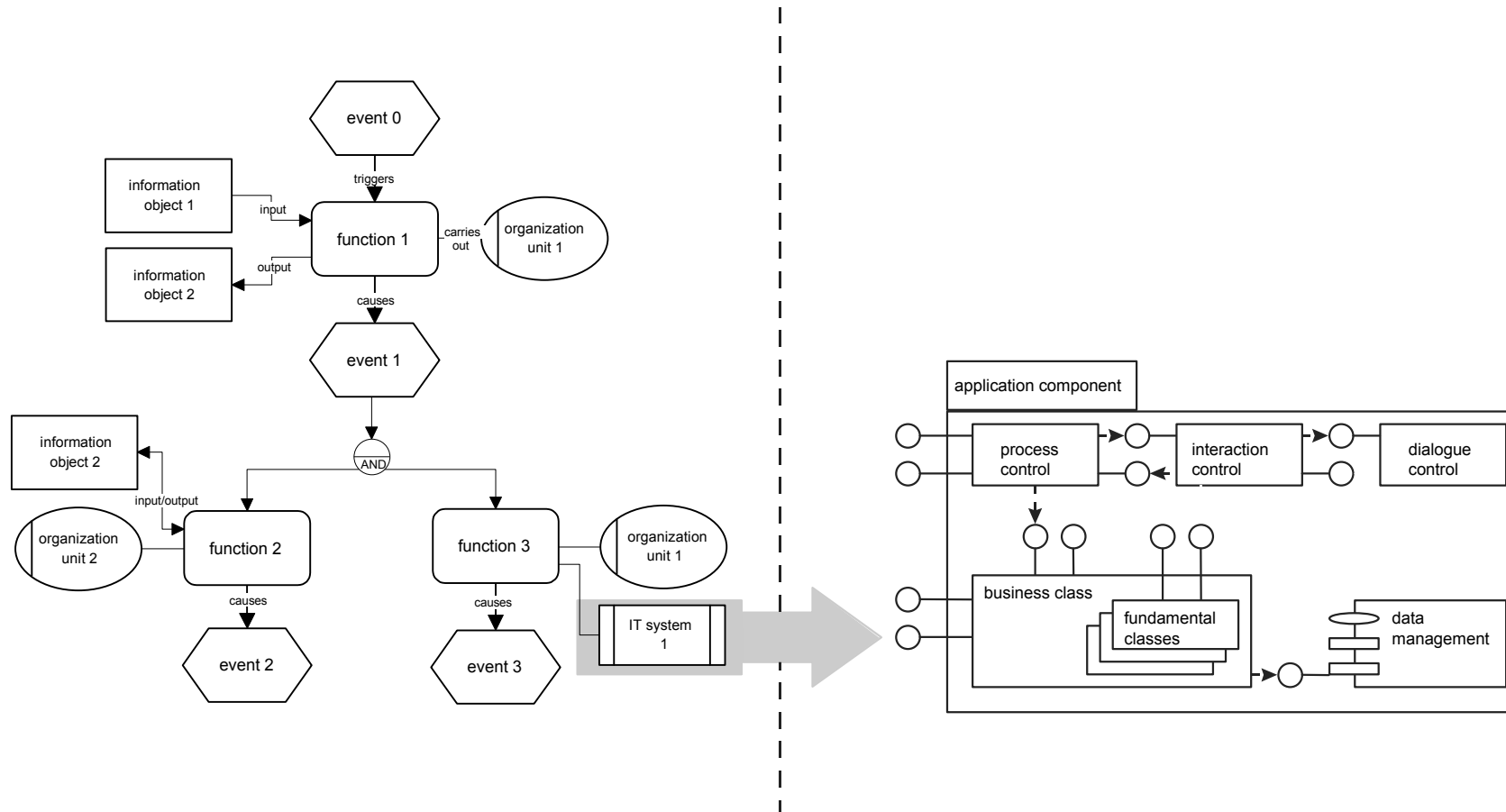


Figure 6: EPC - UML application architecture transformation

### 3 Integration Approach: „The Object-oriented Event-driven Process Chain (oEPC)“

The purpose of the following presented concept of the *object-oriented event-driven process chain (oEPC)* [Scheer et al. (1997)] is on the one hand to preserve the potential and the end users acceptance of the standard *EPC method* and on the other hand to integrate object-orientated methods.

In this context, a business process is defined as the event-driven processing and interaction of business objects. The *oEPC* differentiates between *business process*, *business object*, the corresponding resources such as *organization units*, *IT* and *production resources* and *rules/events*.

Within the *object-oriented* methodology, *business objects* are regarded as *generalized objects* which can usually be specialized. For instance, the business object *customer order* can be specialized into the objects *customer order header* and *customer order items*. Often, *business objects* are called *object clusters* or *complex objects*.

*Events/rules* describe the state transition of a *business object* at a certain time caused by the execution of one of its *operations*. They are defined as independent meta objects. Within the *oEPC* method *business objects* and *events/rules* are defined as *object classes* on type level. Hence, *business objects* can be described in greater detail by assigning *attributes* and *operations* to the classifying *business object* class.

*Business process modeling* focuses on finding and solving organizational problems and media incompatibilities in business processes. For this reason, *organization units* and *resources* can be assigned to *business objects* similar to the standard *EPC* method.

The interaction between *business objects* is based on message exchange. *Messages* reflects the *control flow* i.e. the decision- and control mechanism of a *business process*.

Messages can also describe a kind of *customer-supplier-relationship* of *business objects*. The message sender (*customer*) triggers the recipient (*supplier*) to produce a result, which the sender needs for the further execution of the process. But within business process modeling, *customer-supplier-relationships* do not come to the fore.

Furthermore, the *EPC* method disposes of a set of *boolean operators*, used to split a process or to combine different processes. Hence, the business decision interrelationship within the process execution can be illustrated.

The combination of *boolean operators* and *events/rules* make up the link to common business roles in analogy to the standard *EPC*.

In figure 7, the structure of a *business process* model is shown by means of *oEPC* symbols illustrating graphically the *control flow* defined by *event-driven messages*.

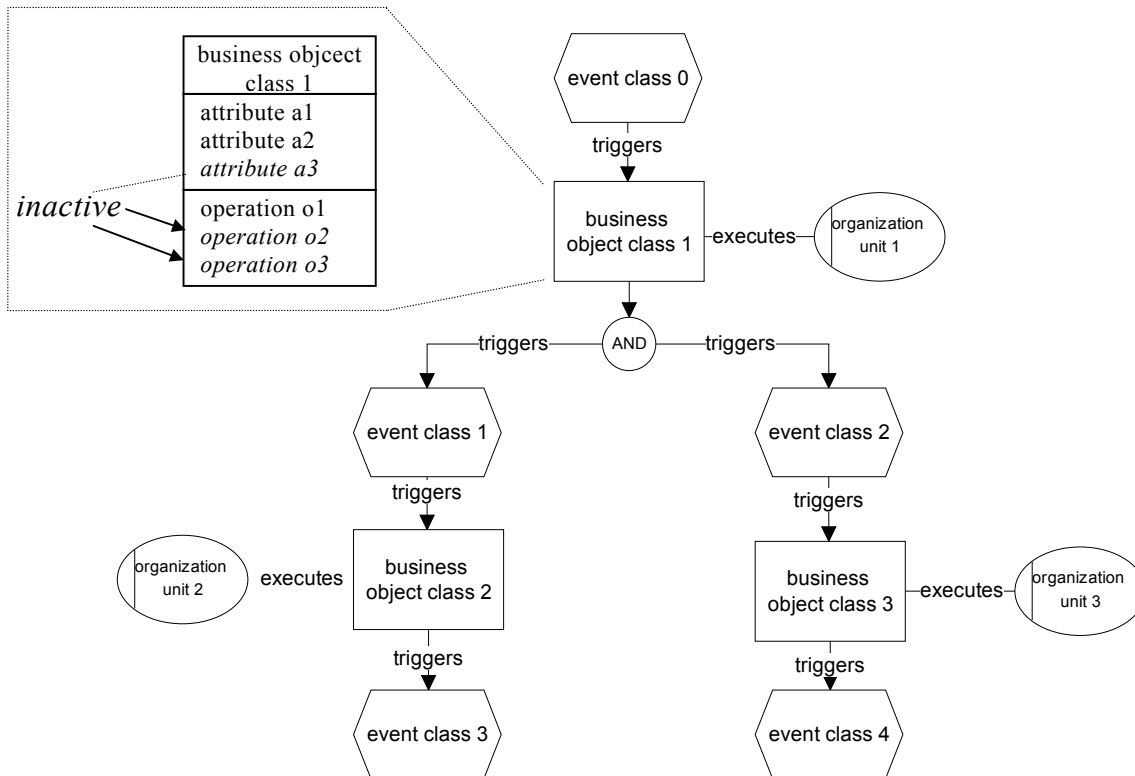


Figure 7: Example for the oEPC structure of a business process model

Because of the complementary usage of *object attributes* and *object operations*, the transformation of an *oEPC* model into the static *UML class diagram* is possible and can be the basis of a further coherent implementation specification.

## 4 Conclusion

Concepts for the modeling of the static structure of object classes, e.g. *UML class diagrams*, are methodically sophisticated approaches which are increasingly used in practice and which will probably replace other traditional approaches for static modeling like the *entity relationship modeling language*.

Even today, usefully adapted and simplified *object-oriented* languages for static modeling can be used in the context of business modeling. In addition to this, trough

refinement and consideration of *IT* relevant aspects, the *business model* can be transformed into an implementation specification.

The *object-oriented* modeling of dynamic behavior, especially within *business processes*, and the relationships between *dynamic diagrams* and *static class diagrams* are just insufficiently analyzed and discussed.

The main *UML* diagram framework still focuses on the implementation specification whereas the recent *UML* extensions for business modeling just introduce other symbols for the existing diagram structures. Thus, the *UML extensions for business modeling* can hardly be used for business process modeling.

The presented *transformation approach* as well as *integration approach* are based on the idea of finding a synergetic combination of *process-* and *object-oriented* concepts in order to profit from the advantages of both methods. This idea, which is also increasingly used in literature, is changing the rather dogmatic discussion on methods into an discussion on integration of methods.

The further scientific work within the context of the presented *object-oriented event-driven process chains (oEPC)* will primarily deal with the development of a coherent proceeding model and the illustration with the help of modeling tools.

## References

DAVENPORT, T.H. (1993): Process Innovation. Reengineering Work through Information Technology, Boston.

HAMMER, M.; CHAMPY, J. (1993): Reengineering the Corporation. A Manifesto for Business Revolution, New York.

KELLER, G.; NÜTTGENS, M.; SCHEER, A.-W. (1992): Semantische Prozeßmodellierung auf der Grundlage "Ereignisgesteuerter Prozeßketten (EPK)", Veröffentlichungen des Instituts für Wirtschaftsinformatik, Heft 89, Saarbrücken, URL: <http://www.iwi.uni-sb.de/public/iwi-hefte/heft089.zip>.

KELLER, G.; TEUFEL, T. (1997): R/3 prozeßorientiert anwenden: Iteratives Prozeßprototyping zur Bildung von Wertschöpfungsketten, 2. edition, Bonn.

LANGNER, P.; SCHNEIDER, C.; WEHLER (1997): Prozeßmodellierung mit ereignisgesteuerten Prozeßketten (EPKs) und Petri-Netzen, Wirtschaftsinformatik 39, 479-489.

NÜTTGENS, M. (1997): Event-driven Process Chain (EPK) - Some Links and Selected Publications, URL: <http://www.iwi.uni-sb.de/nuettgens/EPK/epk.htm>.

OESTEREICH, B. (1997): Objektorientierte Softwareentwicklung mit der Unified Modeling Language, 3. edition, München 1997, 85ff.

- ÖSTERLE, H. (1997): Business Engineering, Prozeß - Systementwicklung, Volume 1: Entwurfstechniken, Berlin.
- RATIONAL SOFTWARE (editor)(1997): UML Notation Guide 1.1, Unified Modeling Language Version 1.1, Santa Clara (USA), URL: <http://www.rational.com/uml/documentation.html>.
- RATIONAL SOFTWARE (editor)(1997): UML Extension for Business Modeling version 1.1, Unified Modeling Language version 1.1, Santa Clara (USA), URL: <http://www.rational.com/uml/documentation.html>.
- RUMP, F. (1997): Erreichbarkeitsgraphbasierte Analyse ereignisgesteuerter Prozeßketten, Technischer Bericht, Fachbereich Informatik, Universität Oldenburg, URL: <http://www-is.informatik.uni-oldenburg.de/~rump/paper/analyse/analyse.ps>.
- SCHEER, A.-W. (1992): Architecture of Integrated Information Systems - Foundations of Enterprise-Modeling, Springer, Berlin.
- SCHEER, A.-W. (1994): Business Process Engineering - Reference Models for Industrial Enterprises, 2nd edition, Springer, Berlin.
- SCHEER, A.-W. (1996): ARIS-House of Business Engineering, Veröffentlichungen des Instituts für Wirtschaftsinformatik, Heft 133, Saarbrücken, URL: <http://www.iwi.uni-sb.de/public/iwi-hefte/heft133.zip>.
- SCHEER, A. W.; NÜTTGENS, M.; ZIMMERMANN, V. (1997): Objektorientierte Ereignisgesteuerte Prozeßkette (oEPK) - Methode und Anwendung, Veröffentlichungen des Instituts für Wirtschaftsinformatik, Heft 141, Saarbrücken, URL: <http://www.iwi.uni-sb.de/public/iwi-hefte/heft141.ps>.