

Towards an Integrated Product and Process Modelling: oEPC Markup Language (oEPML) for object-oriented Event-driven Process Chains (oEPC)

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Abstract: The responsibilities for products and processes are usually split between the organisational, IT or financial divisions. Connections and interdependencies are consequently often only insufficiently recognised. Integrated product and process models (IPP) are a highly promising approach to counter these deficits. Based on an IPP framework, we describe a modelling approach that aims at an Integrated Product and Process Model for the public administration on the basis of object-oriented Event-driven Process Chains (oEPC) and UML class diagrams. We demonstrate the approach on the business case "business registration" and describe a prototypical implementation based on the modelling tool bflow* Toolbox.

1 Introduction

The fundamental objective of an integrated product and process modelling is a joint model understanding by organisers and modellers on the one hand and the reusability of process models, component-based services and software components on the other hand. This results in a more flexible adjustment with process changes and thus shorter and more cost-effective implementation times. Integrated product and process models (IPP) are a highly promising approach to depict the requirements and resulting complexity based on models. The benefit potential of an IPP can be enhanced further on a services-based architecture. However, this also requires an integrated approach in the system and a new degree of cooperation between the IT department, the organisational department and beyond departments to customer integration. For the industrial sector, there are conceptual approaches for the integration of product and process models (cf. e.g. [ES05], [We04], [K103], [Br00]); in the public administration sector, these have not yet established themselves.

In the discourse area of public administration, the European Commission considers e-Government to be at a decisive turning point. Accordingly, further important progress will only be possible when certain fundamental prerequisites are set up. Against this backdrop, the EU Commission drew up the “i2010 e-Government action plan – Accelerating e-Government in Europe for the Benefit of All” in Spring 2006 for pan-European access to e-Government services for the period up to 2010 [EU06a]. Within the framework of the creation of the prerequisites, Directive 2006/123/EC of the European Council regarding services in the internal market, in short EU Services Directive [EU06b], is particularly important and places high demands on public administrations.

Based on an IPP framework, the paper describes a modelling approach that aims to achieve an Integrated Product and Process Model for public administration on the basis of object-oriented Event-driven Process Chains (oEPC). The paper is structured as follows: In the second section, the underlying research design is presented. The core requirements of public administration to implement the EU Services Directive are then described. In the case of the registration of a business, the modelling approach is specified on the basis of an IPP framework in the context of the implementation of the EU Services Directive. In section five a first prototypical tool support is presented. The paper closes with a summary and the outlook with regard to the need for further research.

2 Research design

The paper is part of a research, the central goal of which is the (1) design and (2) evaluation of an Integrated Product and Process Model that is suitable in the form of a reference model and a modelling methodology that can be generalised for (3) the application area of public administration. There is a focusing on (4) the requirements of the EU Services Directive with regard to (5) the municipal administration level (towns, districts and municipalities). The latter is particularly required to align its structures and processes to the EU Services Directive by the end of 2009 as it combines the most procedural and decision-making responsibilities of the state in Germany [BM06, p. 15]. In Germany alone, there are more than 12,400 towns and municipalities [BBR08]. The concept of the research is divided into three sub-areas: (a) integrated product and process modelling, (b) case studies and (c) comparative studies. Initial work results regarding the sub-areas are found on (a) in [HN08], on (b) in [HKN08] and on (c) in [HBN08].

2.1 Research question

The sub-area “Integrated product and process modelling” forms the “core area” of the paper. The investigation focuses on the fundamental principles for integrated product and process modelling that lay the conceptual, methodological and technical basis for the development of integrated product and process models. The course of the investigation in this paper is guided by the following research question: Are object-oriented Event-driven Process Chains (oEPC) a suitable technical and conceptual starting point to link business-related process information with UML modelling concepts in order to lay the foundation for a systematic and process-compliant development of a services-based architecture?

2.2 Research methodology

Methods in business information technology can be divided roughly into development methods (for the design of information systems) on the one hand and in research methods as an instrument of acquiring knowledge on the other [WH07, p. 281]. The methodology of cognitive science is divided further into design-scientific (construction science) and behaviouristic (behavioural science) research paradigms. The sub-areas of the research work make different demands on the research methodology and are consequently processed with different research methods. Regarding the spectrum of methods in business information technology cf. e.g. [WH07], [Ha02], [Kö96], [He95].

The processing of the sub-area “Integrated Product and Process Modelling” is done using the research method of reference modelling and, based on this, the development and test of a prototype (so-called prototyping). The aim of reference modelling is the model-based depiction of a planned or optimised reality [WH06, S.7]. The central goal of the research paper is the design and evaluation of an Integrated Product and Process Model that is suitable for the application area of public administration and can be used as a reference model in a large number of administrations.

The aim of the prototyping is the development of an executable pre-version of an application system [WH06, S.10] that is available quickly. To support the modelling activities in practice, the development and evaluation of an EPC modelling tool that can be used in joint projects by organisers as well as IT representatives is also envisaged within the framework of a prototyping.

A methodological approach is presented in this paper that (1) links the modelling concept of the object-oriented Event-driven Process Chain (oEPC) with (2) UML modelling concepts in order to be able to lay a basis for a systematic and process-compliant development of a (3) services-based architecture concept. Comparable papers that combine these three concepts with one another in an integrative modelling approach have not been published up to now.

2.3 Related work

Established approaches for object-oriented product and process modelling can be found in the scientific literature, primarily on the Unified Modelling Language (UML) [OMG08]; [Oe06], on the Semantic Object Model (SOM) [FS06]; [FS95], on object Petri nets [Ba90]; [Ob96]; [ZH00]; [SL05]; [KLO08] and on the object-oriented Event-driven Process Chain (oEPC) [NZ98]; [SNZ97]. Approaches for the integration of process orientation in the object-oriented paradigm in the context of Event-driven Process Chains can also be found in [Sc01]; [Zi98]; [ScSc97].

3 EU Services Directive

The EU Commission understands by the term service “any self-employed economic activity normally provided for remuneration” [EU07, p. 11]. Administration-related activities and services are to be excluded from this definition of service. Their goal is to support the setting up and carrying out of the entrepreneurial activity. These include in particular support services in the form of processing the necessary approvals and registrations on the basis of legal standards (such as laws and ordinances).

The EU Services Directive calls upon the member states to put the necessary law and administrative regulations into force that are necessary to meet the objectives of the directive by the end of 2009. The directive is intended to substantially simplify and facilitate the trade of services within the community. The core of the objectives is the simplification of the administration for the benefit of companies (Chapter 2 of the directive). Accordingly, the member states are called upon to:

- check the valid procedures and formalities for setting up and carrying out a service activity with regard to their simplicity, and where necessary, to simplify them (Art. 5 – Simplification of procedures),
- to set up single points of contact, through which the service providers can deal with all processes and formalities within the framework of their service activity (Art. 6 – Points of single contact),
- ensure that all procedures and formalities can be handled easily at a distance and electronically via the single point of contact or at the authority responsible (Art.8 – Procedures by electronic means).

All domestic and foreign companies that are based in the European Union [EU07, p. 23] are intended to benefit from the directive. On the one hand, there are the requirements of the companies, and on the other the consequences for the public administrations [HKN08].

4 Framework

4.1 Overview

When viewed abstractly, processes in public administration have only a low structural variance (usually application processing) with regard to their objectives, but significant differences can be discerned based on organisational structures, administrative regulations and case studies that have evolved over the course of time [SNZ97]. In addition to issues of data protection and political decision-making, this heterogeneity is a major reason why there have hardly been any integrated application systems here up to now; instead, there have been stand-alone solutions for individual organisational areas [Zi98, p. 183].

The effective provision of administrative services requires, however, a linking of the services and service bundles (products) offered, of the resources (processes) used for the procedures and of the technical services and consequently a product and process architecture with application systems and IT infrastructure aligned to this. Integrated product and process models are thus a highly promising approach to align the information technology in public administration to the new requirements. Through the integration of products, processes and systems as well as the provision of reusable services, important integration potential can be depicted and implemented. Figure 1 shows the components of a framework for an Integrated Product and Process Model that is suitable for the EU Services Directive.

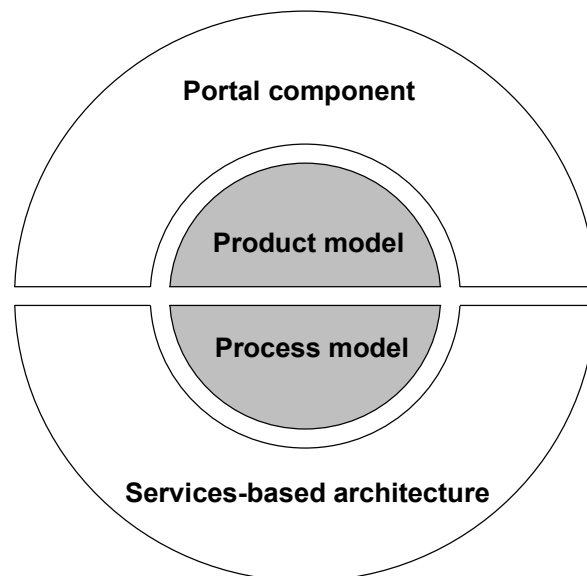


Figure 1: IPP framework for the implementation of the EU Services Directive

Accordingly, the major components of the IPP framework include:

- Portal component: The implementation of the EU Services Directive requires that company-related administrative services are made available electronically and can also be used from a distance. To facilitate this, a portal component in the front office provides the company-related administrative services in such a way that individual service packages in line with requirements can be created by the companies via the portal.
- Product model: The product model incorporates all the company-based administrative services and thus forms the basis for the content of the portal. It describes all of the services provided in the respective organisation for companies. By product, we mean a result of an administrative process that is discernible from the customer's perspective, whereby the resource aspect is initially taken into account [BHL98].
- Process model: Each product is more or less based on a work-sharing business process. A business process is understood as an event-driven processing of business objects. On the basis of models on current processes, weak points can be analysed and target process models derived. Process models in the IPP framework are also the central starting point for the designing of data models as the basis for the technical realisation of electronic procedures.
- Services-based architecture: A services-based architecture [Jo08; LDL07] also forms the technical basis for the use of reusable, component-based services within the framework of the portal and of the partial or full automation of the processes. Services-based architectures (SOA) thus form a suitable platform for the product- and process-oriented implementation of the EU Services Directive [MG05]. Already existing IT infrastructures and software components can thus be integrated without having to replace these completely because of the new requirements.

The framework consistently follows the object-oriented paradigm. Accordingly, an object is defined as "a thing (an entity) with a clear identity. It is characterised by its state and its behaviour. The state is represented by attributes and relationships, behaviour by operations. Objects that are characterised in the same way belong to the same class." [GI08].

A business object is defined as "a representation of a thing active in the business domain, including at least its business name and definition, attributes, behaviour, relationships and constraints. A business object may represent, for example, a person, place or concept. The representation may be in a natural language, a modelling language, or a programming language" [OMG97]. Analogical definitions can also be found, among others, in [Oe06; NZ98; CD91; RBP91]. Administrative objects in this sense are material goods (such as forms or booking receipts), persons (applicant, employee) or immaterial goods (e.g. rights, approvals or registrations).

4.1 Process model “business registration”

With the modelling concept of the object-oriented Event-driven Process Chains, workflows are modelled with events and objects that are linked with connecting elements. Through (AND, OR and XOR) connectors, the process flow can be split up and then joined again. Figure 2 shows a modelling approach on the basis of the object-driven Event-driven Process Chains introduced in [SNZ97]. The oEPC notation for the business object is closely aligned to the notation for UML classes [OMG08] in this figure, which benefits the preparations for an IT-based partial or full automation of processes.

The “business registration” is symbolised here as a business object and includes all the business attributes and methods that are required for the processing and status changes. The business object “business registration” thus forms the “core object” in the process that determines and controls the progress of the process through the change of its status. Each change of an attribute value does not represent a change in status here, but rather only those events that have a fundamental impact on behaviour [Oe06, p. 319].

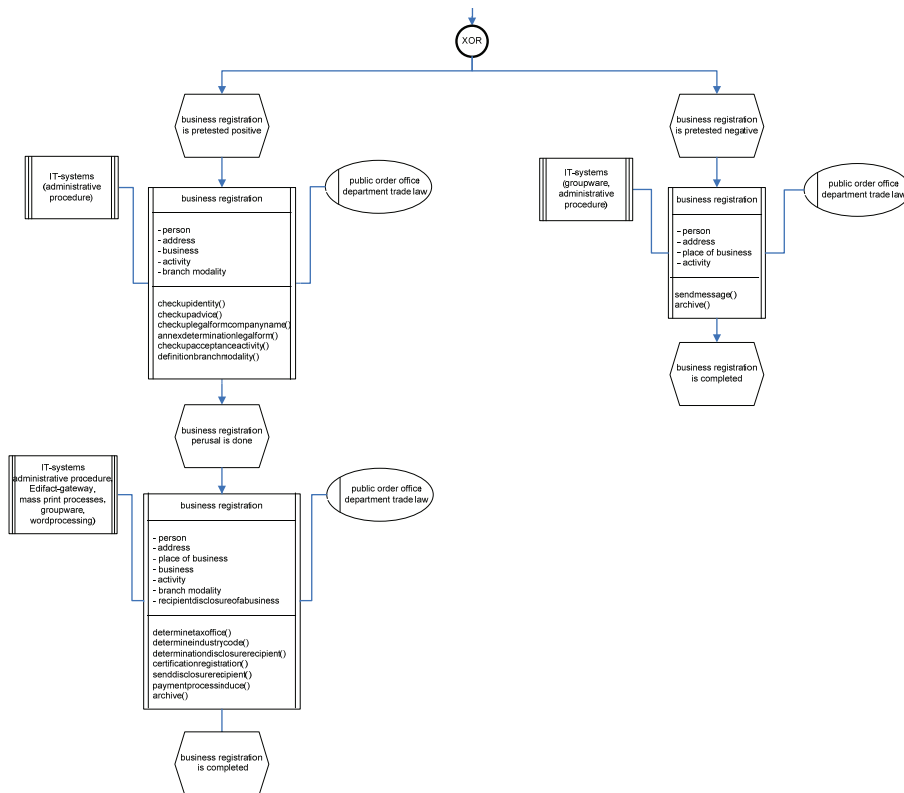


Figure 2: EPC process model for business registration (part)

4.2 Class diagram “business registration”

As the basis for the technical realisation of the electronic procedures as required by the EU Services Directive, the business objects are specified further below with their business attributes and methods from the oEPC in an UML class diagram; Figure 3 shows the class diagram for “business registration” (part). The clear allocation of methods to attributes can be done, depending on process complexity and necessary granularity, both through a refinement of the oEPC as well as in separate diagram types.

In addition to the attributes, the classes include all the operations that are necessary for the processing and changes of status of the “business registration”. The highlighted operations are not technically supported at present but are done manually by the clerk. Nevertheless, these operations may be necessary in a large number of administrative processes, for instance:

- the operation “determineindustrycode” is not only used in the process for business registration but also in the registration of a change of business; this operation is also relevant in other administrative processes, for instance in processes of economic development, or
- the operation “determinetaxoffice” is also used not only in the process for business registration but also in the change of business and in other administrative processes, for instance in processes for business taxation.

With a view to the IPP framework, the highlighted operations in Figure 3 form the basis for determining new technical services that can be used as reusable components in various processes. The selected class diagram thus forms the methodological basis for the development of the services-based architecture within the framework of the IPP. Insofar as the selected modelling tool – as is the present case – also already generates a corresponding Java code on the basis of classes, this also creates a starting point for the technical realisation of the selected services on the basis of classes.

5 Tool Support

An important aspect of the research methodology is the development of a prototypical tool support that enables the application and evaluation of this framework. Thus, we have extended an existing EPC modelling tool, the bflow* Toolbox¹ (abbreviation bflow), with the oEPC language. Bflow is a community-driven open-source tool that relies technically on the Eclipse technologies. Based on the abstract bflow metamodel we have defined an oEPC metamodel and a concrete syntax. The tool provides refactoring transformations for business attributes and business methods. Furthermore a continuous validation support for process models [KKGL09] was adapted to oEPCs. For the reuse of existing oEPC models the tool provides a Visio import wizard.

¹ <http://www.bflow.org>

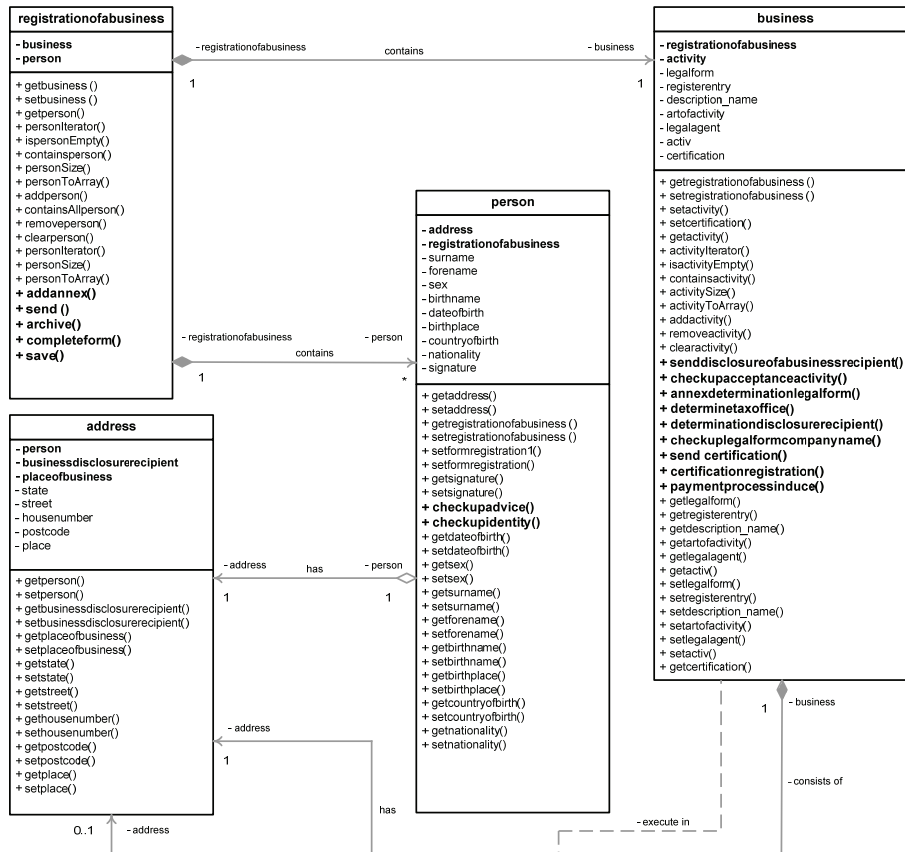


Figure 3: UML class diagram for business registration (part)

A crucial requirement was the serialization of process models as an XML format. Such a XML serialization enables easily, for instance, the exchange, storage and versioning of process models. The specified XML schema is based on the EPC Markup Language [15] and extends EPML with object-oriented concepts such as business objects and is called OEPC Markup Language² (oEPML), see Figure 4. We have reused the most complex type from the EPML schema and have defined new types such as oepc type or businessObject type. The implementation of the XML export is realized by a model transformation with XPand from openArchitectureWare³.

² <http://www.informatik.uni-leipzig.de/~kern/oepml/oepml.xsd>

³ <http://www.openarchitectureware.org/>

```

<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema"
xmlns:oeqml="http://www.informatik.uni-leipzig.de/~kern/oeqml/oeqml.xsd"
xmlns:epml="http://www.epml.de">
  <xs:import schemaLocation="http://wi.wu-wien.ac.at/home/mendling/EPML/EPML_12.xsd"
namespace="http://www.epml.de"/>
  <xs:complexType name="typeOEPC">
    <xs:complexContent>
      <xs:extension base="epml:tExtensibleWithAttributes">
        <xs:sequence>
          <xs:choice minOccurs="0" maxOccurs="unbounded">
            <xs:element name="configurationRequirement" type="epml:typeCReq"/>
            <xs:element name="configurationGuideline" type="epml:typeCReq"/>
          </xs:choice>
          <xs:choice minOccurs="0" maxOccurs="unbounded">
            <xs:element name="event" type="epml:typeEvent" minOccurs="0"/>
            <xs:element name="businessObject" type="oeqml:typeBusinessObject" minOccurs="0"/>
            <xs:element name="processInterface" type="epml:typeProcessInterface"
minOccurs="0"/>
            <xs:element name="and" type="epml:typeAND" minOccurs="0"/>
            <xs:element name="or" type="epml:typeOR" minOccurs="0"/>
            <xs:element name="xor" type="epml:typeXOR" minOccurs="0"/>
            <xs:element name="controlFlow" type="epml:typeArc" minOccurs="0"/>
            <xs:element name="informationFlow" type="epml:typeArc" minOccurs="0"/>
            <xs:element name="system" type="oeqml:typeSystem" minOccurs="0"/>
            <xs:element name="organizationUnit" type="oeqml:typeOrganizationUnit"
minOccurs="0"/>
            <xs:element name="document" type="oeqml:typeDocument" minOccurs="0"/>
          </xs:choice>
        </xs:sequence>
        <xs:attribute name="oeqcId" type="xs:positiveInteger" use="required"/>
        <xs:attribute name="name" type="xs:string" use="required"/>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>

```

Figure 4: oEPML elements as a syntax tree (part)

6 Summary and conclusion

6.1 Summary

The paper describes a framework for integrated product and process modelling in the public sector. This is traditionally marked by (partially) redundant, paper-based forms. The basic requirement for digitalisation, bundling and virtualisation of the services is initially to have a joint understanding of the model by all those involved (such as organisers, modellers, programmers) and the development of reusable reference processes and component-based services. Using the example of the administrative process for business registration, the modelling concept of the object-oriented Event-driven Process Chain (oEPC) with UML modelling concepts (classes, class diagram) is linked in such a way that the basis for a systematic and process-based development of a services-based architecture concept can be laid.

6.2 Limitations

Various approaches for object-oriented product and process modelling have established themselves in the scientific literature (cf. 2.3). The depicted modelling approach presents the results of the ongoing research work on the basis of object-oriented Event-driven Process Chains (oEPC). To what extent other approaches are suitable to achieve the goal is reserved for other investigations.

In addition, the current number of investigated processes, modelled by using the oEPC, do not yet permit any watertight statements with regard to the manageability of the modelling tool for practical use. This needs to be evaluated further in follow-up investigations.

6.3 Conclusion

On the basis of the current status of research, additional scientific questions arise that need to be answered within the framework of future papers:

- Is the modelling concept of the object-oriented Event-driven Process Chain (oEPC) a suitable means of description for the modelling of company-related administrative processes the case study of a large city?
- Can the IPP framework presented and the modelling approach which is based on it, be transferred to other large cities as well as to small and medium-sized municipalities?

The IPP framework presented in this paper and the modelling approach selected currently serve as the basis for the development of a comprehensive EU Services Directive reference model and to build up an oEPC-modelling tool based on the bflow-Toolbox [RN08]. The research work is developed further and also extended to include small and medium-sized municipalities. In addition to the manageability, the focus is also on the additional benefit generated for the end users. The validation is done in close cooperation with business associations and companies. The case study is a best-practice example [HKK08] for the implementation of the EU services directive as part of the Germany Online initiative [DOL08].

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