

Event-Driven Business Process Modeling and a Quick Guide to Application Modernization

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Abstract. This paper presents an event-driven business process model, which is easy to understand by non-technical experts and at the same time is precise enough to be used as a specification for software design. The paper describes how the event-driven model is constructed, and then, at a high level, illustrates how it can be transformed into a software design.

1 Introduction

Business processes are typically described by various diagramming techniques, such as BPMN (OMG 2011) and flowcharts (ISO 5807). An apparent problem with these descriptions is that the non-technical experts must understand the notation and its precisely defined semantics. When presenting a business process to people who do not fully understand what arrows, boxes, and other symbols on a diagram exactly mean, they will easily get a false impression that the process correctly describes what they think even if it does not, they easily miss subtle details, cannot assess all the consequences to which the process leads, and their feedback is limited because they do not know how to express their thoughts on a diagram.

This paper is structured as follows: The first two sections deal with the problem domain, and outline how to create an as-is and to-be event-driven business process model. The following two sections deal with the solution domain – how to create an information architecture and integrations between applications so that the software application fulfills the requirements of the business process model.

2 Event-Driven Business Process Model

Creating the event-driven business process encompasses several steps briefly described below. By event, we mean an external event that occurs in the real world. This is the main difference from Domain-Driven Design and event-driven software architectures that focus on the events generated by applications, because their main goal is not business process description but software design and implementation.

The modeling process starts by identifying all economic resources that users of an enterprise would like to plan, monitor, and control, such as labor, hardware, software, material, services, money, etc. A typical modernization project has only some economic resources in its scope.

For each economic resource, we identify all events that occur in the real world and affect the resource, i.e. change its state. For each event, we describe how various software applications and organizational units respond to this event. The result from a human resource management domain is illustrated in Tab. 1.

Tab. 1 illustrates two processes of an economic resource labor; the joiner and leaver process. Note this is a simplified example to illustrate the idea; the real-world complexity is discussed later in this paper.

The core part of Tab. 1 is the second column labeled Event, containing all events changing the state of the labor economic resource, thus representing the labor lifecycle. The processes in the first column are convenient groups of events; processes are useful for communication, but conceptually they are secondary modeling artifacts compared to the events.

The remaining columns represent the applications and organizational units that may respond to the events. The HR system, such as Workday and SAP Success Factors, stores and manages employee data and supports human resource personnel in their administrative activities. The User Account Management application is, for example, Microsoft Active Directory coupled with Microsoft Exchange. The ITSM tool is, for example, ServiceNow, often used also as an automation platform. The Local IT support is a physical service desk, where technicians help employees with various IT issues.

Process	Event	HR System	User account management	ITSM Tool	Local IT support
Joiner Process	open position	register	ignore	ignore	ignore
	contract signed	-register	-create user ID -create email address	-create user -run onboarding workflow	reserve equipment
	week before start date	ignore	activate account	ignore	ignore
	start date	ignore	ignore	ignore	issue equipment
Leaver process	letter of termination	register	ignore	run leave workflow	expect equipment return
	end date	revoke access rights	deactivate account	deactivate account	receive equipment

Tab. 1 Event-driven business process model for the labor economic resource

The first event is a management decision of an *Open Position*, which is registered by the HR system, and does not have any effect on other applications. The *Contract Signed* event is registered in the HR system, and consequently, the User Account Management app creates a user ID and email address; the user is also created in the ITSM tool, which runs the onboarding workflow, where the hiring manager decides about what IT equipment for the new employee. Consequently, the local IT reserves the equipment. *A day before the start date* the User Account Management app and ITSM tool activate the already created user accounts. At the *start date* event, the local IT issues the equipment to the new employee.

For each event, there is typically only a one application that registers it and then notifies other applications. This response is indicated by bold font in Tab. 1.

Responses to some events can be quite complex, for example, the *Run Onboarding Workflow* of the ITSM tool may be an algorithm encompassing interactions and information exchange with other applications and organizational units. This complexity is out of the scope of the event-driven business process model and is handled in the following steps described later.

The result is a precise and accurate business process model, yet described in plain English, so it is easy to understand by non-technical subject matter experts. The event-driven business process model determines the application architecture supporting the described business processes, as shown in sections 4 and 5.

2.1 Is the Model Complete?

The main goal of the event-driven business process model is wholeness – to describe the complete lifecycle of each economic resource, from its creation to consumption. How to identify additional events?

One way is to examine the data stored in existing applications dealing with the given economic resource. For example, the Employee table in SAP Success Factors has 52 attributes, though HR typically uses only about half of them. For each attribute that HR uses, there must exist at least one external event that sets or updates this attribute.

Another way is to create an economic model of the enterprise using, for example, the REA or POA ontologies, and verify that all events specified by these ontologies are part of the model. For example, for each process, there should be one or more events representing a plan or intention, corresponding to the commitment in the REA ontology, and one or more events representing the execution of the plan, corresponding to the economic event in the REA ontology. Likewise, for each economic resource, there should be a process (a collection of events) describing how the economic resource gets under the control of the enterprise and a process describing how it leaves the enterprise's control, for example, for labor the Joiner and Leaver processes, for material the Purchase and Disposal processes or Production and Consumption processes.¹

A precise representation of the lifecycle is a state diagram, which can be created for each economic resource. The state diagram will not only identify the events affecting the resource but also the actions performed upon state change.

3 Describe the Future State and Roadmap

In this step, the subject matter experts identify the pain points and responses to real-world events that need attention, and decide, which of them should be fully or partially automated, or can run manually because they are very rare.

¹ Our question for fellow VMBO participants to discuss at the workshop: can business ontologies be useful in some more important way than checking consistency?

This is also an opportunity to rethink the business processes from scratch, such as whether a response to a real-world event be moved from one to another system.

Process	Event	HR System	User account management	ITSM Tool	Local IT support
Joiner Process	open position	register	ignore	ignore	ignore
	contract signed	-register	-create user ID -create email address	-create user -run onboarding workflow <i>on failure:</i> -create incident -notify initiator <i>on success:</i> - notify hiring manager.	reserve equipment
	week before start date	ignore	activate account	-check workflow completion -notify HR	ignore
	no show on start date	run “no show” workflow	deactivate account	-run leave workflow	ignore
	start date	change status to “active”	change status to “active”	change status to “active”	issue equipment
Leaver process	letter of termination	register	ignore	run leave workflow	expect equipment return
	confirmation of leave	revoke access rights	ignore	Start leaver request	ignore
	end date	run leave checklists and controls	deactivate account	-notify supervisor -notify HR	receive equipment

Tab. 2 Event-driven business process model - future state

Tab. 2 illustrates the future state event-driven process model. Two events were added: *no-show on the start date*, and *confirmation of leave*. Notifications were added to some responses. By notification here we mean merely that some info should be propagated from one application to another. This can in practice be implemented as events, generated by the application; this is an implementation decision belonging to the solution domain. The most important is a decision on which processes will be automated, indicated by the blue color² in Tab. 2.

² Question to the VMBO participants: color is not very practical way to indicate which processes will be automated, as formatting can easily be lost during copy and paste of the documents. Any idea how to better indicate automated responses?

An example of decisions taken in this step is whether the *run onboarding workflow* should be performed by the ITSM tool or the HR system. Likewise, can the creation of a user ID and email address be automated by the User Account Management system from the data already existing in the HR system? We also need to determine the exceptions and issue handling at the business process level. What happens if the onboarding workflow gets stalled and does not finish at date before the start date, for example, should hiring manager be notified? The unhappy scenarios should be described in the table together with sunshine responses.

The result is an updated model created in previous step, determining the future state and roadmap, aligned with user needs and the strategic vision.

4 Determine the Information Architecture

As noted above, there is typically a single application that registers an external event and notifies other applications and organizational units about that event, i.e. the information about the real-world events must be propagated through the application ecosystem.

At this step, we design the application algorithms (fully or partially automated), such as *run onboarding workflow*. It requires a decision of the hiring manager to select appropriate IT equipment for the employee, such as laptop model, application licenses, access to production systems which will trigger additional workflow tasks, etc. Part of the design is error handling, such as what to do if some tasks are not completed on time.

To properly respond to the events and to run the application algorithms, each application and organizational unit typically needs additional data. This determines the required integrations between the applications. For optimizing these data connections in a digital solution, we can use several patterns for distributed computing, such as orchestration, usually suitable for smaller systems, event broker typically used with microservices, or data mesh determining data ownership.

5 Implement the Integrations and Application Algorithms

This step requires decisions about the actual data transfer mechanisms between applications, such as REST, gRPC, file transfer using batch jobs, etc. Existing applications usually set constraints on what transfer mechanisms are available.

We should not ignore that, as with any distributed computing system, the data are eventually consistent. That is, different applications may, for some time, contain different versions of the data. It cannot be completely avoided due to the CAP theorem, but fortunately, there are several ways to deal with this problem. For example, we can design the information architecture in section 4 such there is only a single way to propagate the truth; there are also other solutions, so the eventual consistency does not become a business issue.

6 Discussion

The event-driven business process model is a novel approach that provides the following benefits:

- **Understandability.** Although it is a precise model, it is expressed in plain English and is easily understandable to non-technical subject matter experts. Anecdotal evidence is when a process has been presented to HR personnel as a BPMN diagram, the response was “looks good”. However, presenting the same process to the same audience as an event-driven business process model started a discussion and constructive feedback – some application responses were not accurately described, some responses needed additional clarification and some pain points of the current implementation were identified.
- **Completeness.** The event-driven business process model is a top-down approach ensuring nothing important has been forgotten, which can easily happen when working with more complex information models.
- **Consistency.** The event-driven business process model makes it clearly visible how each event is affecting various applications of the enterprise.
- **Automation.** The event-driven business process model enables the subject matter experts to make a qualified decision on whether a response to an event should be automated.

7 References

- OMG (2011) BPMN, Business Process Model and Notation, <https://www.bpmn.org/>
- Geerts, G., L., and McCarthy, W., E. (2000). The Ontological Foundations of REA Enterprise Information Systems. Annual Meeting of the American Accounting Association, Philadelphia, PA. <https://msu.edu/user/mccarth4/Alabama.doc>
- Graham Gal, 2023, discussion at VMBO 2023. Graham recommended using the application data model to discover additional events. Thanks!
- ISO 5807:1985, Information processing, Documentation symbols and conventions for data, program and system flowcharts, program network charts, and system resources charts <https://www.iso.org/standard/11955.html>