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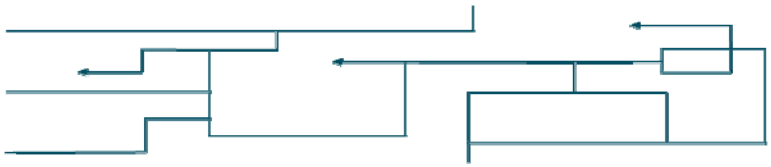
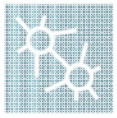


Towards Transformations from BPMN to Heterogeneous Systems

Tobias Küster and Axel Heßler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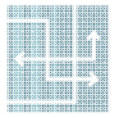
Agent Core Technologies


BPMN is the new standard modelling notation for all kinds of business processes, and many tools provide a transformation to executable BPEL code. But what about other languages?

We present a BPMN modelling and transformation tool, which is generic enough to support not only BPEL, but which can easily be extended with export features targeting other languages, too.

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Introduction

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- DAI-Labor, TU Berlin
  - Prof. Dr.-Ing. Sahin Albayrak
  - *"Smart Services and Smart Systems"*
  - AI, Agents, Networks, Services, Security, …

  http://www.dai-labor.de

- The SerCHo Project (Service Centric Home)
  - services for the home of tomorrow
  - service creation and deployment

  http://www.sercho.de

Introduction: Motivation

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- The Business Process Modeling Notation...
  - is a standardised, intuitive process notation.
  - communicates processes between stakeholders, domain experts, and developers.
  - unifies business process modelling.
  - provides a graphical notation for BPEL.
- What about other executable languages?

Introduction: The Problem

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- Most BPMN editors are specialized on creating executable BPEL code
  - e.g. *Intalio BPMS*, *eClarus SOA Architect*, …
- This has some advantages:
  - editor support for e.g. BPEL expression syntax
  - code can easily be generated and deployed
- But: Loss of language-independence
  - for a transformation to another language the diagram has to be recreated in another editor

Introduction: Our Approach

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- Use sheer BPMN in metamodel and editor
- Transformations can be 'plugged in'
  - additional export / import features
  - additional editing support for these languages
- Make it easy to create new export features
  - third-parties can provide a transformation to *their* execution language

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The Visual Service Design Tool: Background

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- Motivation: Having a tool to '*bridge the gap*'
  - visual creation of distributed systems
  - transformation to Multiagents-Systems (MAS)
    - mapping to MAS still under development
    - export to BPEL as a by-product of this project
- To be used in the SerCHo-Project at TU Berlin
  - goal: creating and combining ambient home services
  - integrating heterogeneous service technologies
- First version implemented as a diploma thesis

The Visual Service Design Tool: Basics

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- Metamodel derived from specification
  - fairly Complex, but hidden from the user
  - extension for structures (Sequence, If-Else, ...)
    - used for structure recognition and transformation
- Diagram editor created with Eclipse GMF
  - some customization /additions for improved usability
    - special thanks to *eclipse.modeling.gmf* and the team of the *Eclipse STP* BPMN editor!

The Visual Service Design Tool: Screenshot

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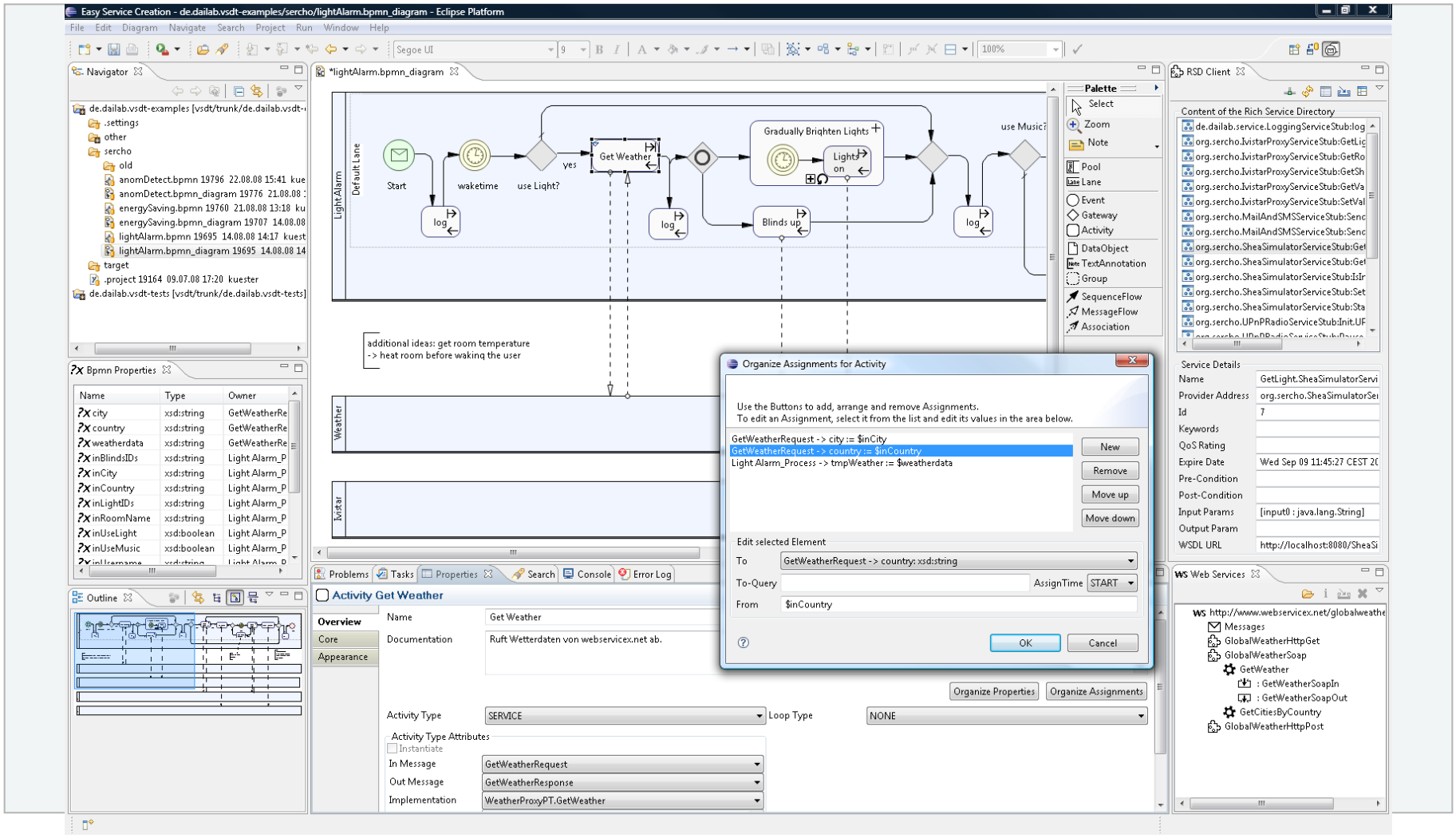

The Visual Service Design Tool: Features

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- Being independent of BPEL has downsides, too
  - reduced editing support, e.g. no syntax validation
- Has to be compensated with plugins, e.g.
  - Web Service View: import existing Web services
  - BPEL Expression Editor (planned): Enter and validate an XPath expression
- Export triggered via Eclipse Export Wizard

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- Transf. from graph to code is a difficult task
  - concept. mismatch, different expressive power
  - capture global semantics of control flow
  - create readable code one can work with
  - unstructuredness results in added complexity
- Topic of many research papers

Wouldn't it be a good thing to make this part reusable?

The Transformation Framework: Overview

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- Primary goal: easy to extend and to reuse
- Split up into several stages
  - Validation, Normalization, Structure Mapping, Element Mapping, Clean Up
  - implementing special Interfaces
  - typically realized as a top-down pass or using graph transformation rules (based on EMT)
- Individual stages can be reused or extended for use in other transformations

The Transformation Framework: Stage 1-2

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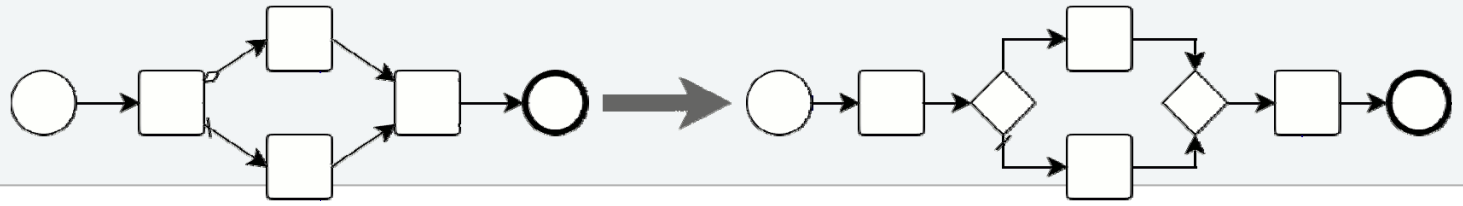
- Validation
  - check constraints, e.g. multiplicities
  - optional: check expression syntax
- Normalization
  - put diagram into "normal form"
  - much fewer cases to consider later on
    - Example:



The Transformation Framework: Stage 2

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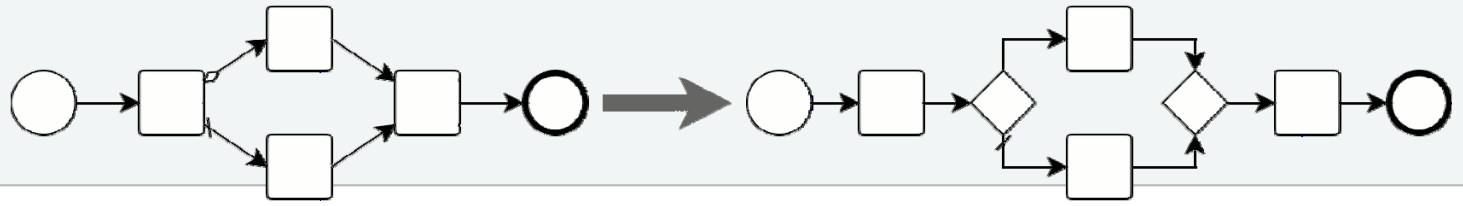
- Normalization Rules
  - insert a Gateway, if an Event or Activity has multiple incoming or outgoing Sequence Flows
  - split a Gateway having both multiple incoming and outgoing Sequence Flows in two
  - insert a no-op Task between two Gateways or an Activity with Event Handlers and a Gateway
  - add a final Gateway, merging all branches
  - move a Gate's Assignments into a separate Task



The Transformation Framework: Stage 3

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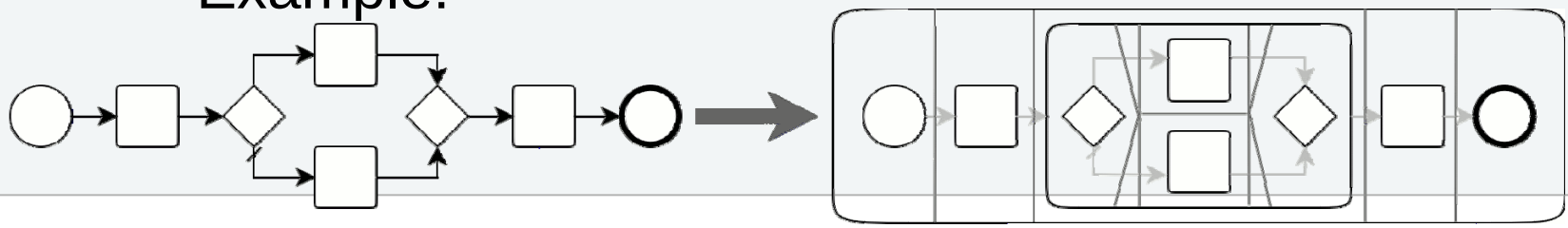
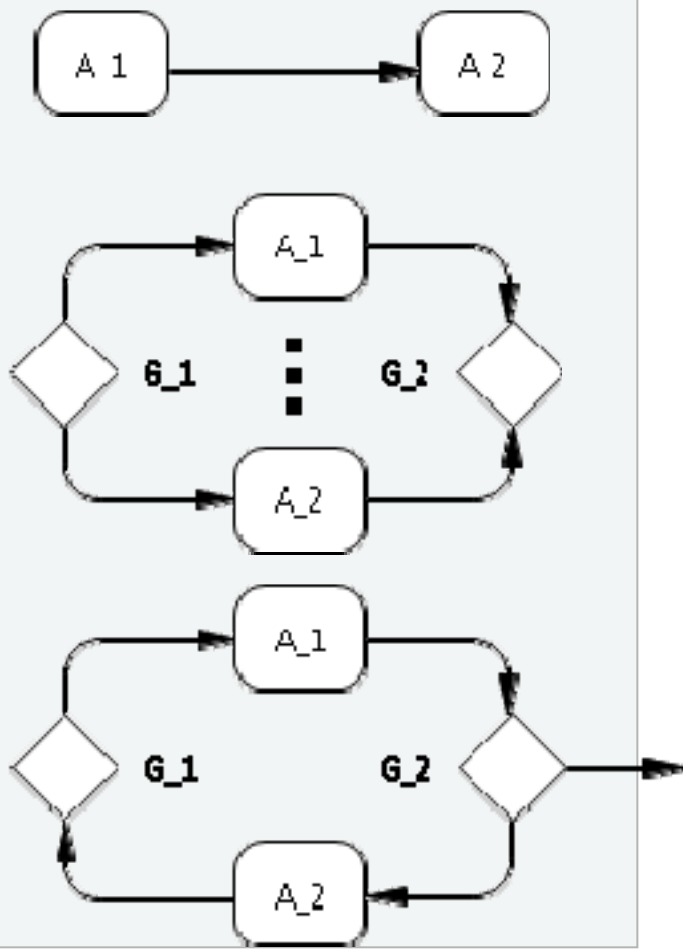
- Structure Mapping
  - transformation from graph to block structure
    - following *Structure Identification* strategy
    - realized using a relatively small set of rules
  - can handle slightly unstructured workflows
  - uses extension of the metamodel to integrate recognized structures directly into the model
    - Example:



The Transformation Framework: Stage 3

- Sequence Rule
  - pre: not more than one inc./outg. Seq. Flow, no event handlers
  - put Flow Objects in Sequence structure, reroute Seq. Flows
- Block Rule
  - look up other branches going from G1 to G2
  - put Flow Objects and conditions in Block structure, reroute SF
- Loop Rule
  - put Flow Objects and conditions in Loop structure, reroute SF



The Transformation Framework: Stage 3

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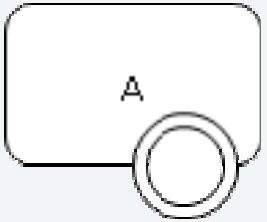
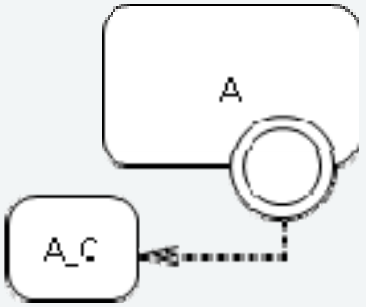
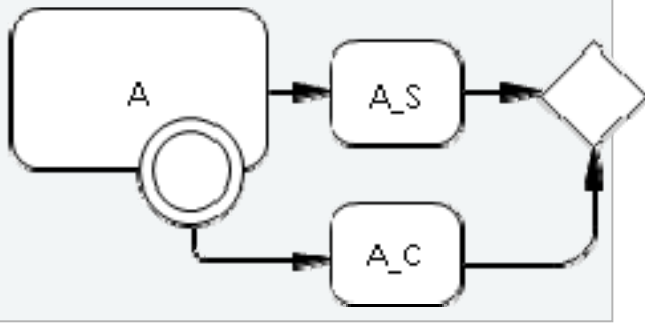
- Event Handler Block Rule
  - wrap A into EH Block structure
- Event Handler Comp Rule
  - if A in EH Block, wrap Event and AC into EH Case structure, add to EH Block
  - detach Event from Activity
- Event Handler Skip Rule
  - if A in EH Block, wrap Event and AC into EH Case, add to EH Block
  - refer to AS as "element to skip"
  - detach Event, remove lower SFs







The Transformation Framework: Stage 4-5

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- Element Mapping
  - create the target model (e.g. a BPEL process) from the normalized, structured process diagram
  - map each element, e.g. a Task, to its equivalent in the target language
- Clean-Up
  - improve readability of generated code, remove redundant code
  - flatten nested sequences, resolve singleton sequences, ...

The Transformation Framework: Example

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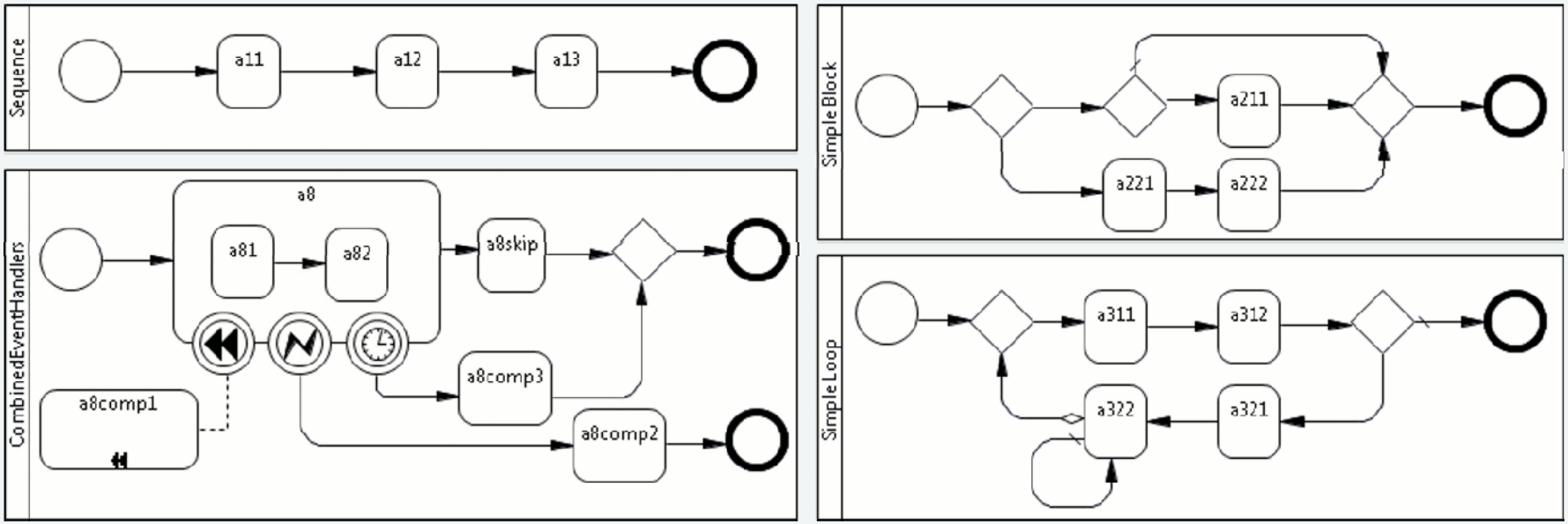
- Examples of transformable workflows



Intermezzo: Example, Step 1

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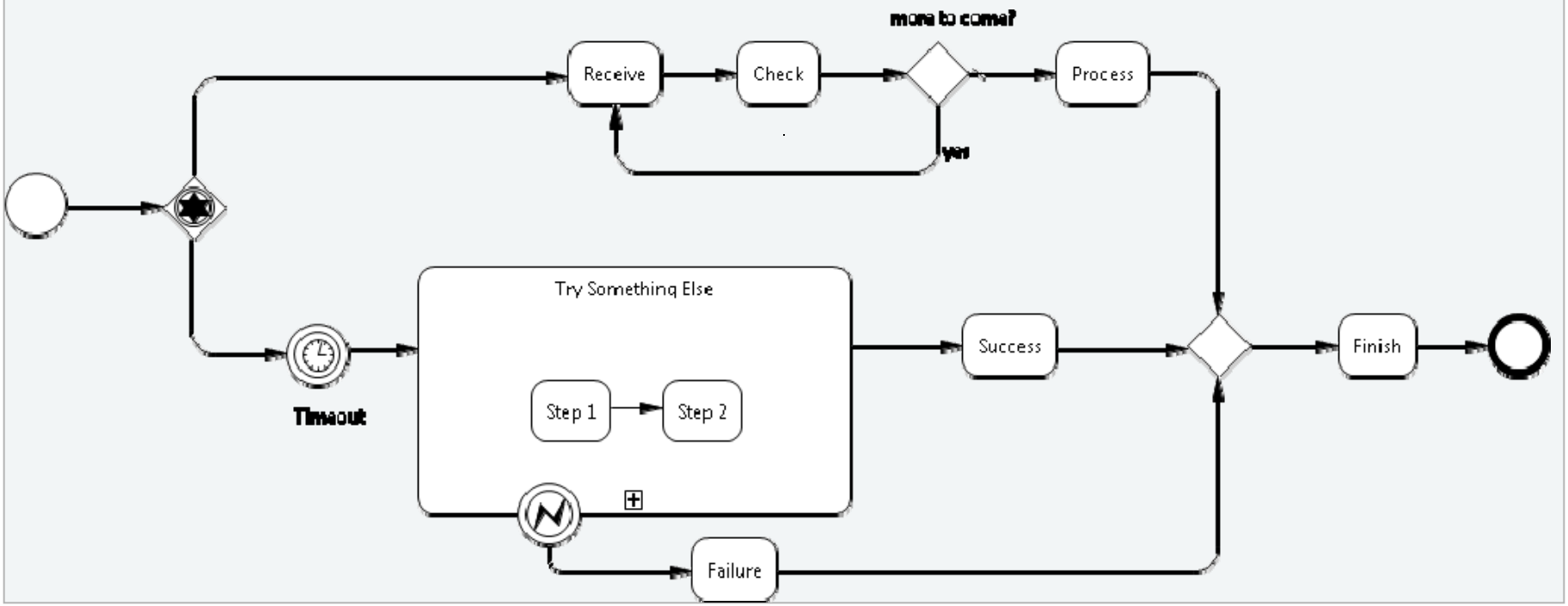
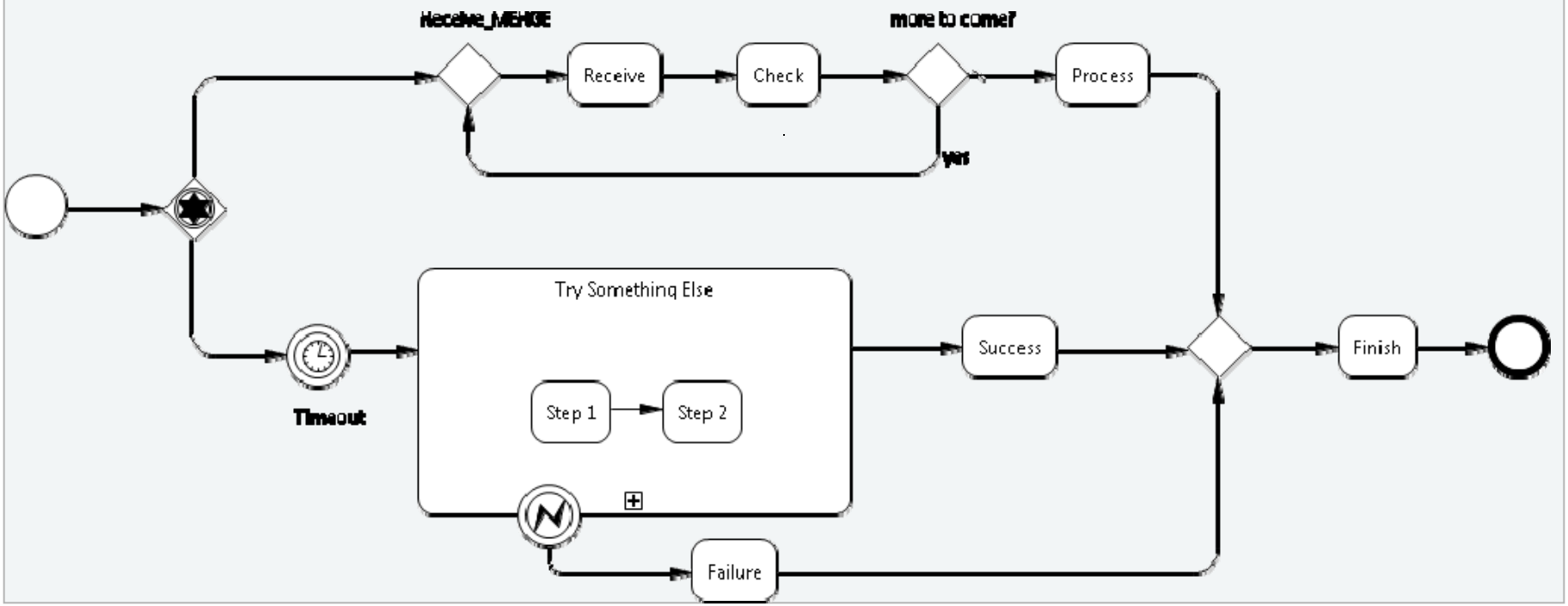
Our starting workflow:



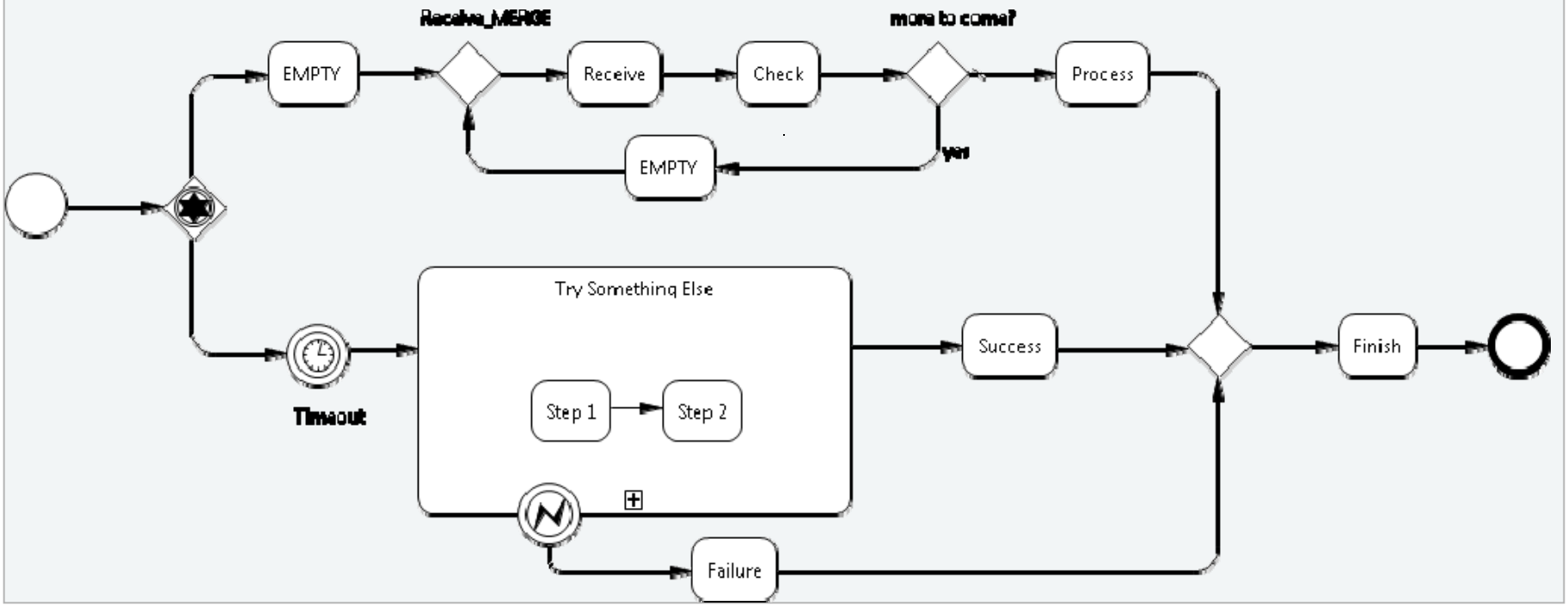
Intermezzo: Example, Step 2

First, insert a Gateway before the Task 'Receive' to simplify the identification of the loop.



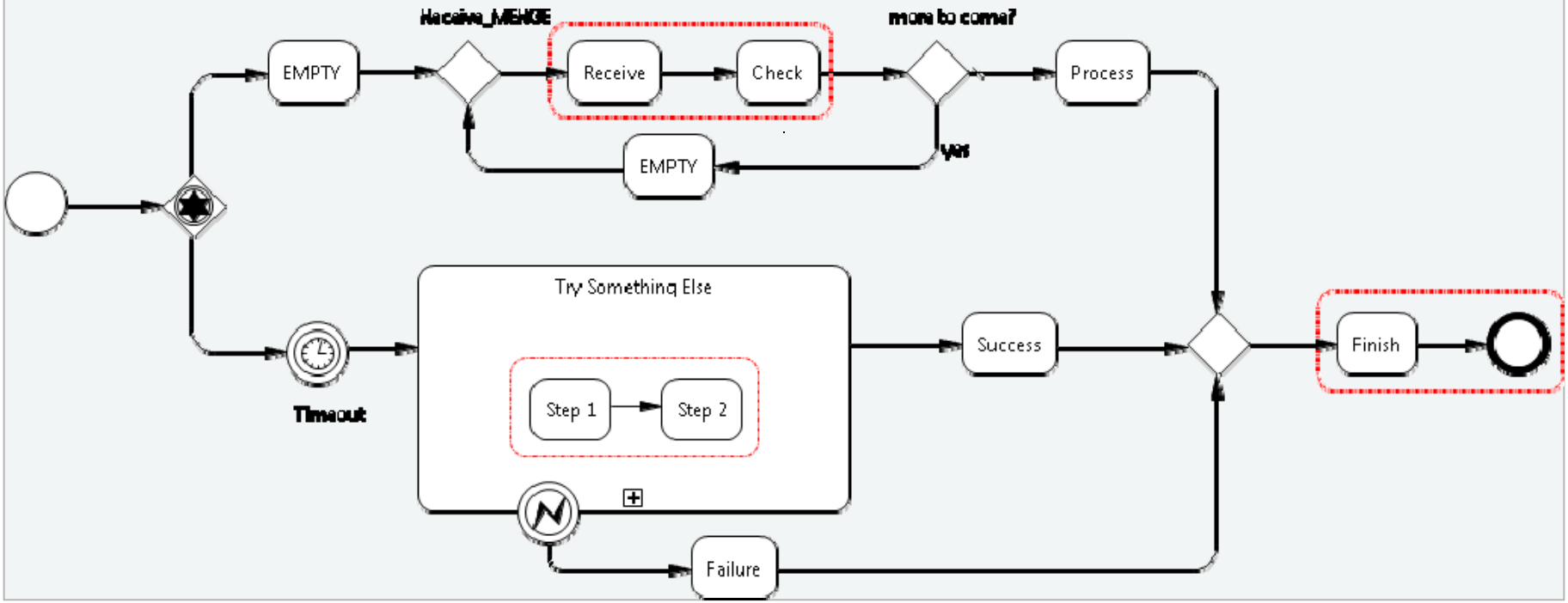
Intermezzo: Example, Step 3

Now, two 'Empty' Activities are inserted between the consecutive Gateways.



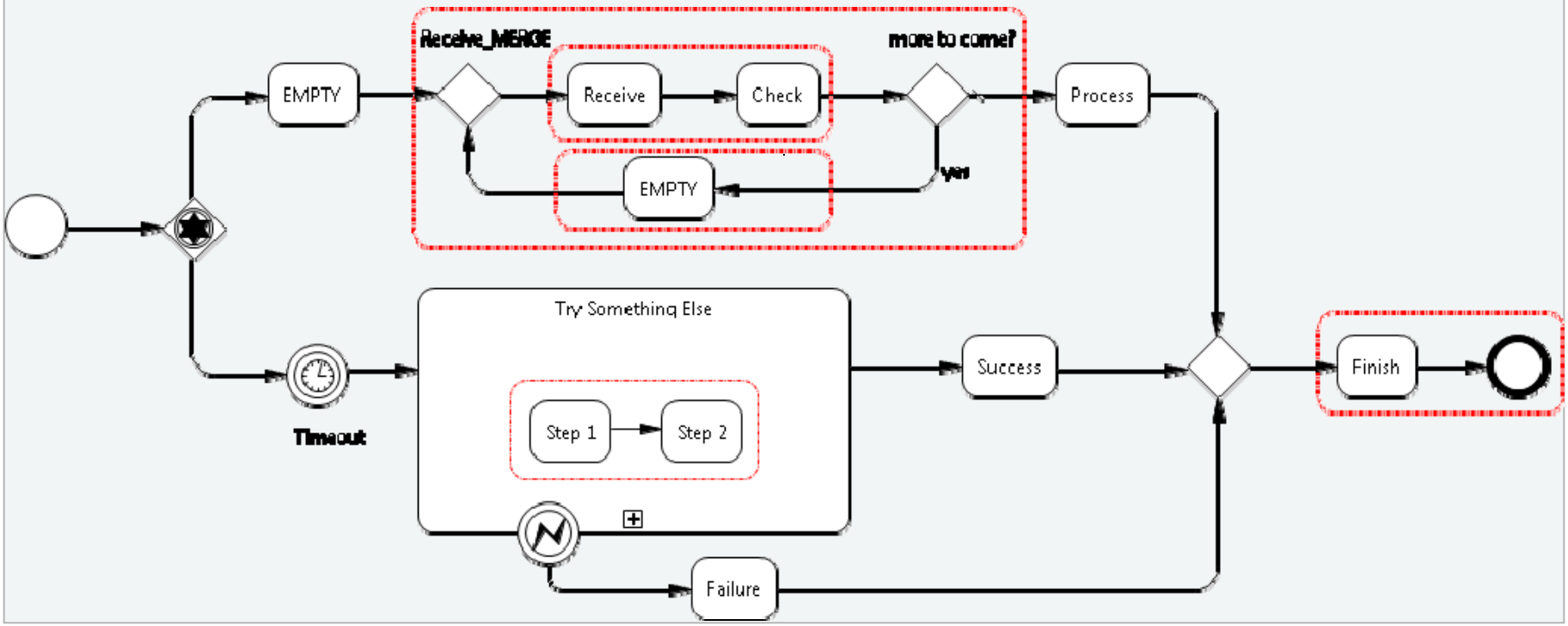
Intermezzo: Example, Step 4

That was the Normalization. The Structure Mapping starts with identifying three Sequences…



Intermezzo: Example, Step 5

Now that the Gateways are only one Flow Object apart, the Loop is identified.



Intermezzo: Example, Step 6

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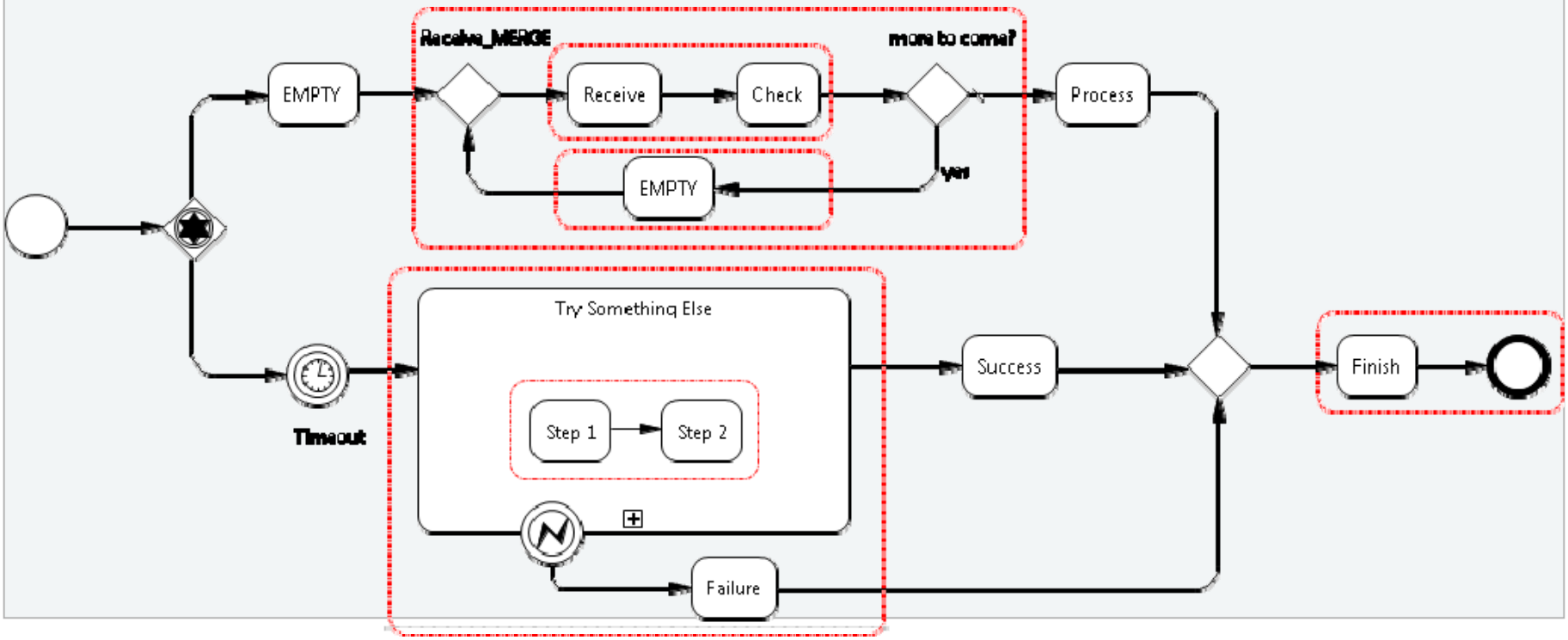
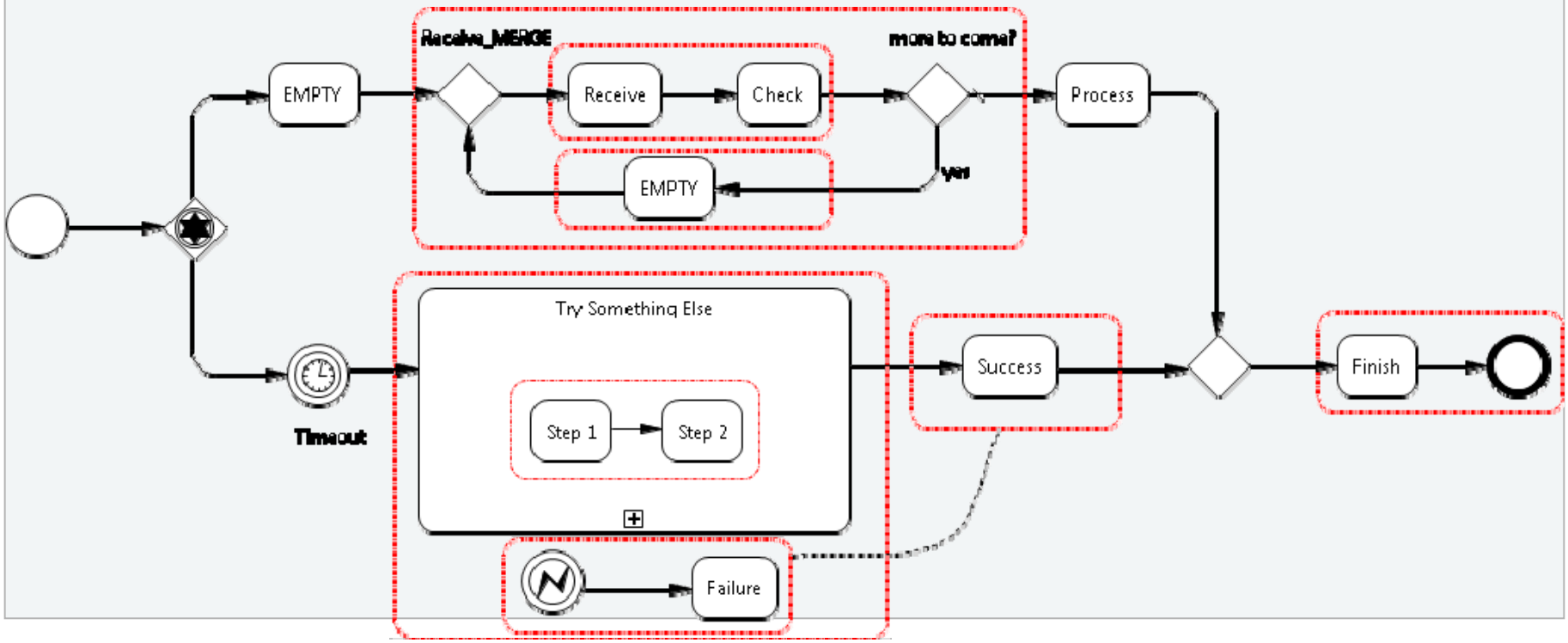
Each Activity with an attached Intermediate Event is recognized as an Event Handler Block.



Intermezzo: Example, Step 7

The Compensation Flow is detached from the Activity and put into the Event Handler Block, together with a reference to the Activity to skip.



Intermezzo: Example, Step 8

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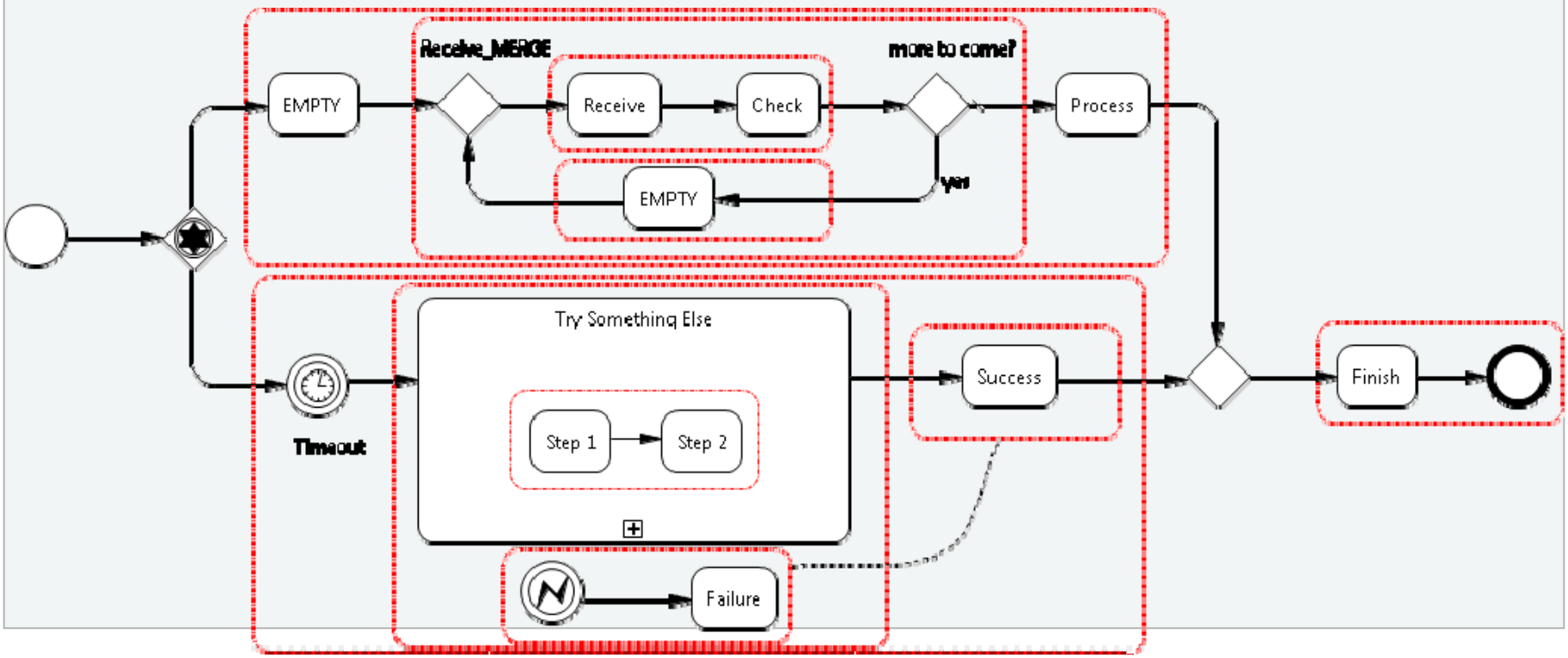
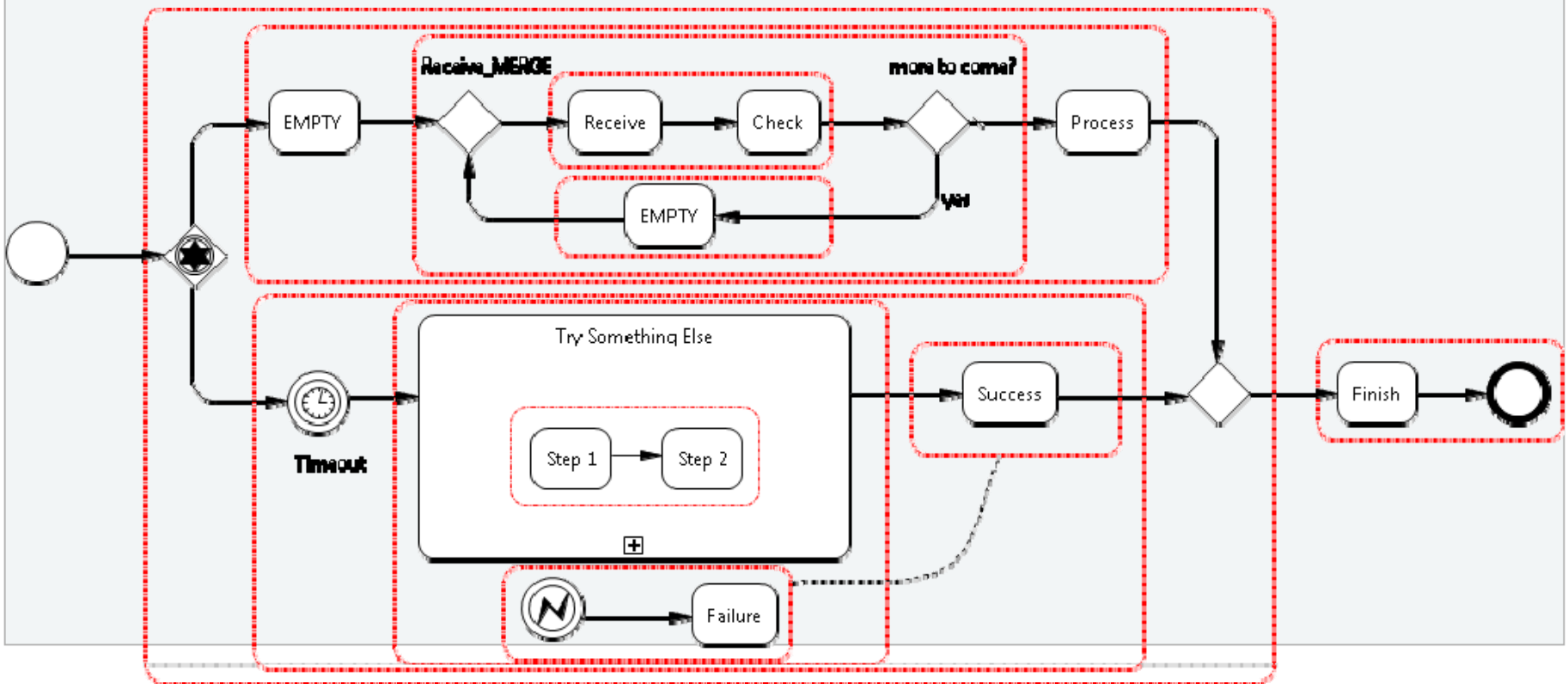
Two more Sequences are wrapped around the branches of the large decision block…



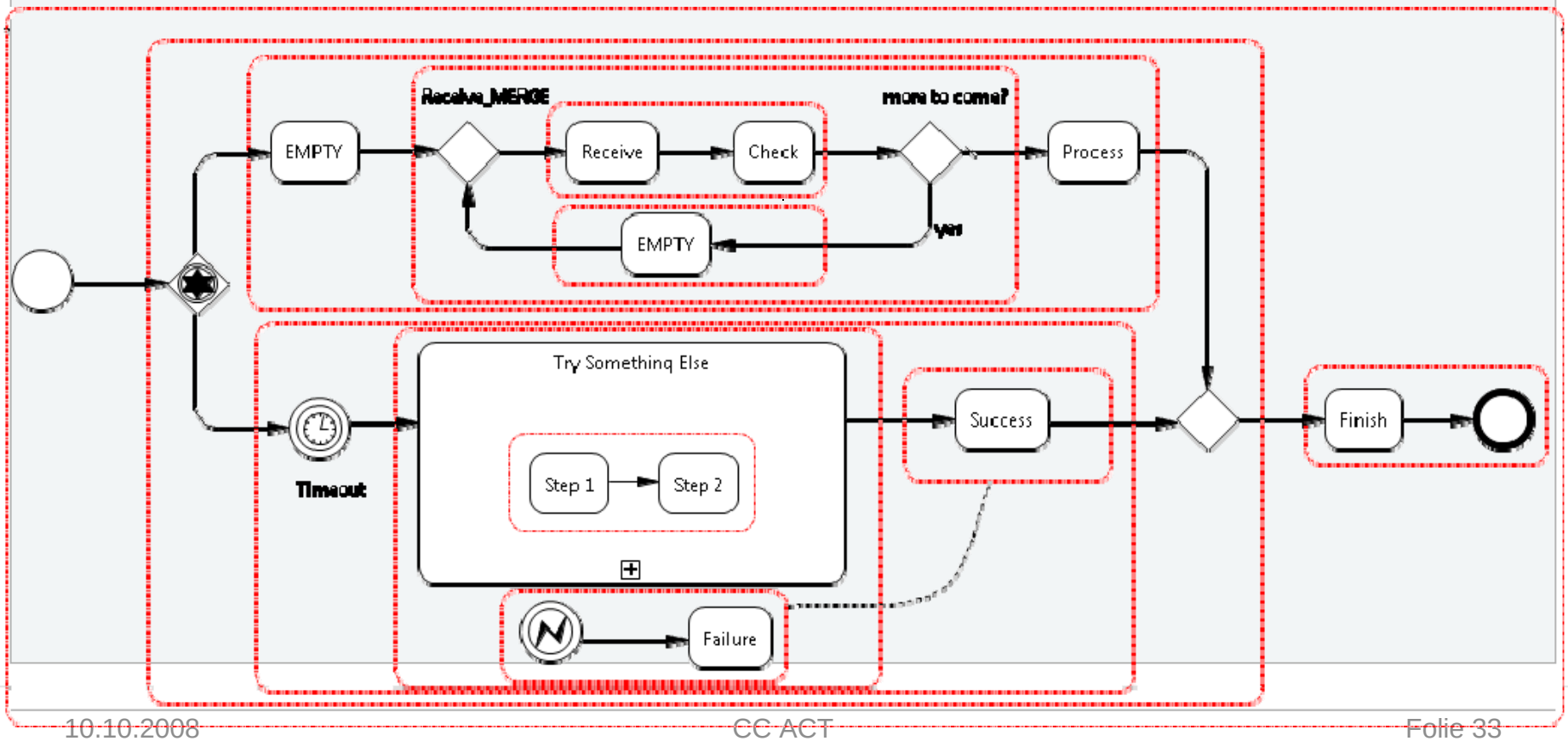
Intermezzo: Example, Step 9

…and in the next step the block itself is identified.



Intermezzo: Example, Step 10

By identifying the outermost sequence the Structure Mapping is finished.



Intermezzo: Example, Step 11

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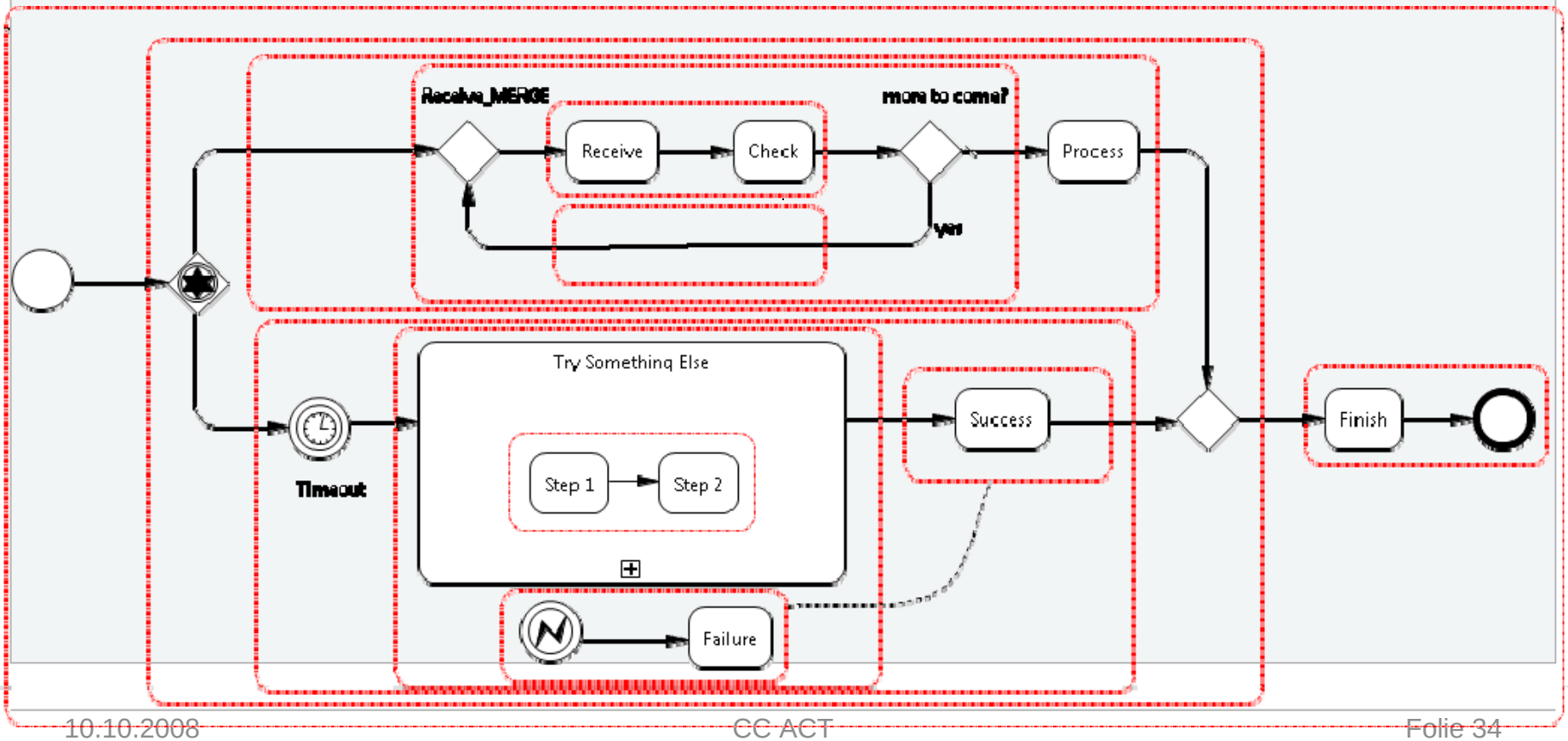
Finally, the 'Empty' Activities inserted earlier are removed.
The result is the input for the Element Mapping stage.



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Transformation to BPEL: Stages

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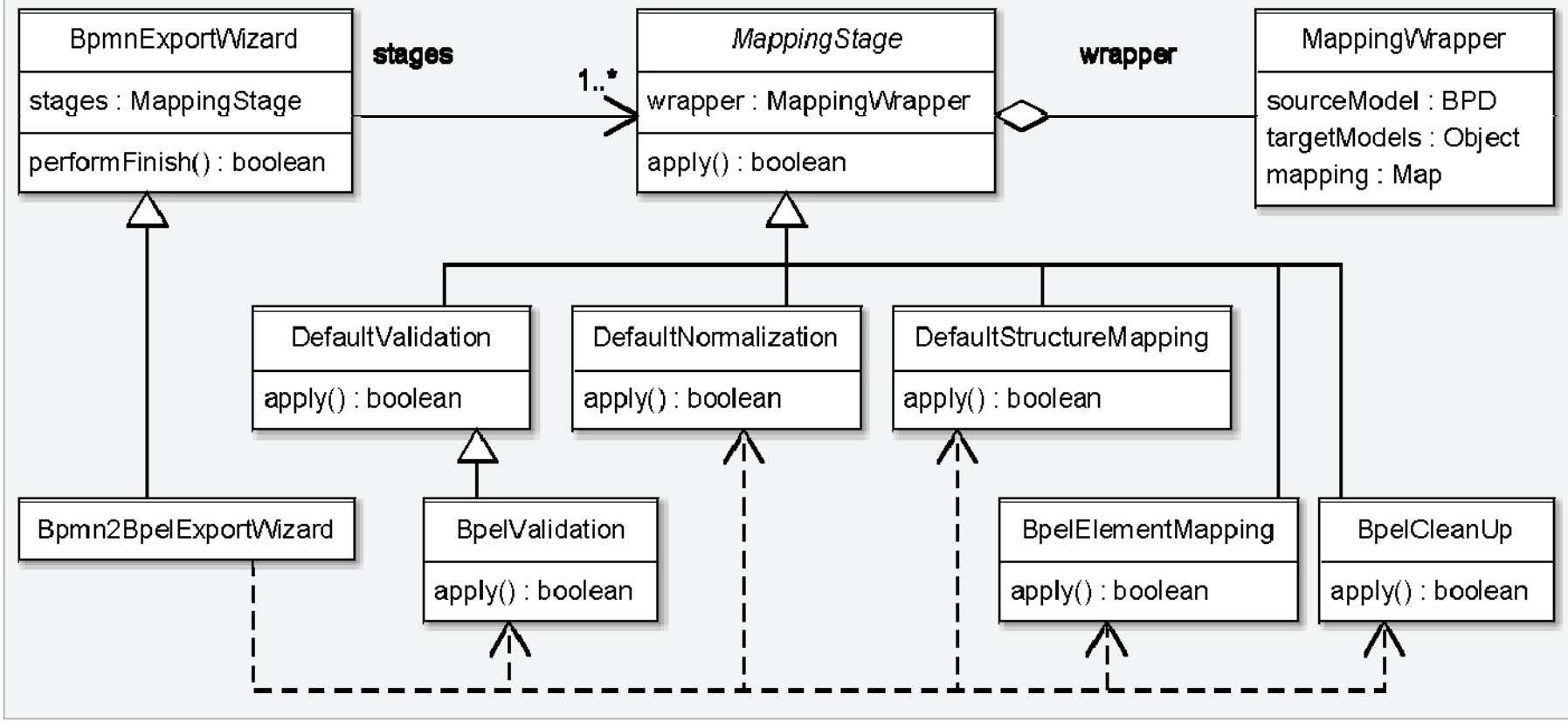
- Transformation Stages in the BPEL case



Transformation to BPEL: Coverage

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- Covers nearly the whole mapping
  - Event Handlers, Event-based XOR, OR, …
  - for some elements the mapping is not clear
    - Rule Event, MI Loop, Independent Subprocess, …
    - mapped as described in the specification, but will require some manual rework
  - creates WSDL file holding desc. of orchestr. services
    - **`<binding>`** and **`<service>`** blocks have to be added manually
- Variable name substitution:
  - Given Process **`p`** with Property **`x,`** Expression **`$x+1`** is changed to **`bpws:getVariableData('p_ProcessData','x')+1`**.

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Tool Demonstration

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Conclusion

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- Introducing the *'Visual Service Design Tool'…*
  - pure BPMN editor, mappings and language-specific editing support can be plugged in
  - advantage: One BPMN diagram can be exported to arbitrary target languages
- … and a versatile Transformation Framework
  - easy creation and integration of new transformations
  - reusable mapping of graph structure
  - can create readily executable BPEL code
  - more to come!

Conclusion: Future Work

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- Future Work
  - further improvement of structure mapping
  - better support for (complex) data types
    - widely disregarded in the BPMN specification
    - both in the editor and during the transformation
  - import from executable code to BPMN
    - still problems with back-transformation of event handlers
  - transformation to further languages
    - focus: Multiagent-Systems
- Long-term goal: Transforming BPMN to Heterogeneous Systems

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