Business Process Management: Concepts, Languages, Architectures

Second Edition

Figures of Chapter 4

Mathias Weske

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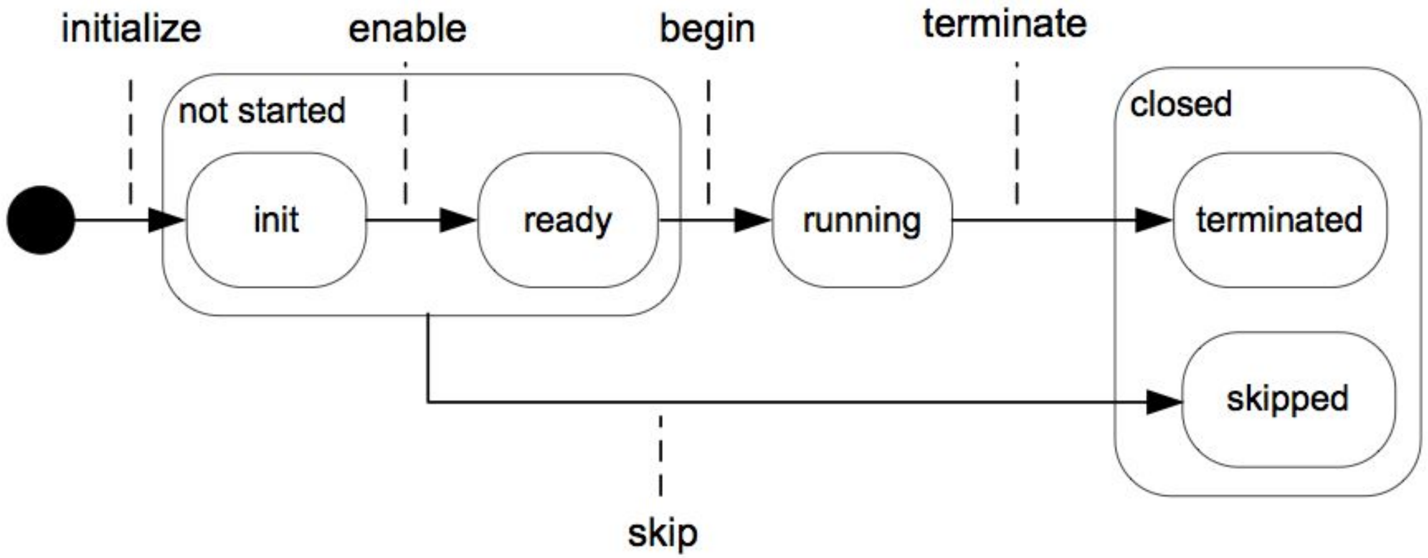

Fig. 4.1. State transition diagram for activity instances

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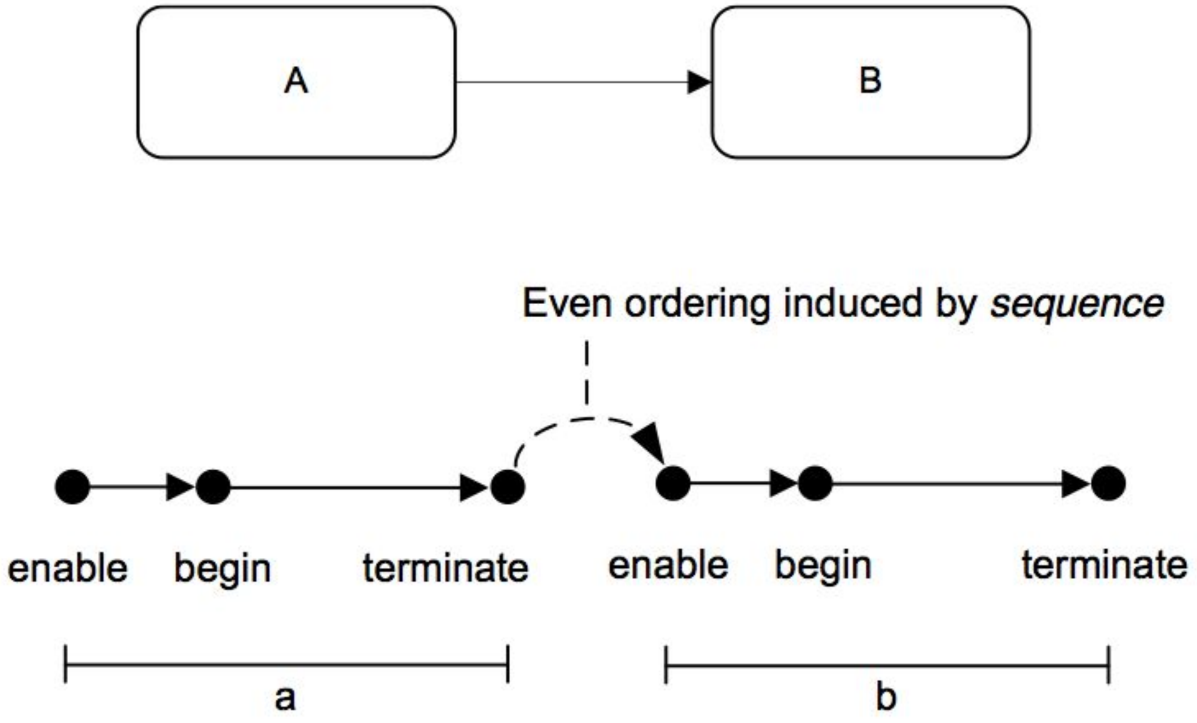

Fig. 4.2. Sequence pattern, with event diagram of process instance

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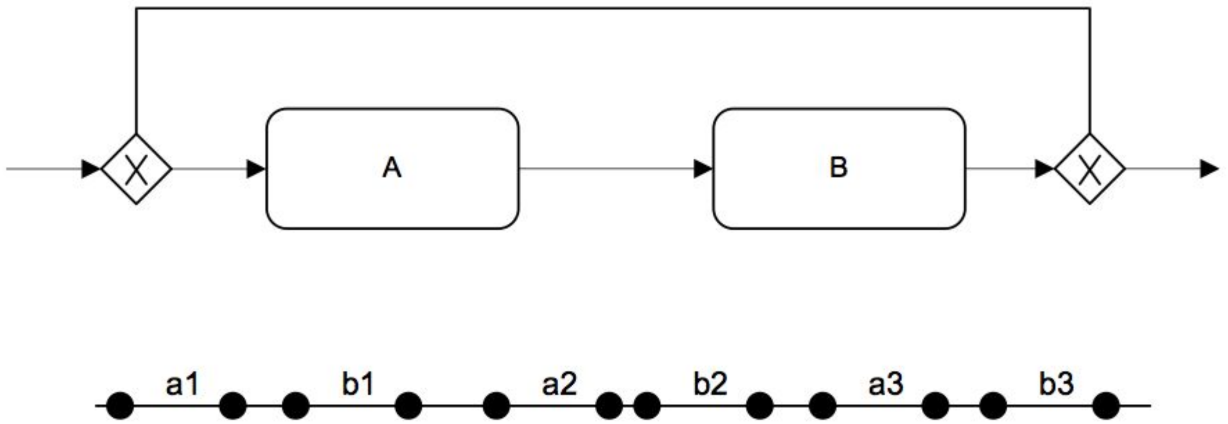

Fig. 4.3. Sequence pattern as part of a loop and event diagram showing three loop iterations

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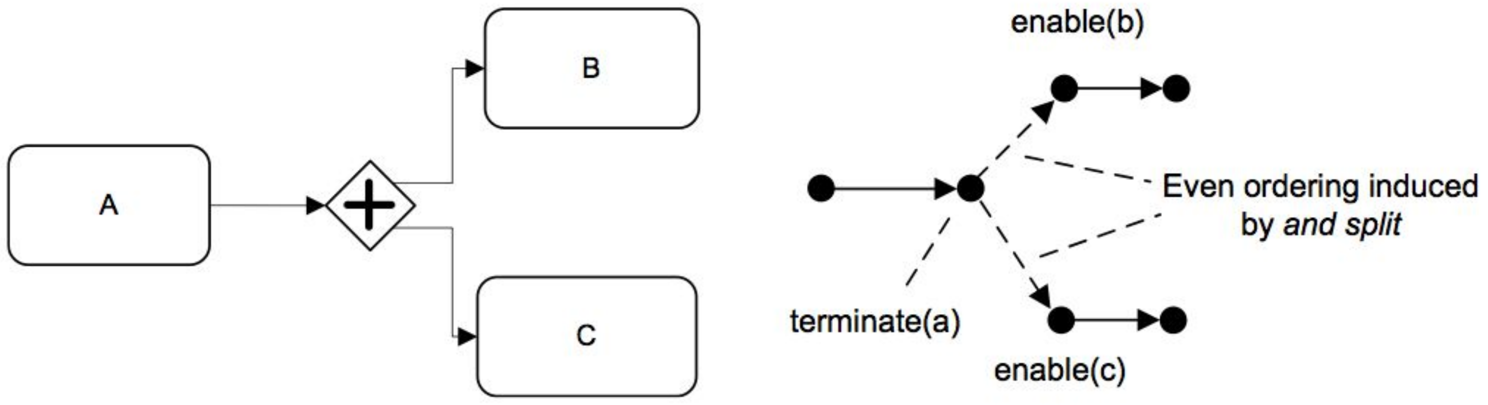

Fig. 4.4. And split pattern

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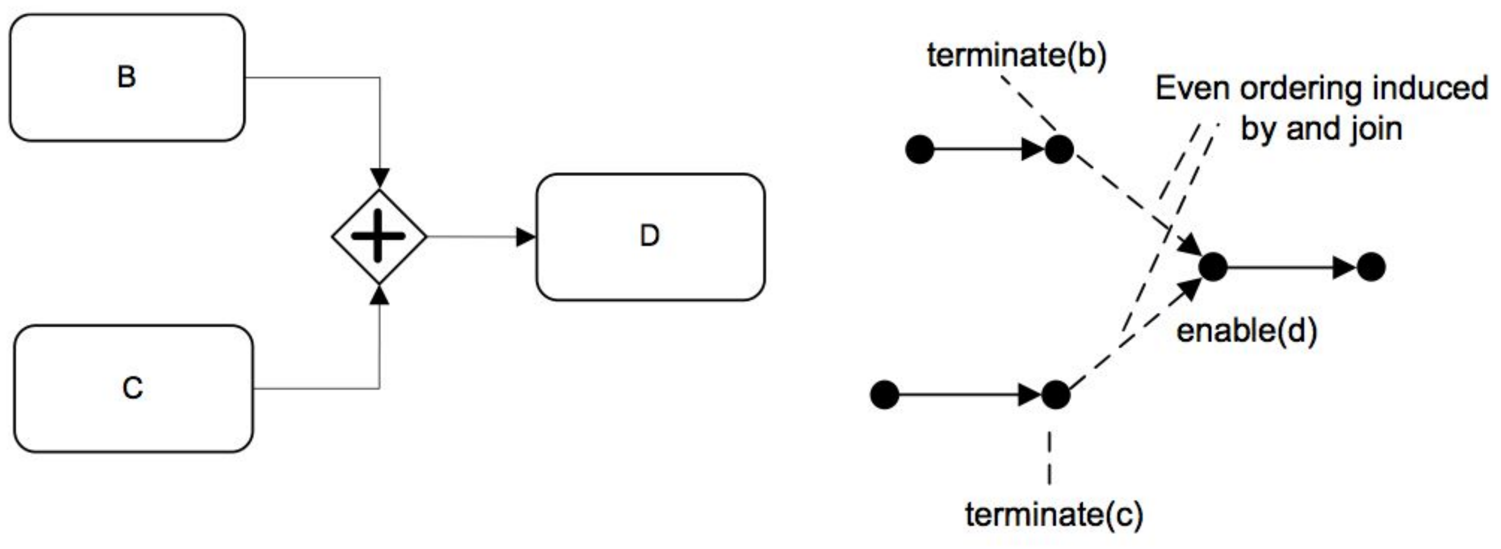

Fig. 4.5. And join pattern

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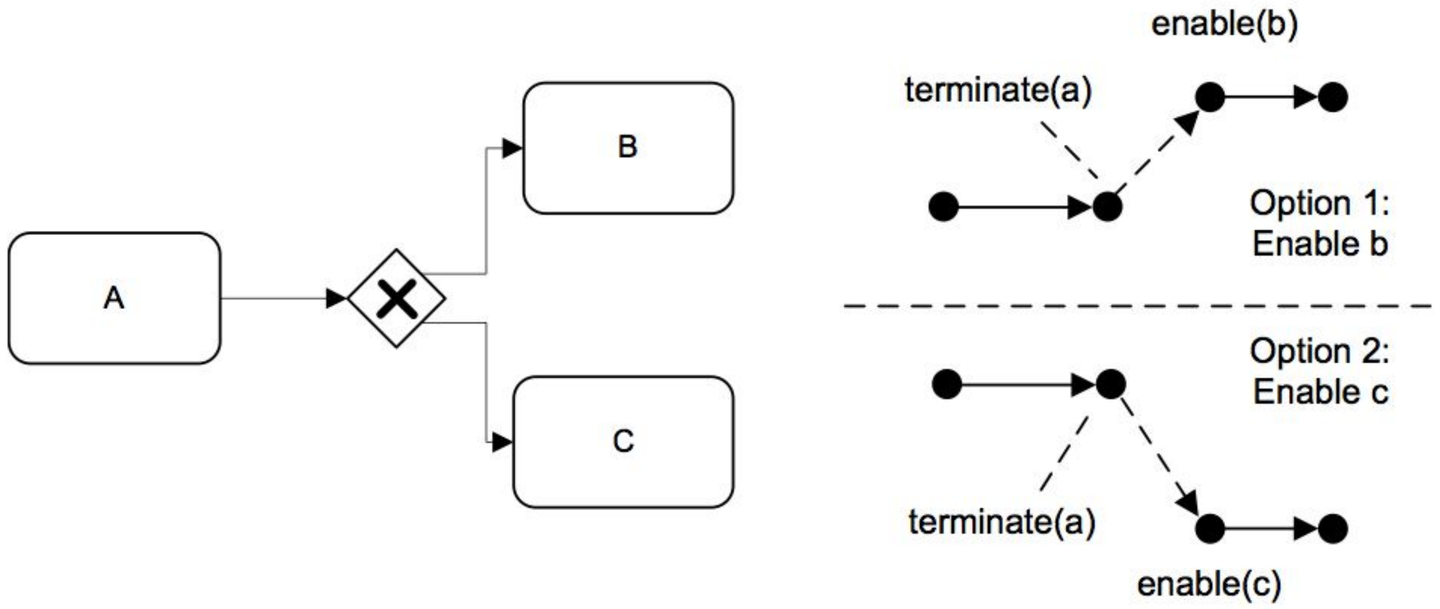

Fig. 4.6. Xor split pattern

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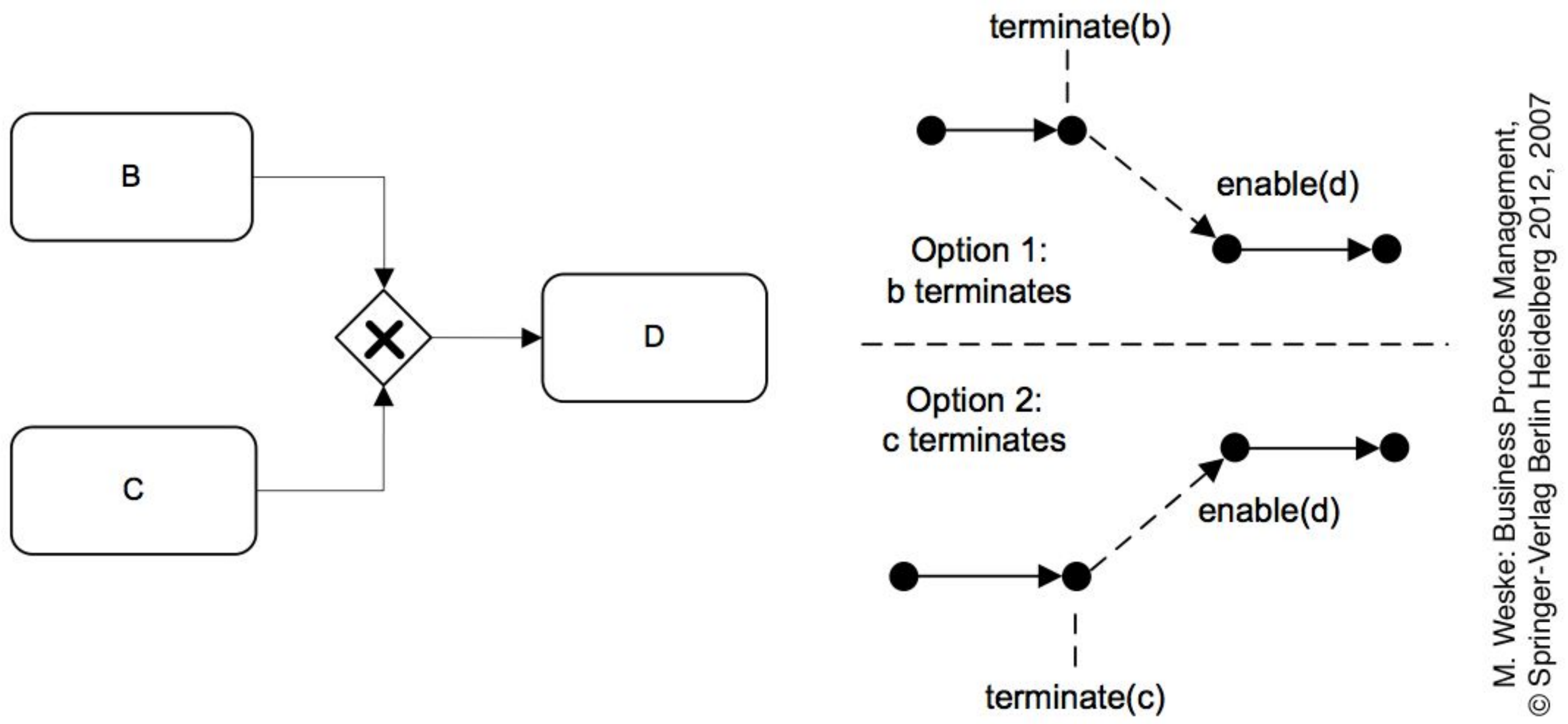

Fig. 4.7. Xor join pattern

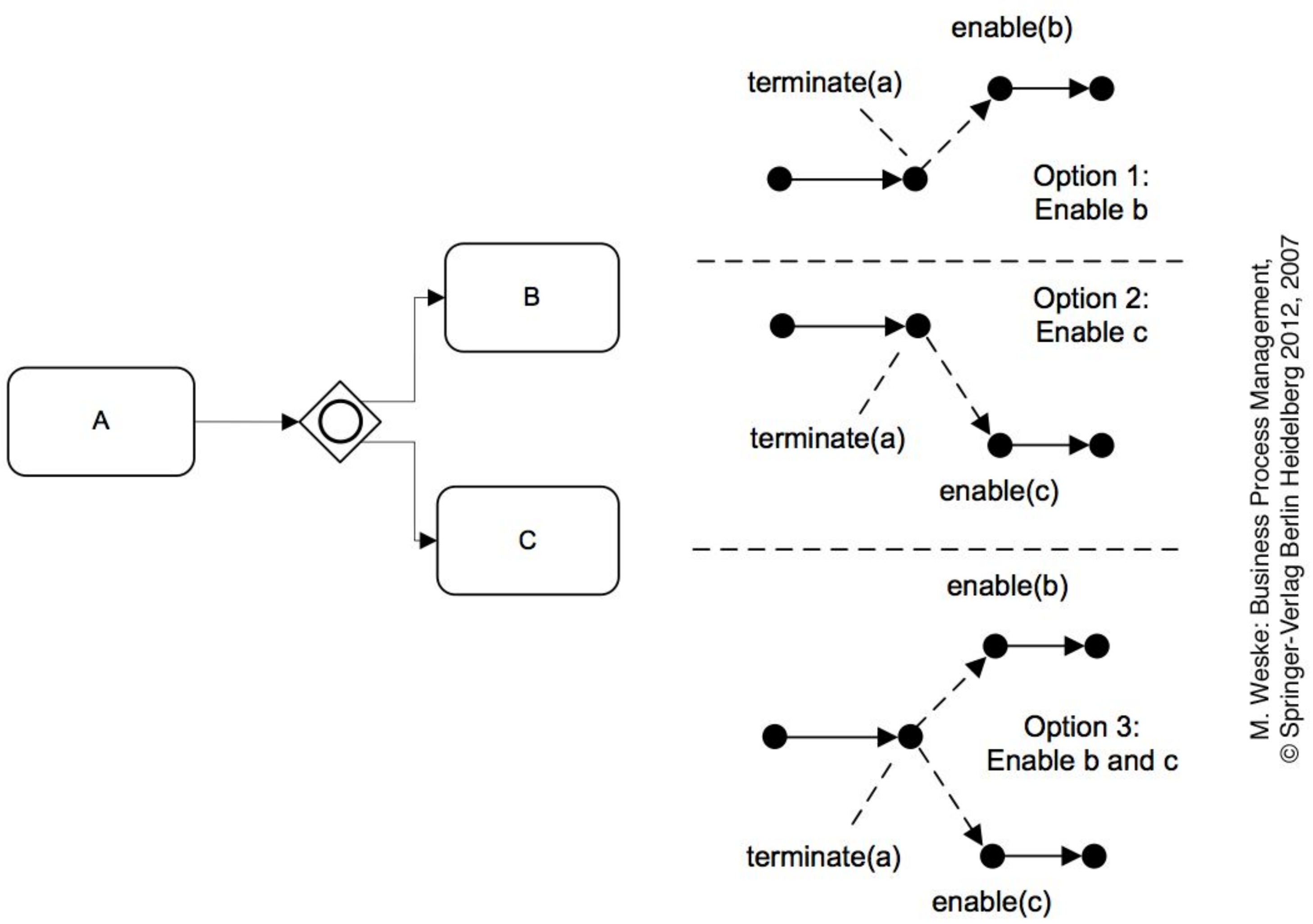

Fig. 4.8. Or split pattern

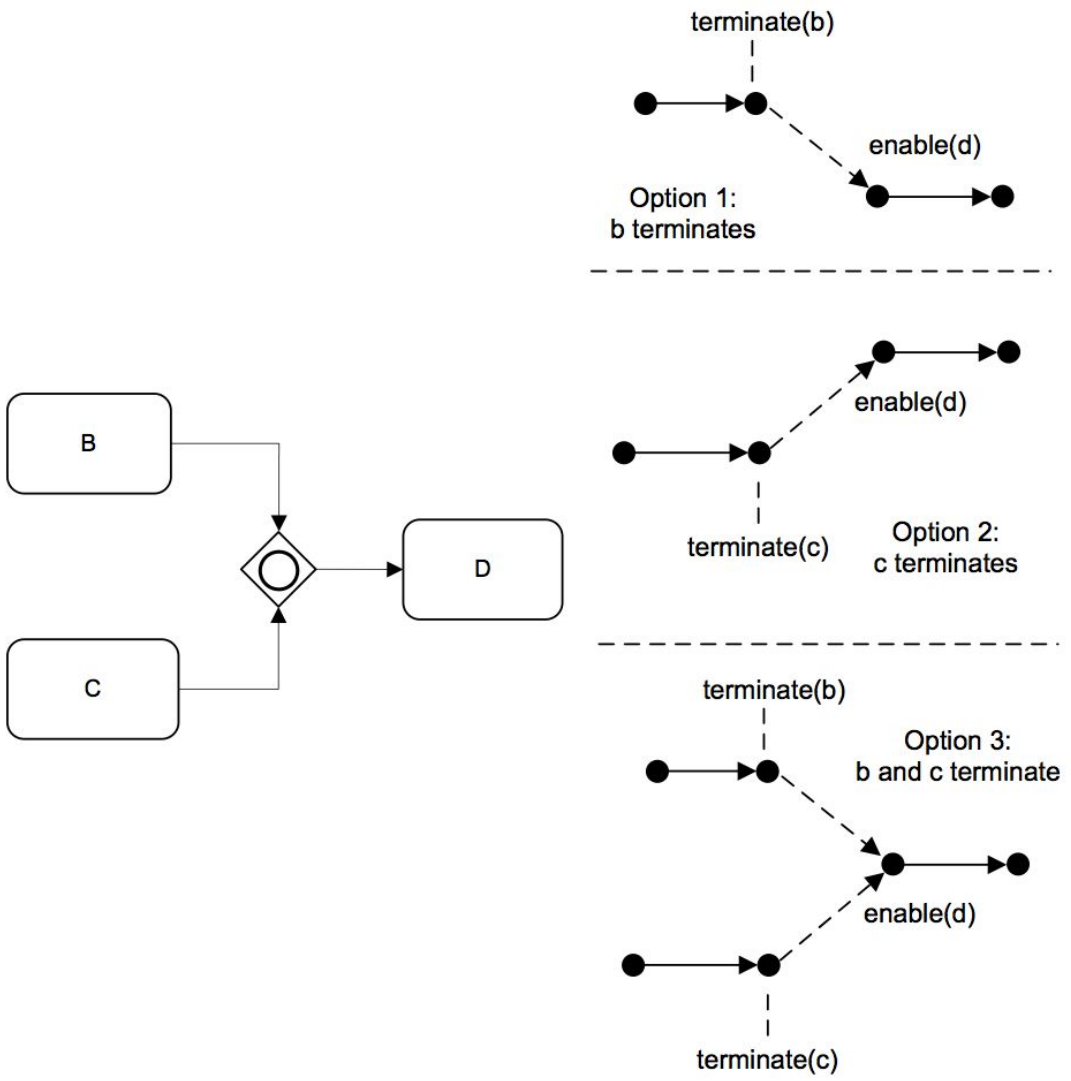

Fig. 4.9. Or join pattern

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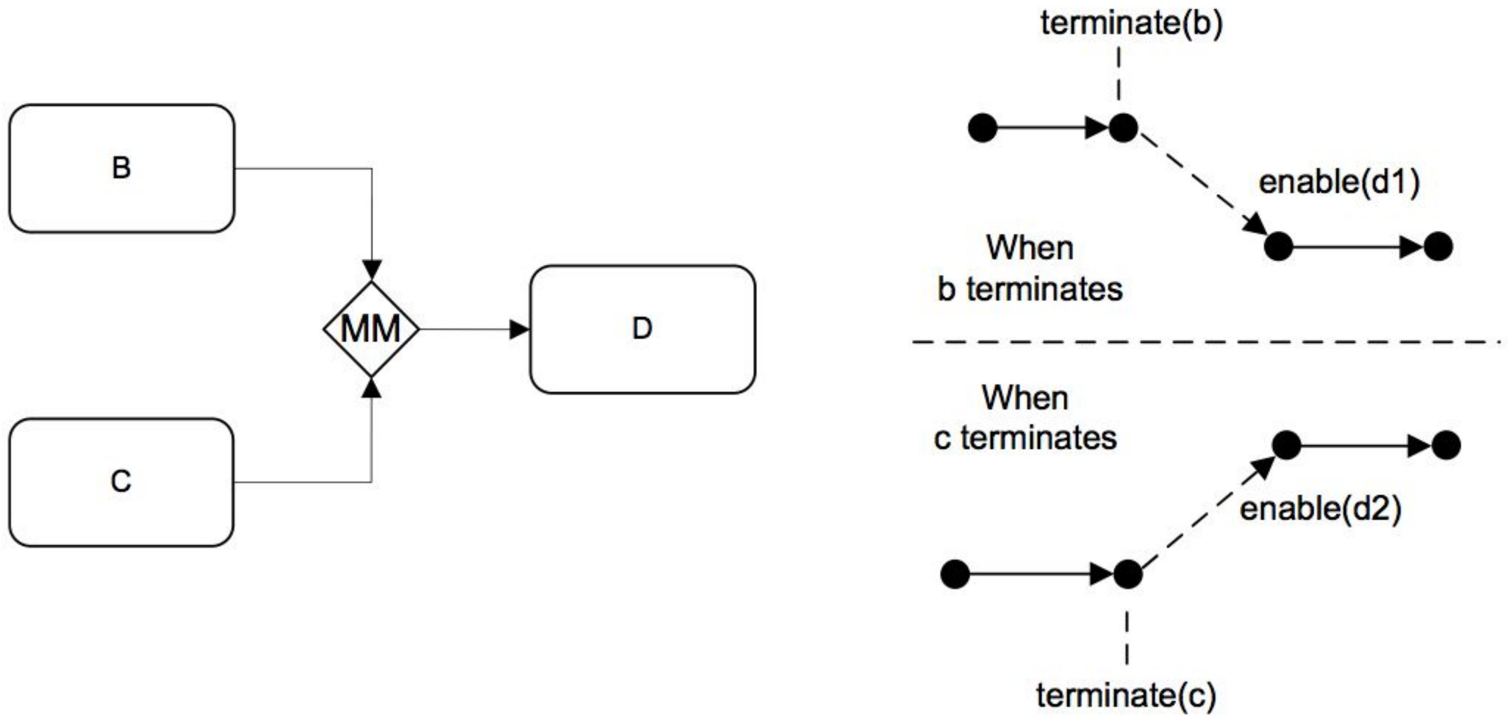

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Fig. 4.10. Multi-merge pattern

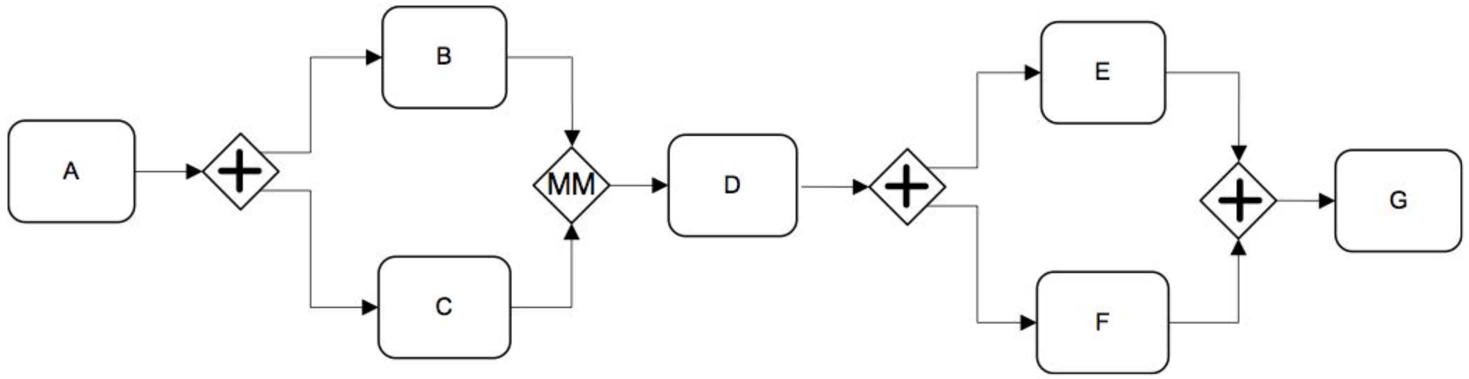

Fig. 4.11. Multi-merge example might lead to incorrect synchronization of branches

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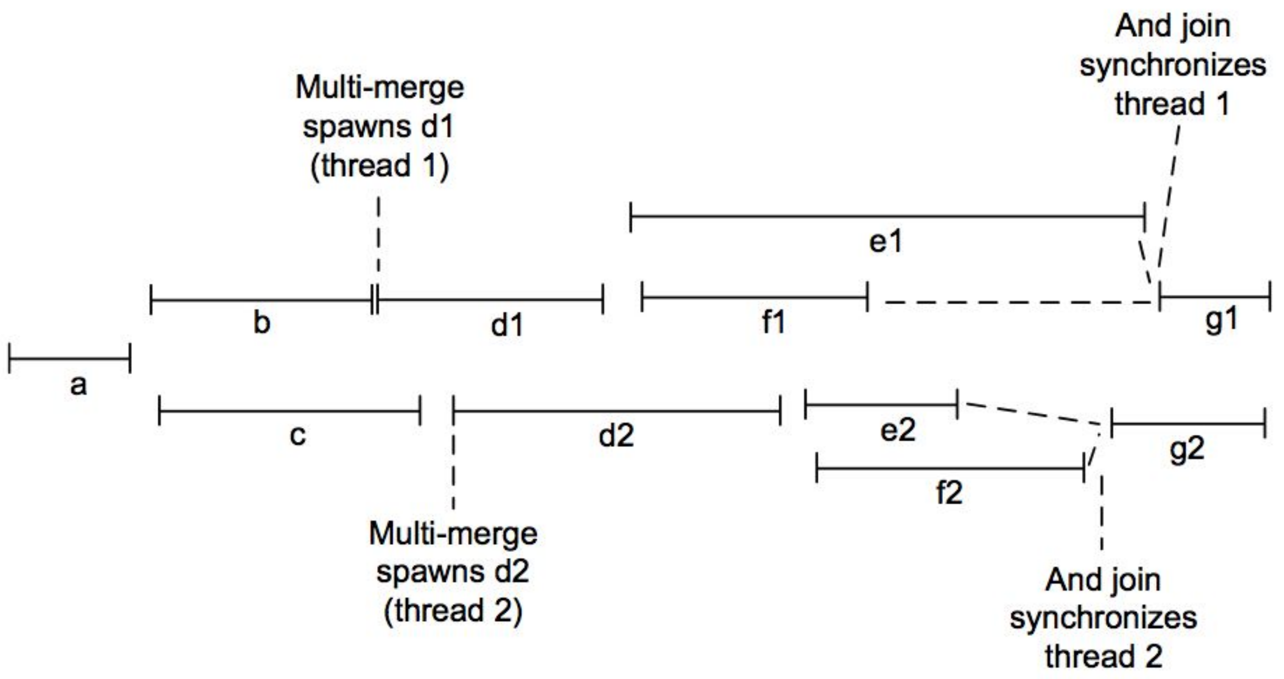
And join synchronizes thread 1
Multi-merge spawns d1 (thread 1)
e1
b
d1
f1
g1
a
c
d2
e2
g2
f2
Multi-merge spawns d2 (thread 2)
And join synchronizes thread 2

Fig. 4.12. Event diagram of a process instance based on the process model shown in Figure 4.11

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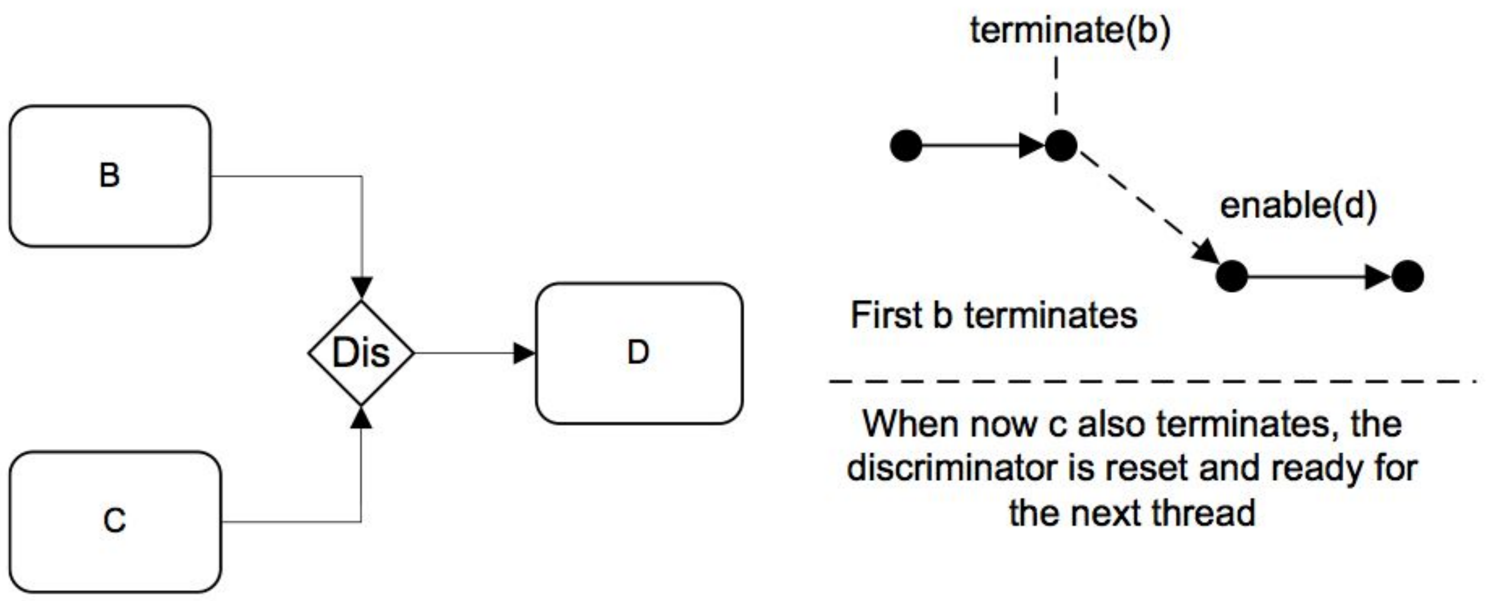
terminate(b)
B
enable(d)
Dis
D
C
First b terminates
When now c also terminates, the discriminator is reset and ready for the next thread

Fig. 4.13. Discriminator pattern

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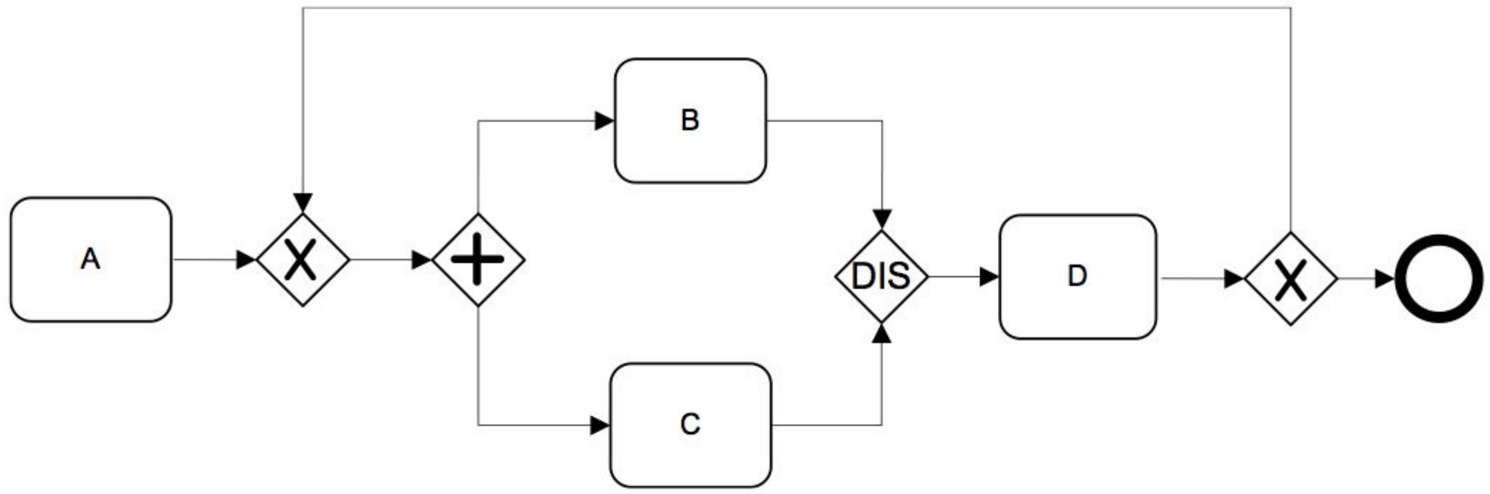

Fig. 4.14. Discriminator example

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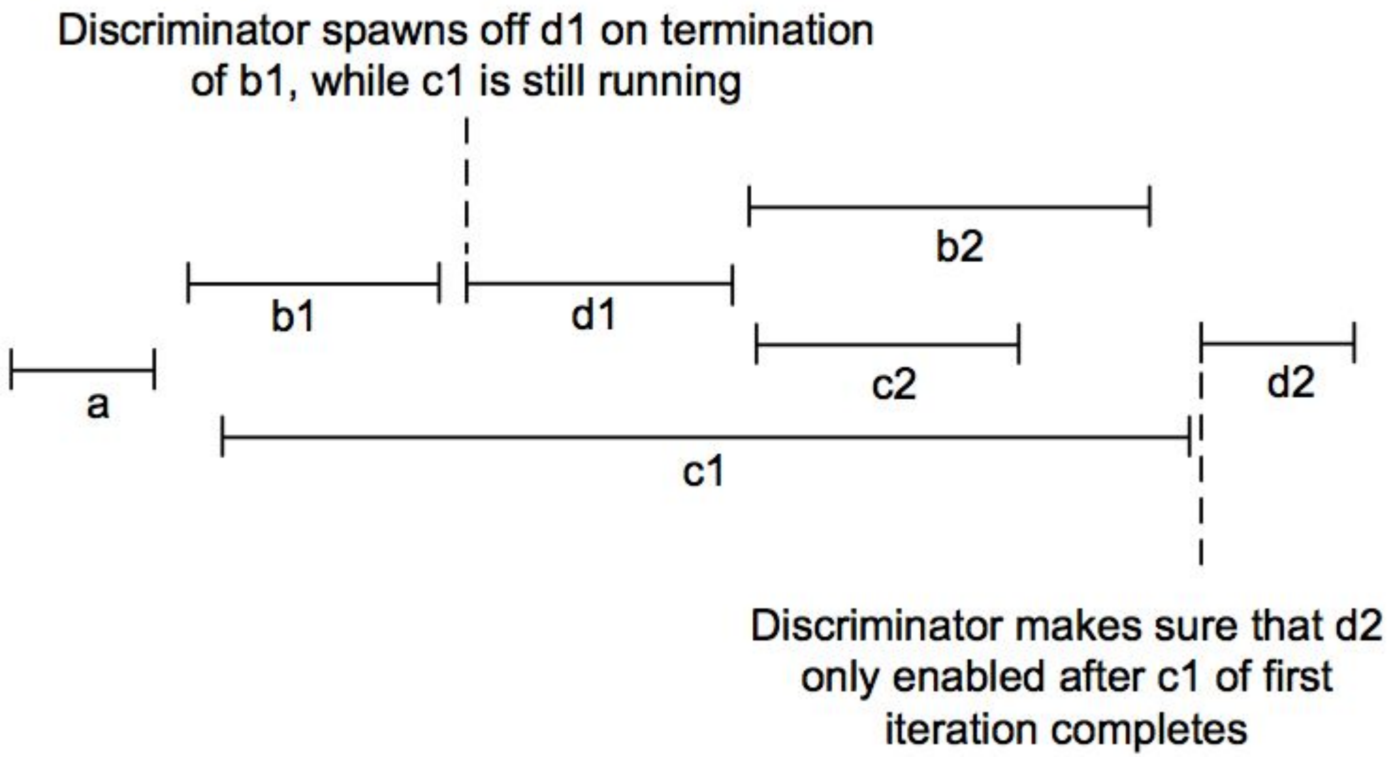
Discriminator spawns off d1 on termination of b1, while c1 is still running
b2
b1
d1
a
c2
d2
c1
Discriminator makes sure that d2 only enabled after c1 of first iteration completes

Fig. 4.15. Event diagram of discriminator example

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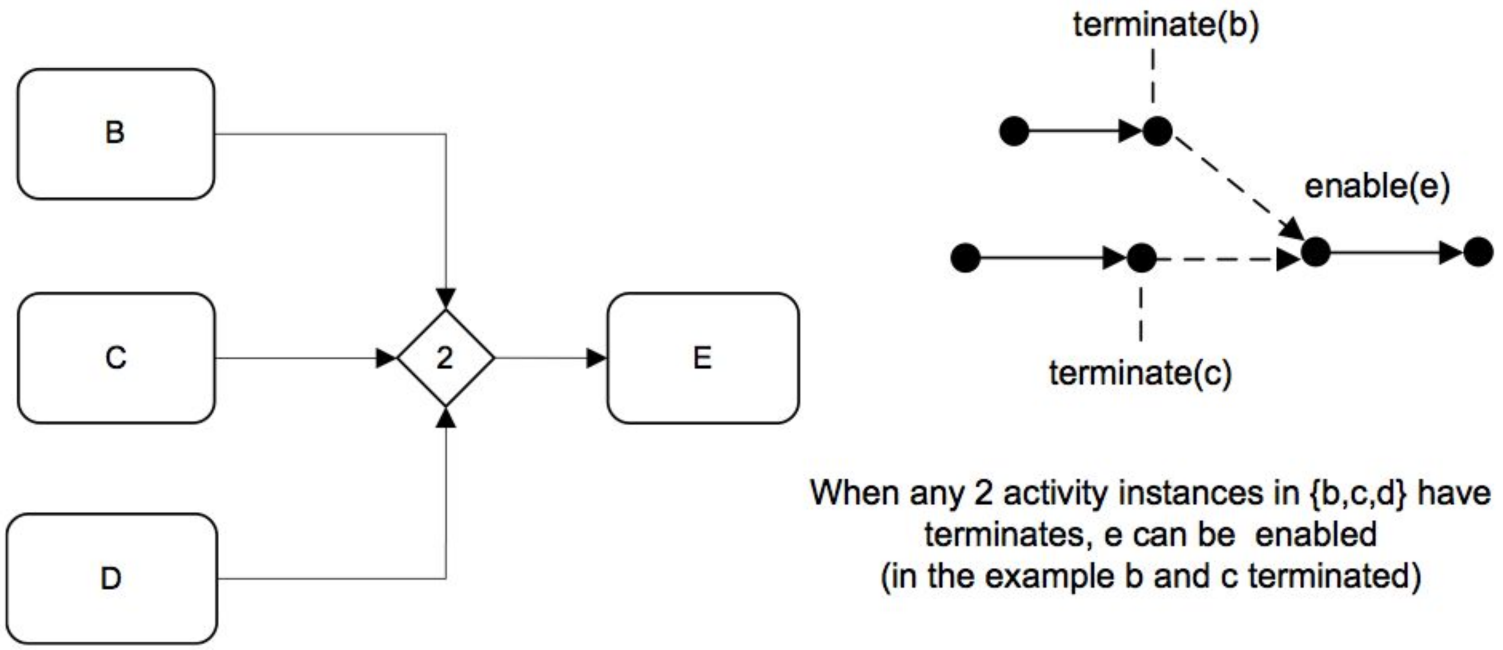

When any 2 activity instances in {b,c,d} have terminates, e can be enabled (in the example b and c terminated)

Fig. 4.16. N-out-of-M join pattern

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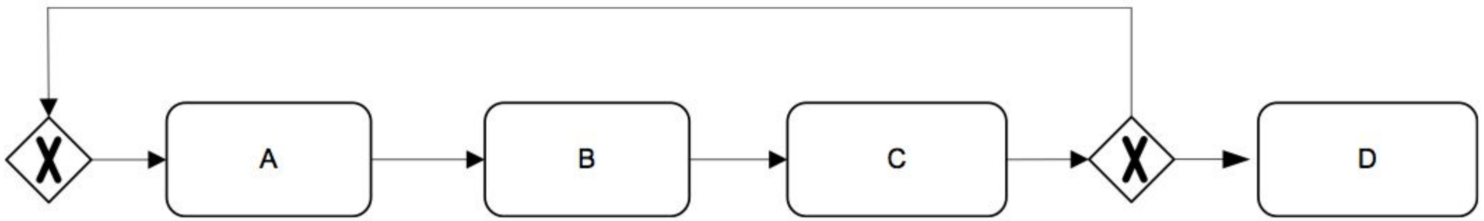

Fig. 4.17. Graphical representation of arbitrary cycles pattern

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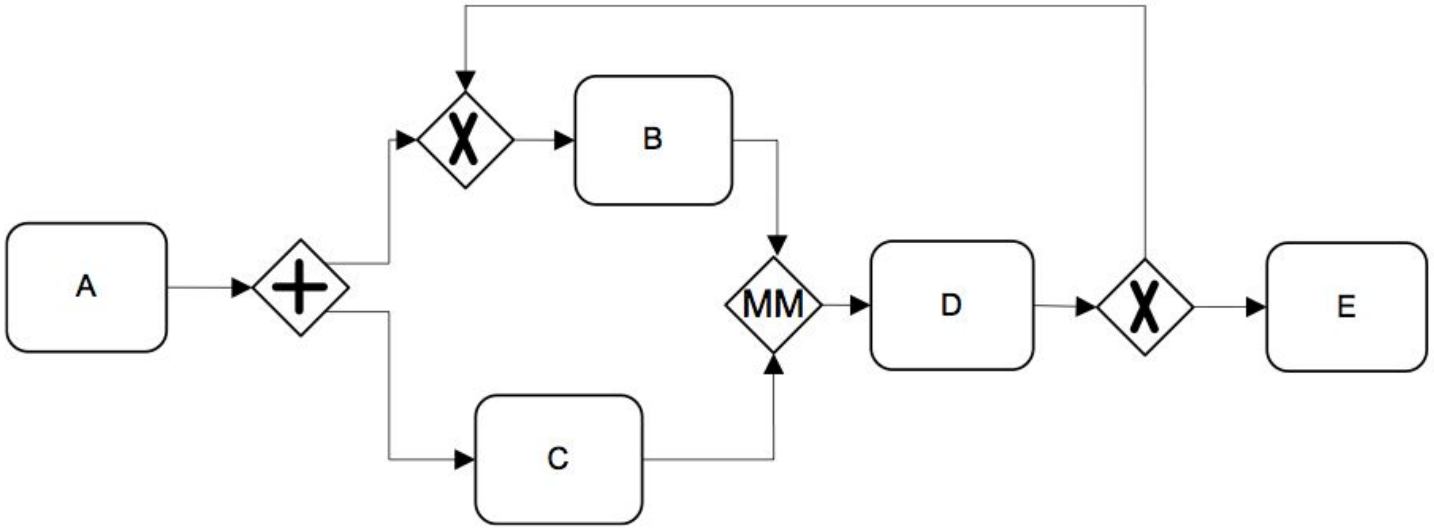

Fig. 4.18. Arbitrary cycles example, using multiple merge pattern

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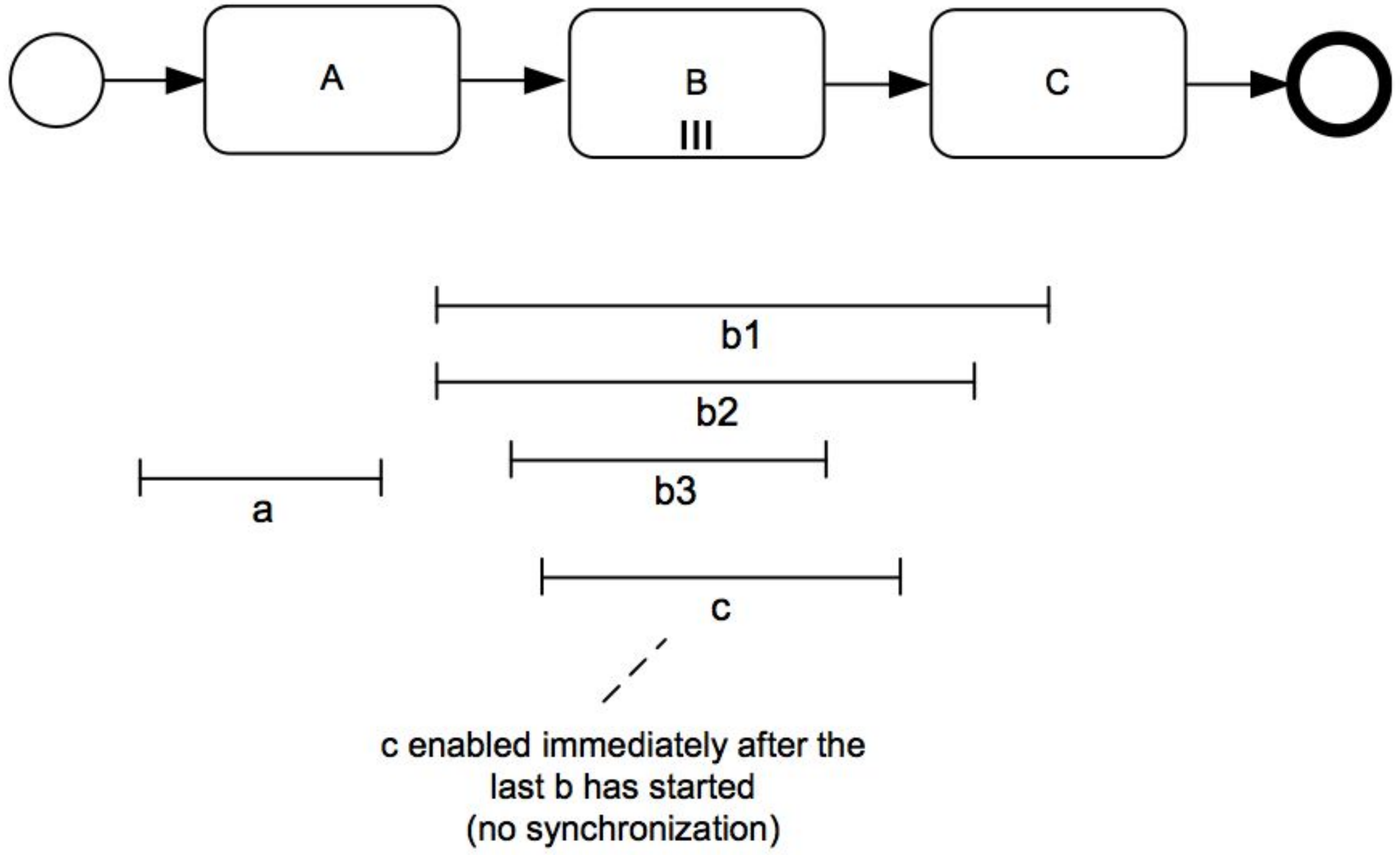

Fig. 4.19. Example for multiple instances without synchronization

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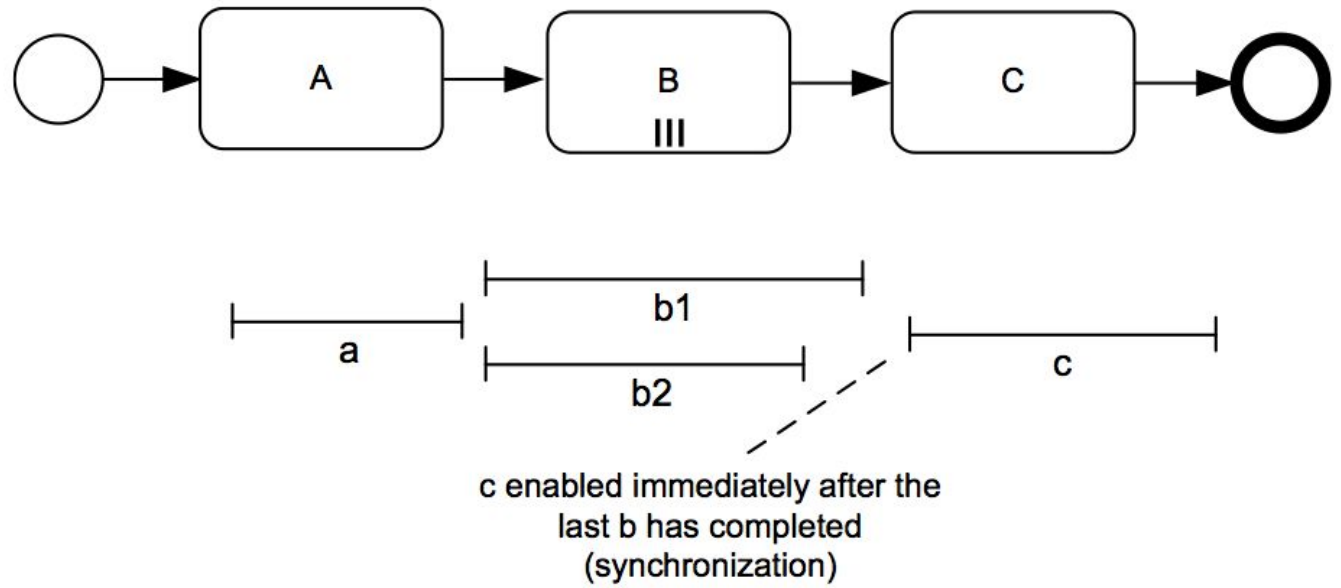
A
B
III
C
a
b1
b2
c
c enabled immediately after the last b has completed (synchronization)

Fig. 4.20. Example for multiple instances with a priori design time knowledge

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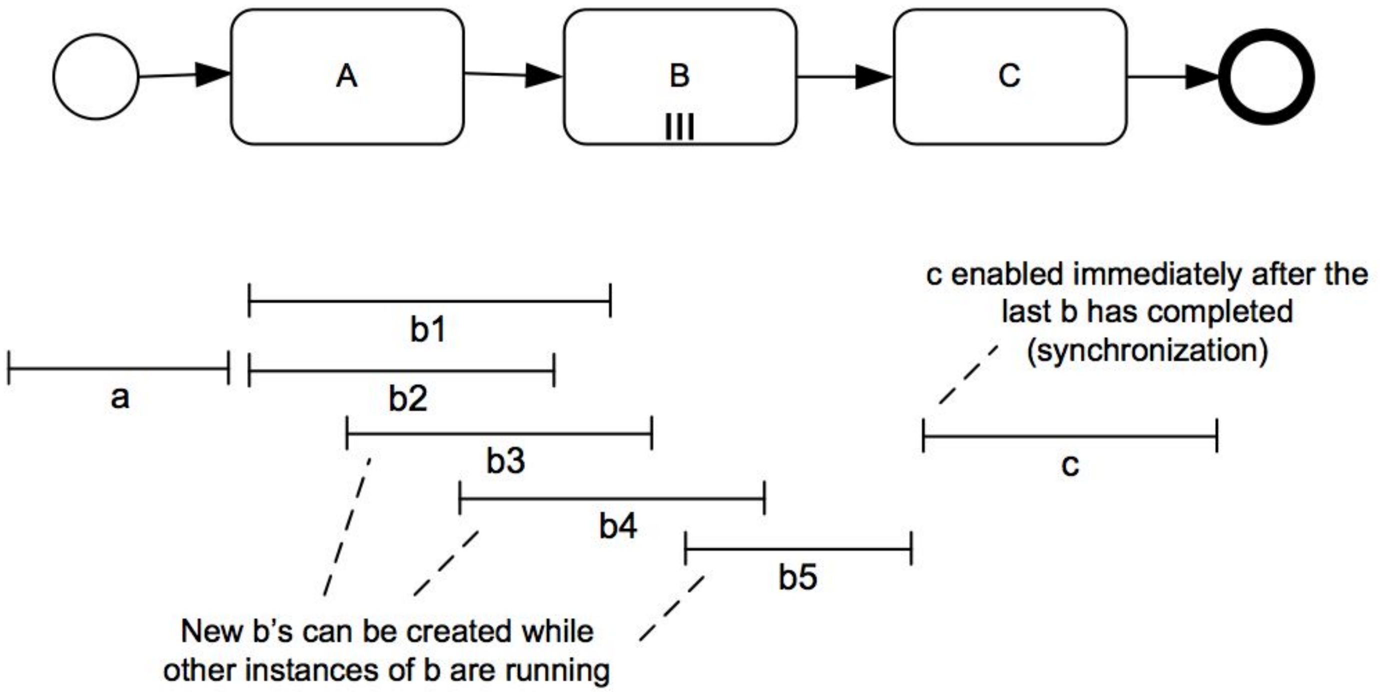
A
B
C
b1
a
b2
b3
b4
b5
c
c enabled immediately after the last b has completed (synchronization)
New b's can be created while other instances of b are running

Fig. 4.21. Example for multiple instances without a priori run time knowledge pattern

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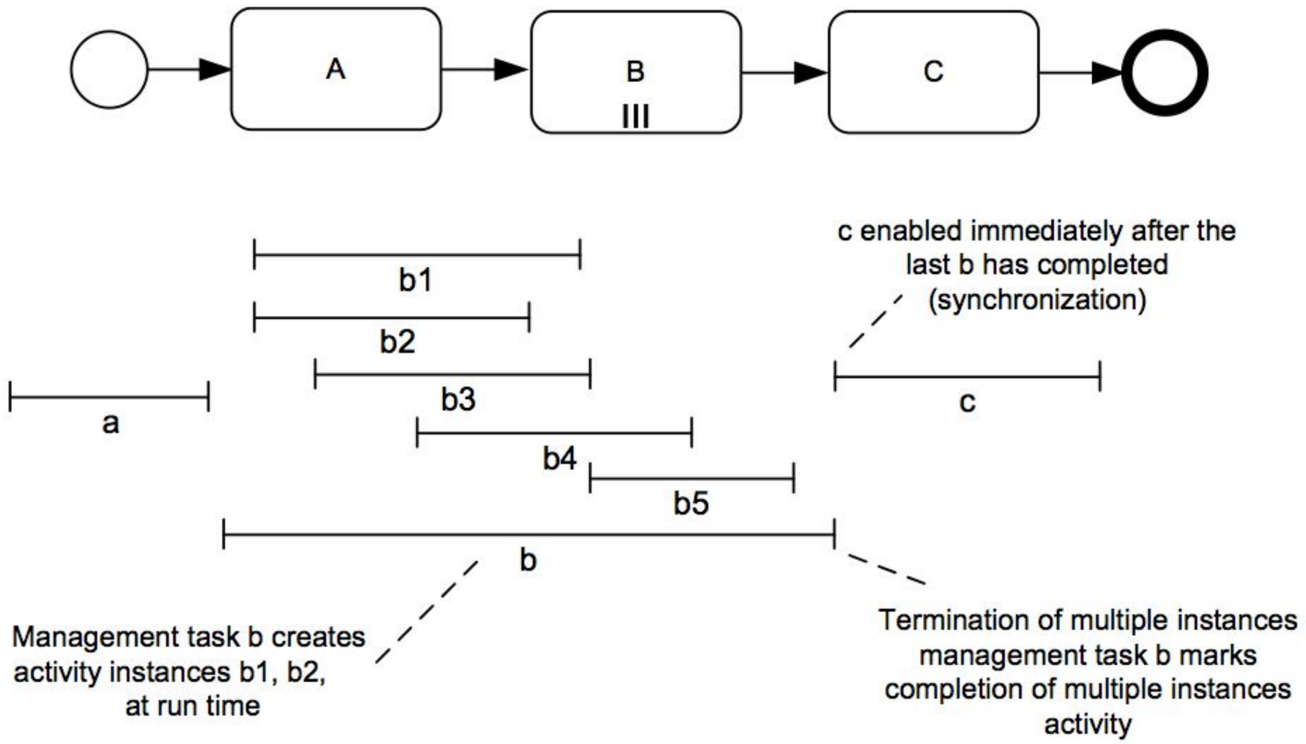
A
B
III
C
b1
b2
b3
b4
b5
a
b
c
c enabled immediately after the last b has completed (synchronization)
Management task b creates activity instances b1, b2, at run time
Termination of multiple instances management task b marks completion of multiple instances activity

Fig. 4.22. Multiple instances without a priori run time knowledge pattern, including management task

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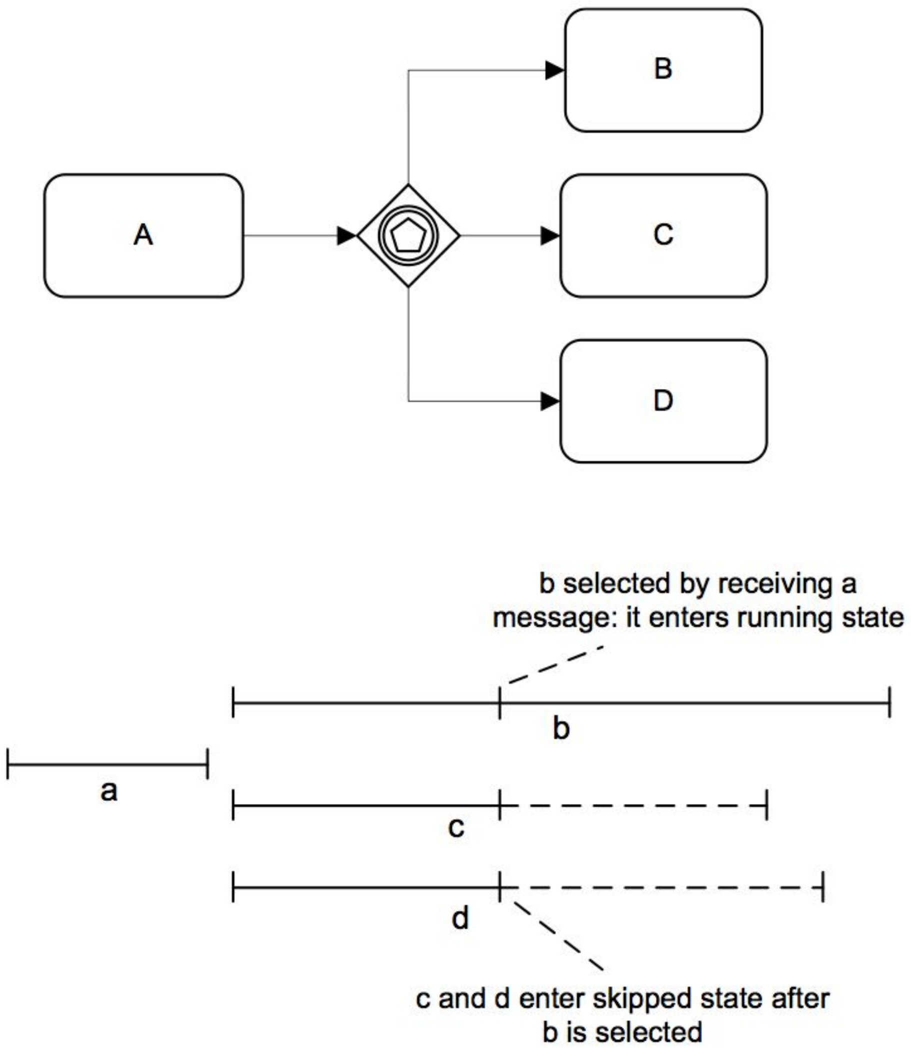
B
A
C
D
b selected by receiving a message: it enters running state
b
a
c
d
c and d enter skipped state after b is selected

Fig. 4.23. Example of deferred choice pattern

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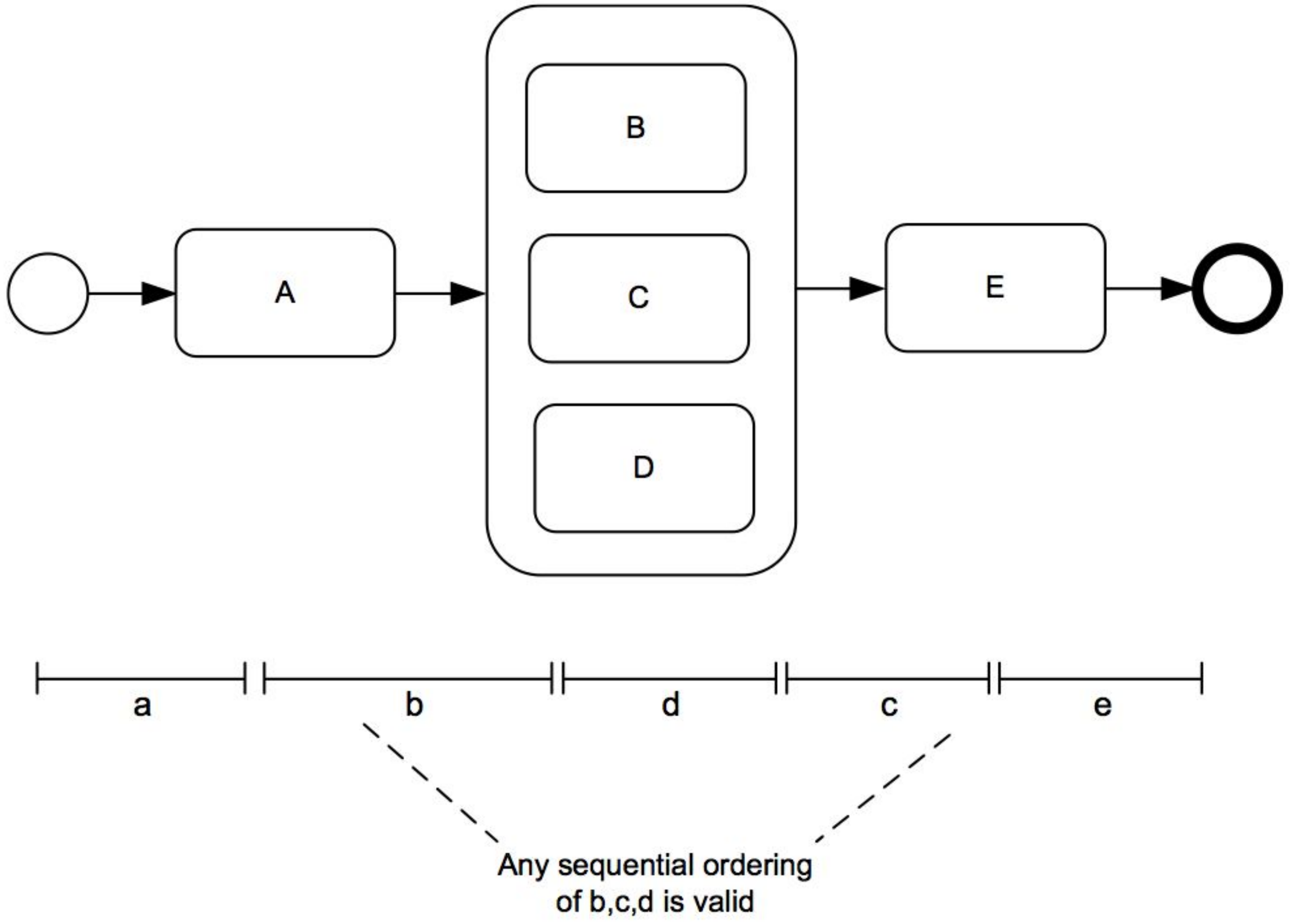

Fig. 4.24. Sequential execution without a priori design time knowledge; any sequential execution ordering of B, C, and D is possible

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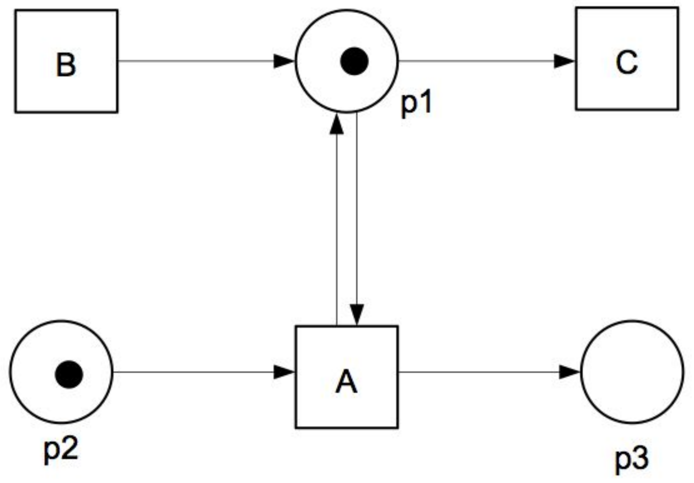
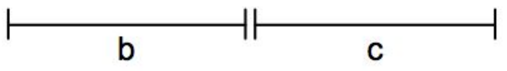
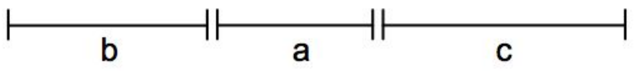


Option 1: *c* is immediately started after *b* completes, so that *a* cannot be executed



Option 2: *a* is started after *b* completes and before *c* starts



More Options: Multiple *a*'s possible, as long as *c* is not started and there are tokens in *p2*

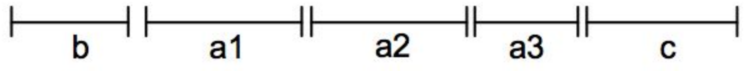


Fig. 4.25. Example of milestone pattern

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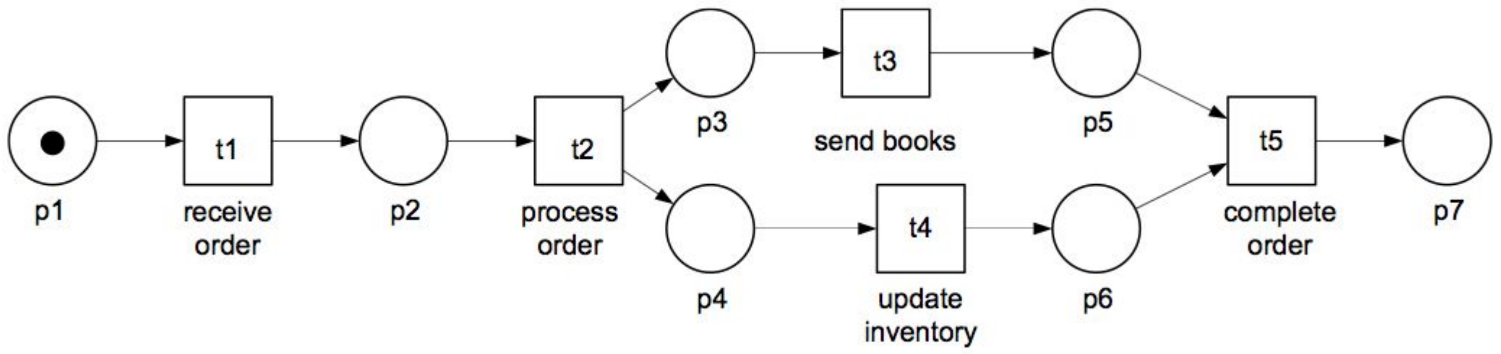

Fig. 4.26. Sample Petri net representing single process instance

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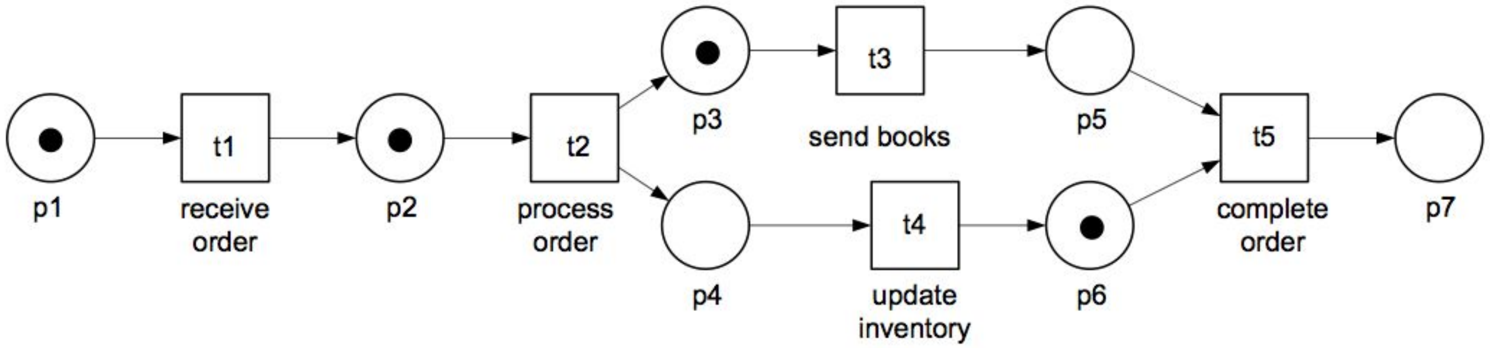

Fig. 4.27. Sample Petri net representing multiple process instances

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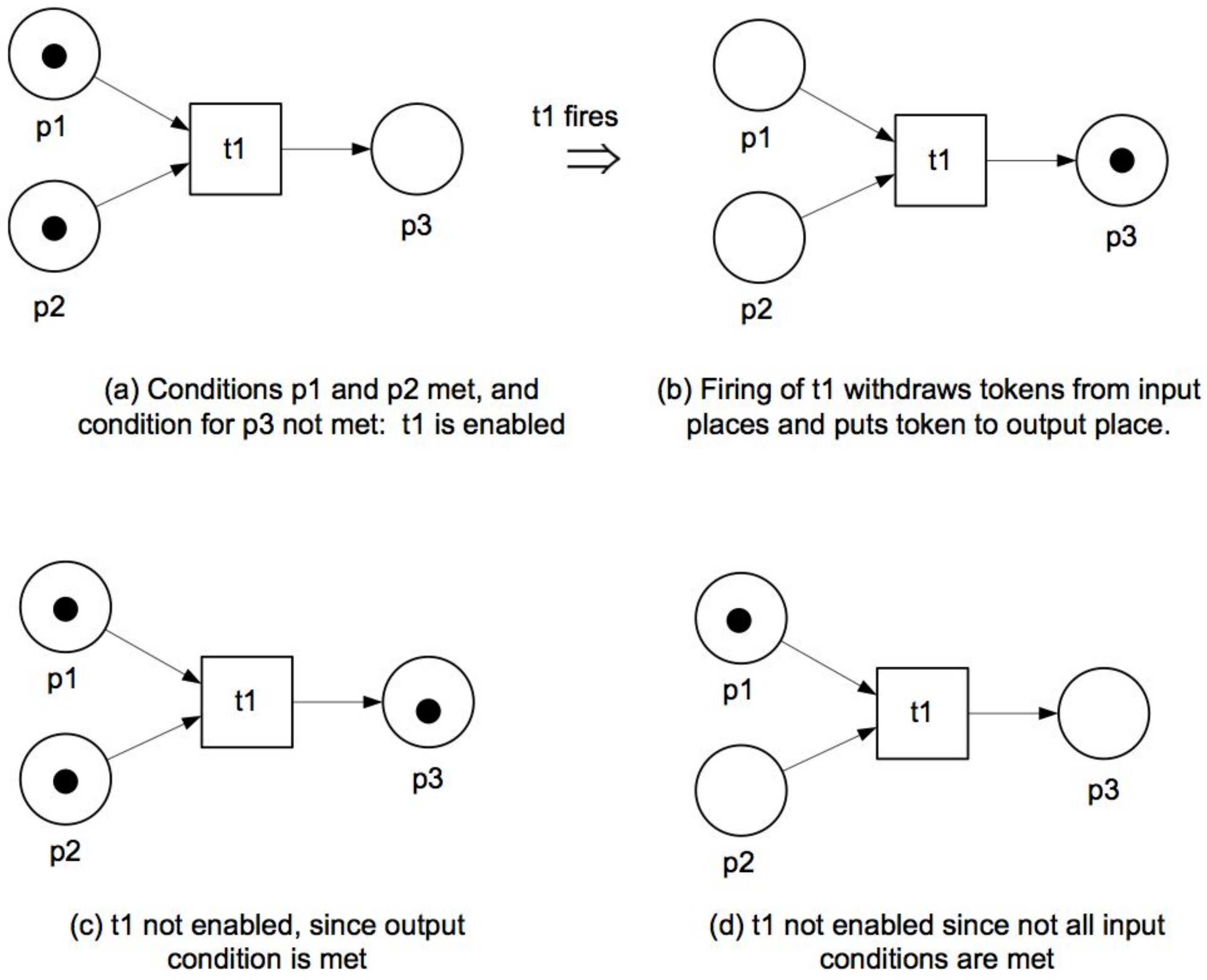
p1
t1
p2
p3
t1 fires
⇒
p1
t1
p2
p3
(a) Conditions p1 and p2 met, and condition for p3 not met: t1 is enabled
(b) Firing of t1 withdraws tokens from input places and puts token to output place.
p1
t1
p2
p3
p1
t1
p2
p3
(c) t1 not enabled, since output condition is met
(d) t1 not enabled since not all input conditions are met

Fig. 4.28. Condition event net

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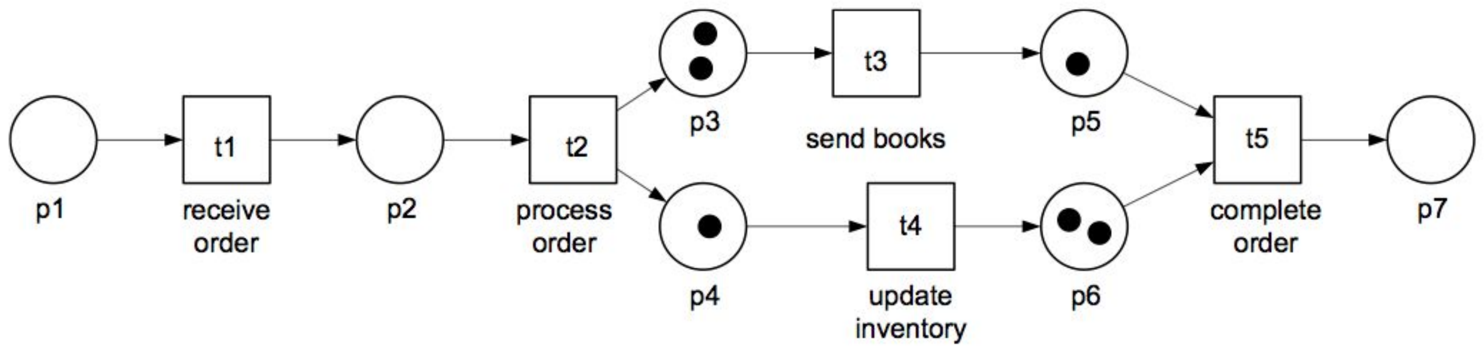

Fig. 4.29. Place transition net with multiple process instances

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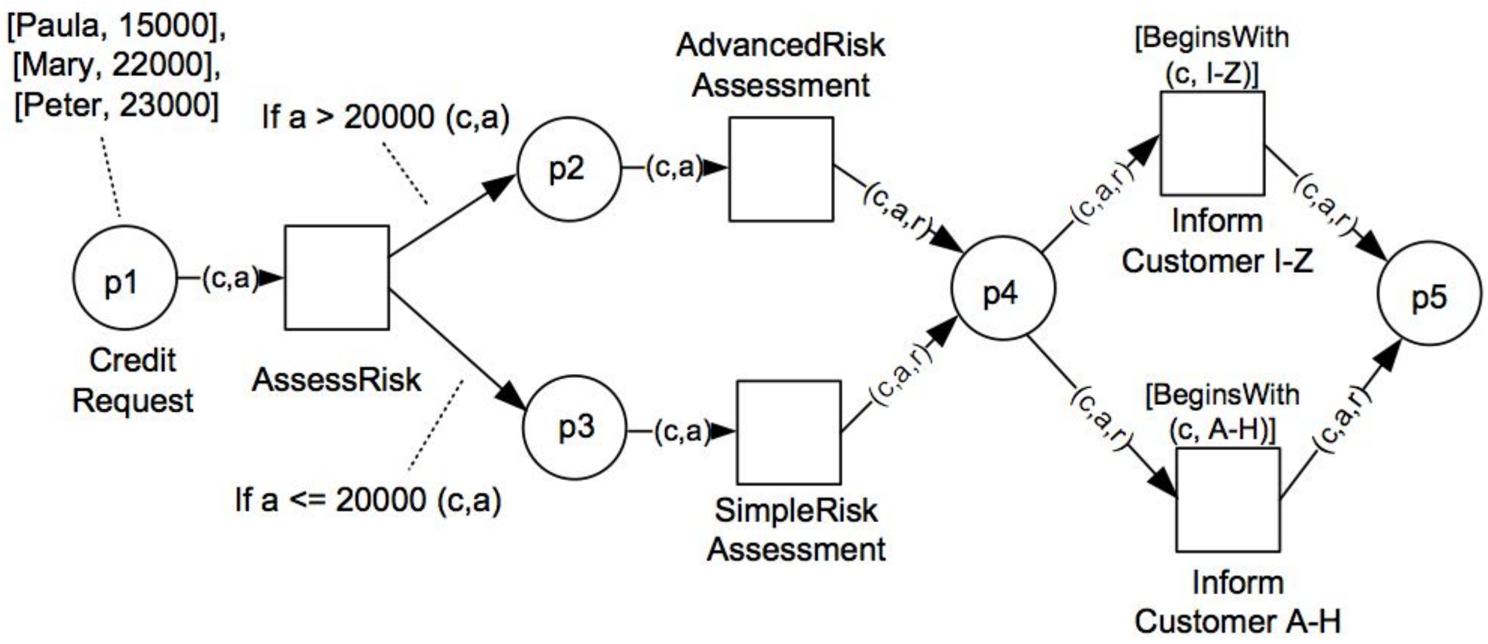

Fig. 4.30. Sample coloured Petri net

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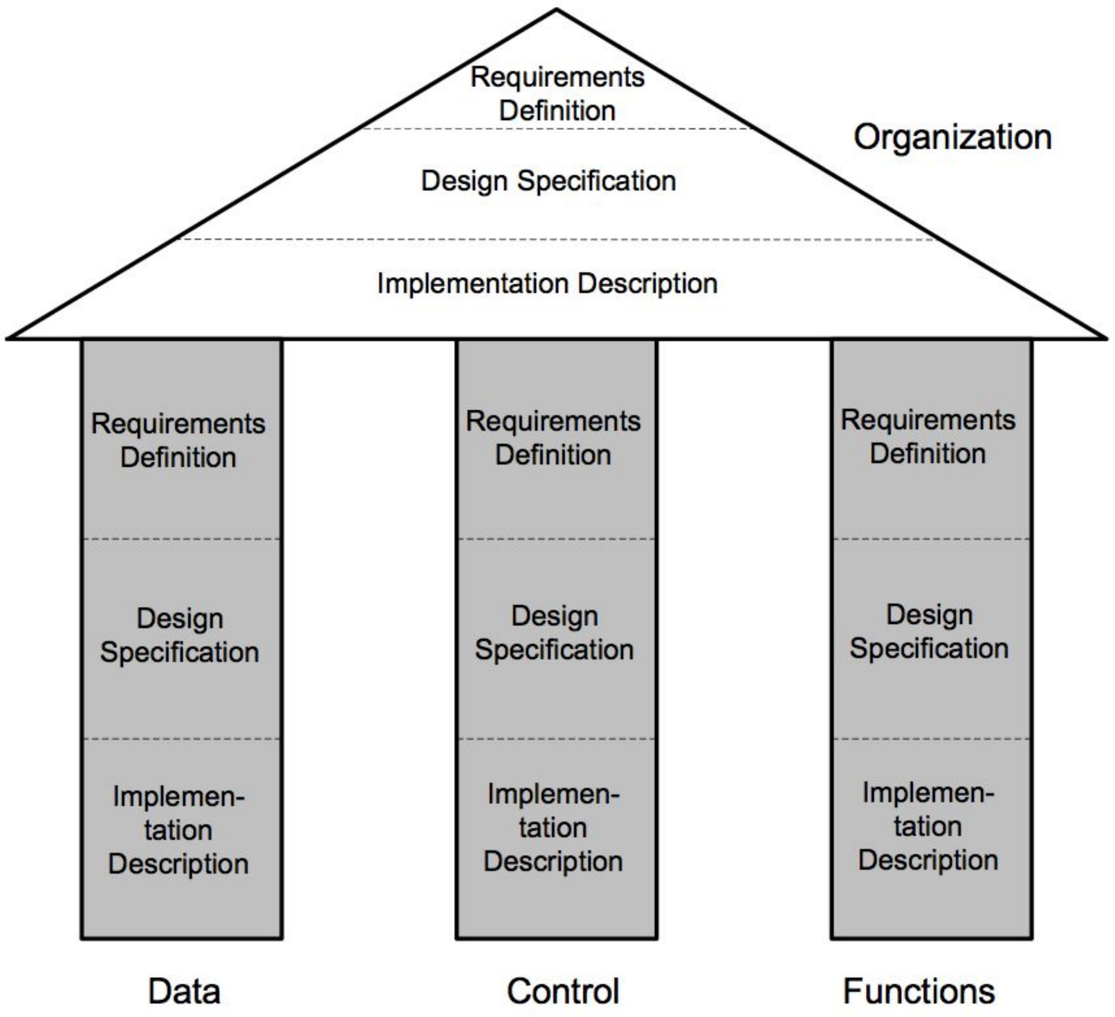

Fig. 4.31. ARIS business process framework, Scheer (2000)

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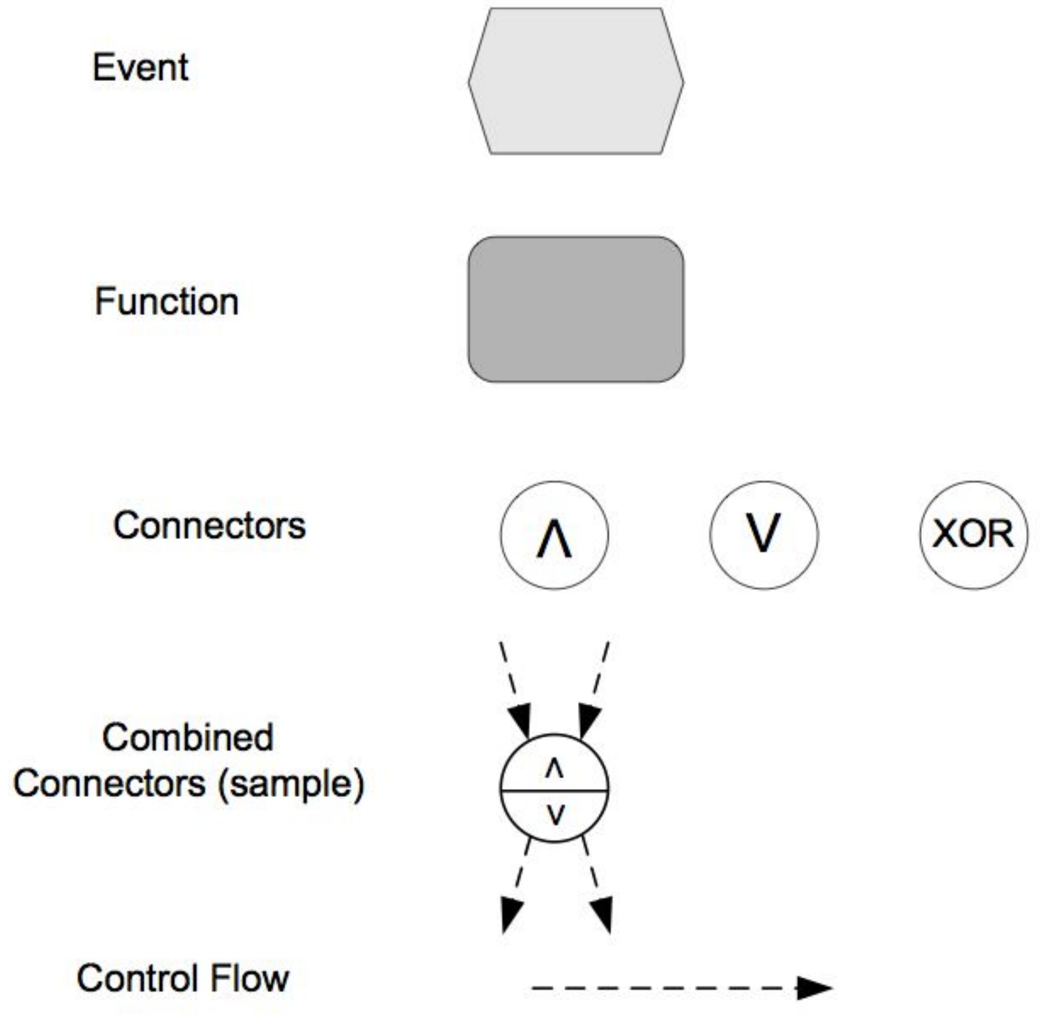

Fig. 4.32. Building blocks of event-driven process chains

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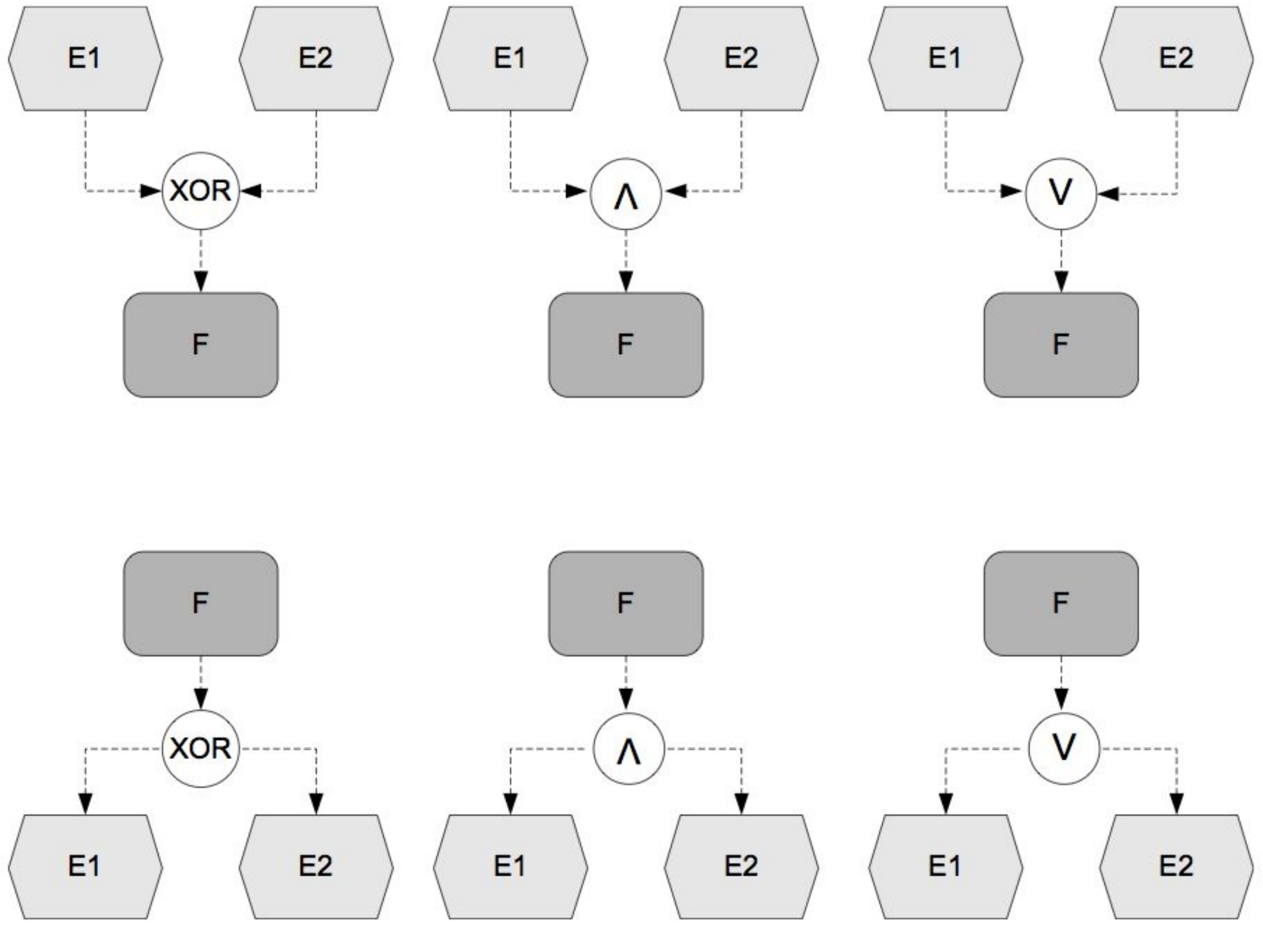

Fig. 4.33. Syntax rules on event-driven process chains: multiple events, single function

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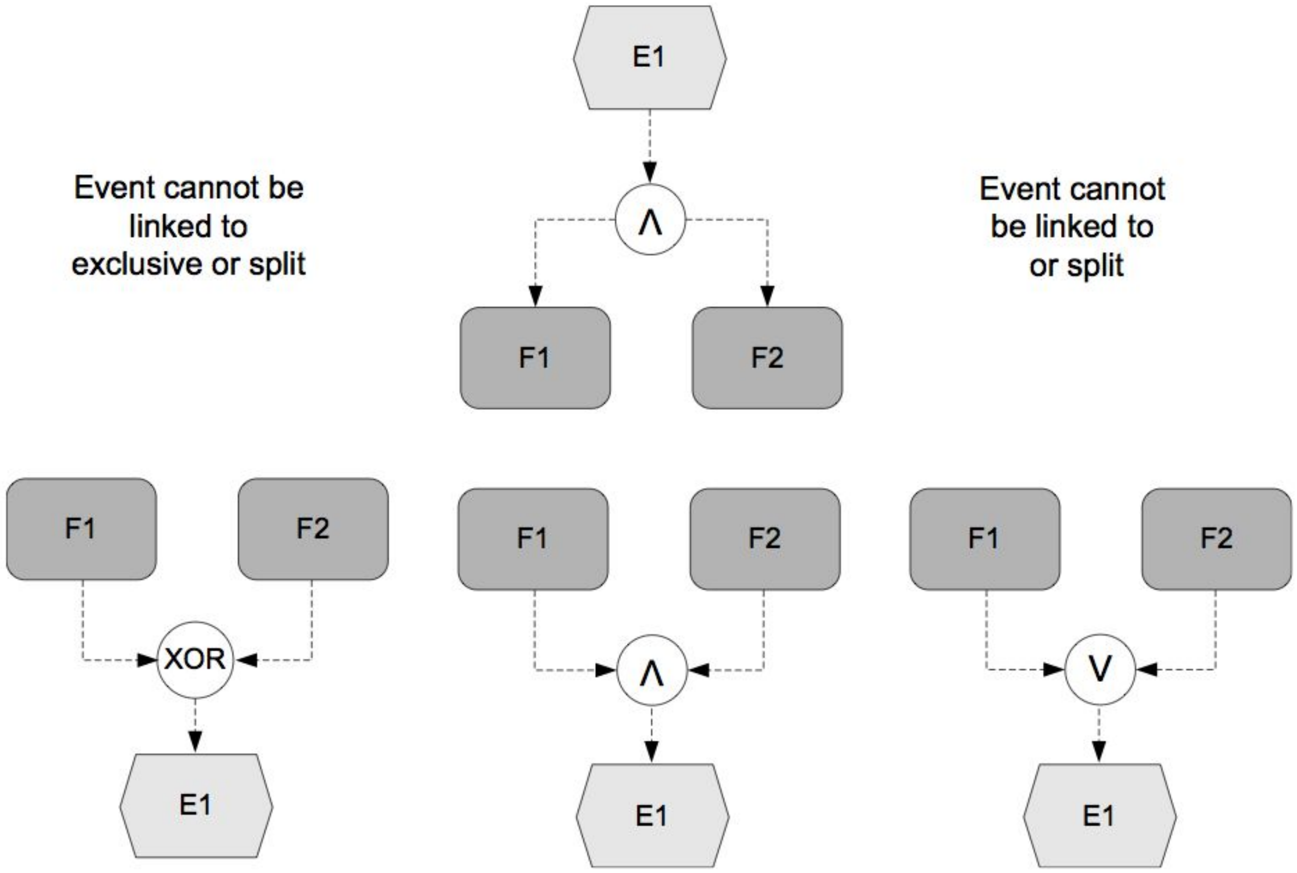
E1
Λ
F1
F2
Event cannot be linked to exclusive or split
Event cannot be linked to or split
F1
F2
XOR
E1
F1
F2
Λ
E1
F1
F2
V
E1

Fig. 4.34. Syntax rules on event-driven process chains: multiple functions, single event

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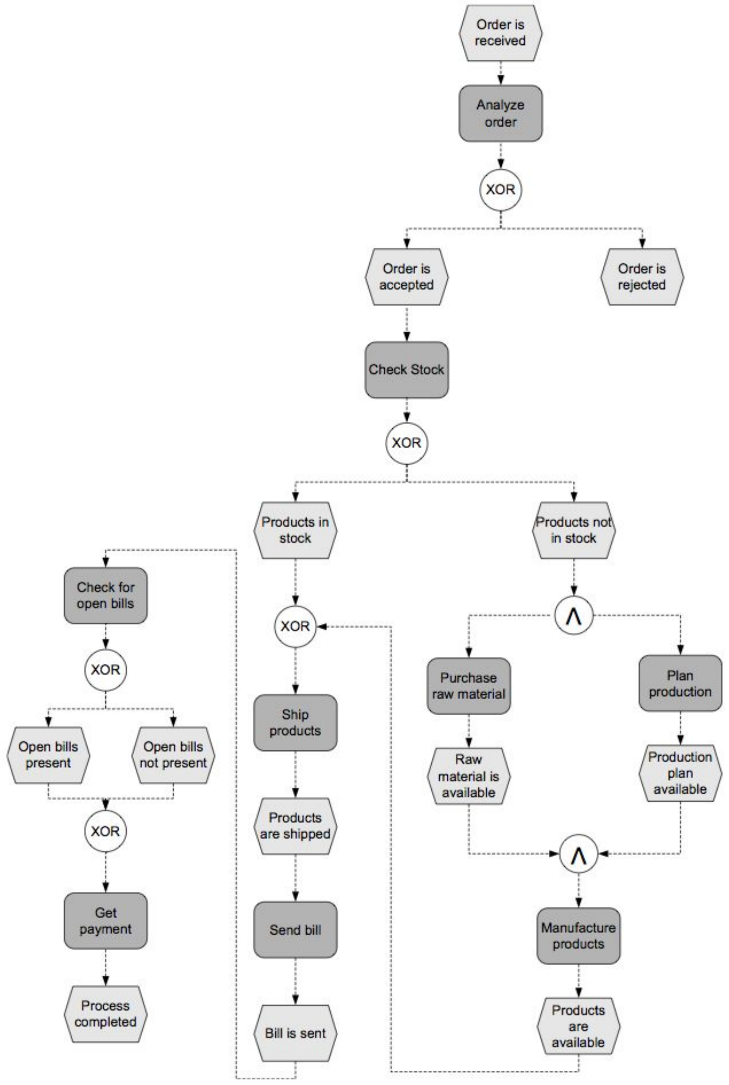

Fig. 4.35. Example event-driven process chain

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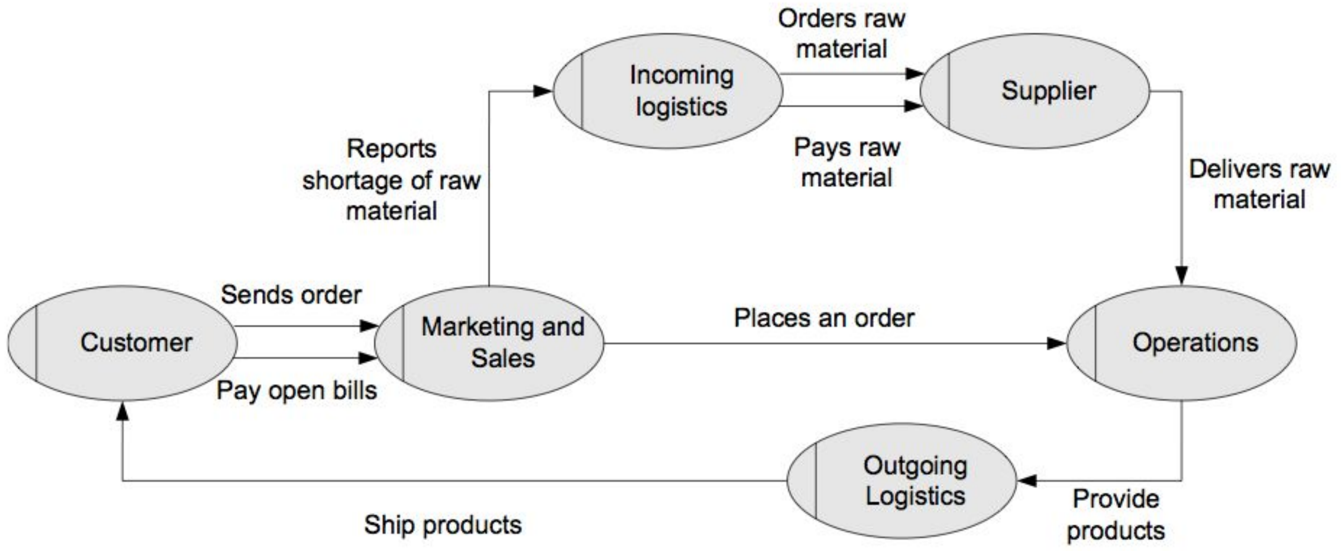

Fig. 4.36. Sample interaction flow diagram, adapted from Scheer et al. (2005)

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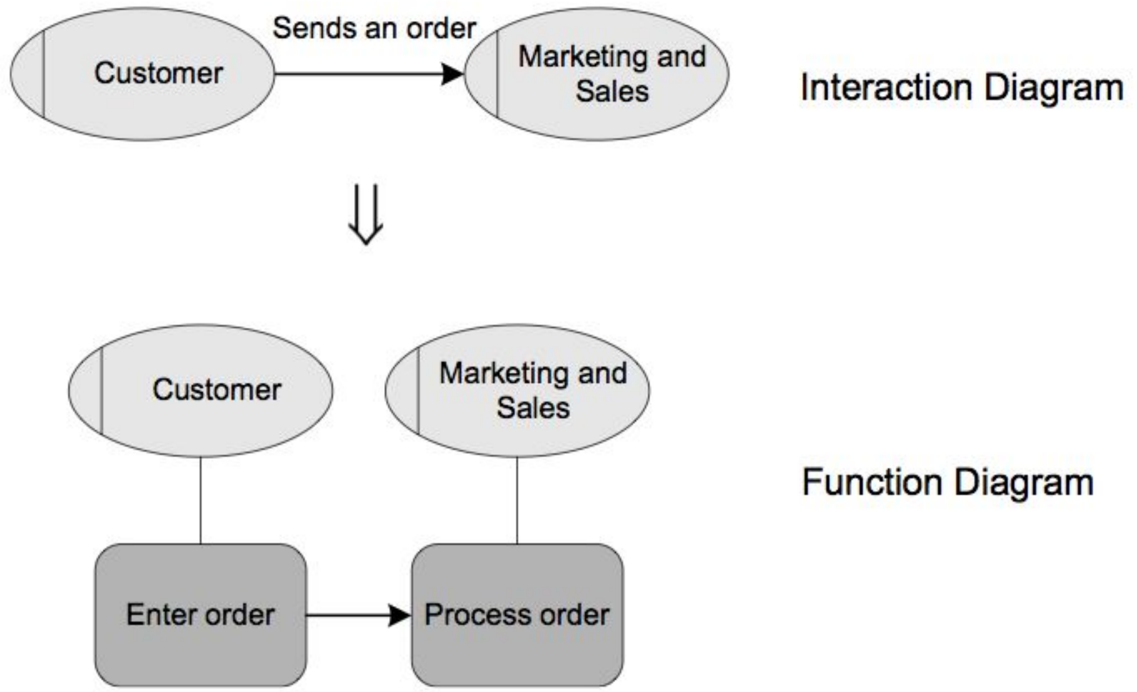

Fig. 4.37. Mapping interactions to relationships between functions

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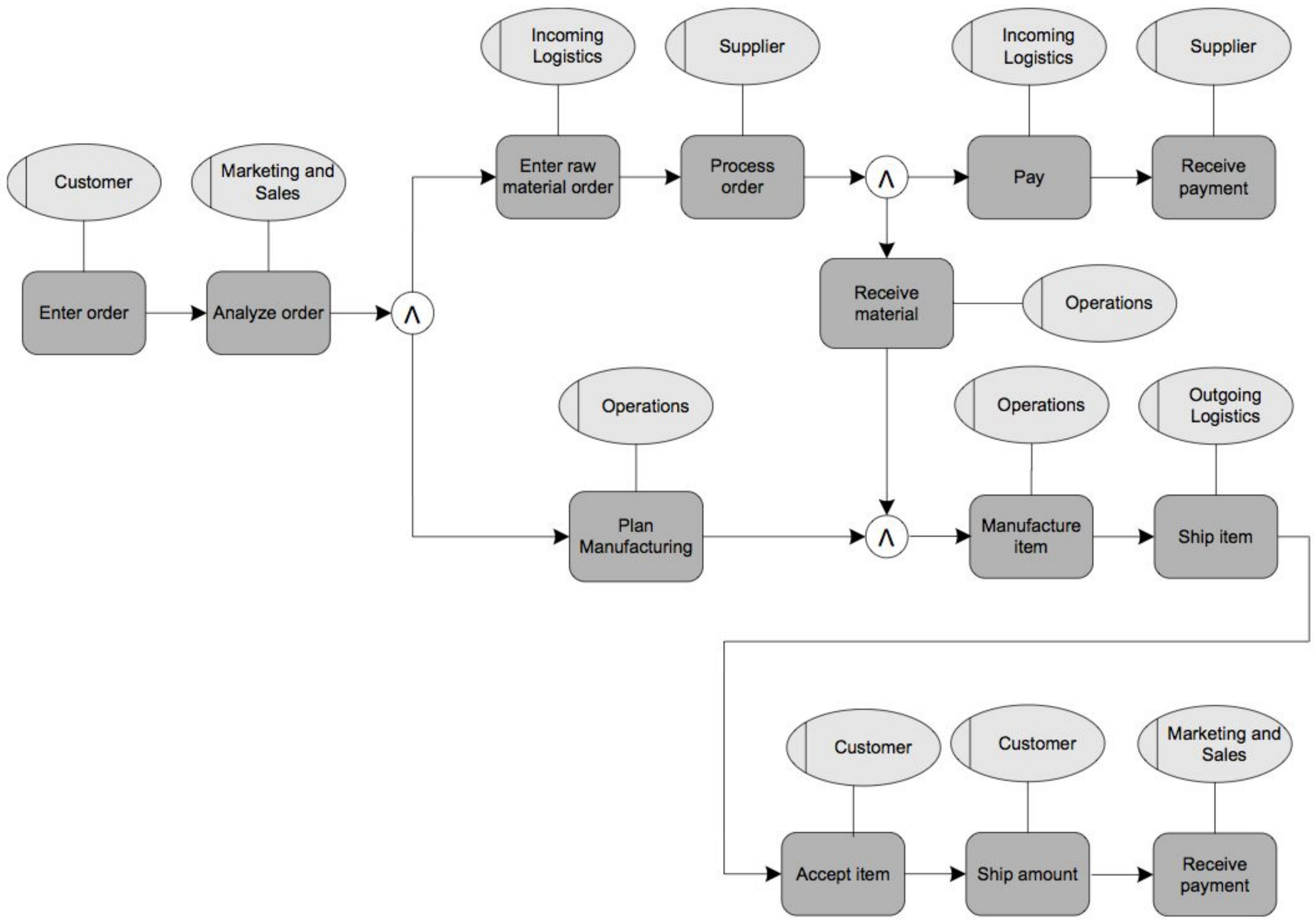

Fig. 4.38. Sample function flow

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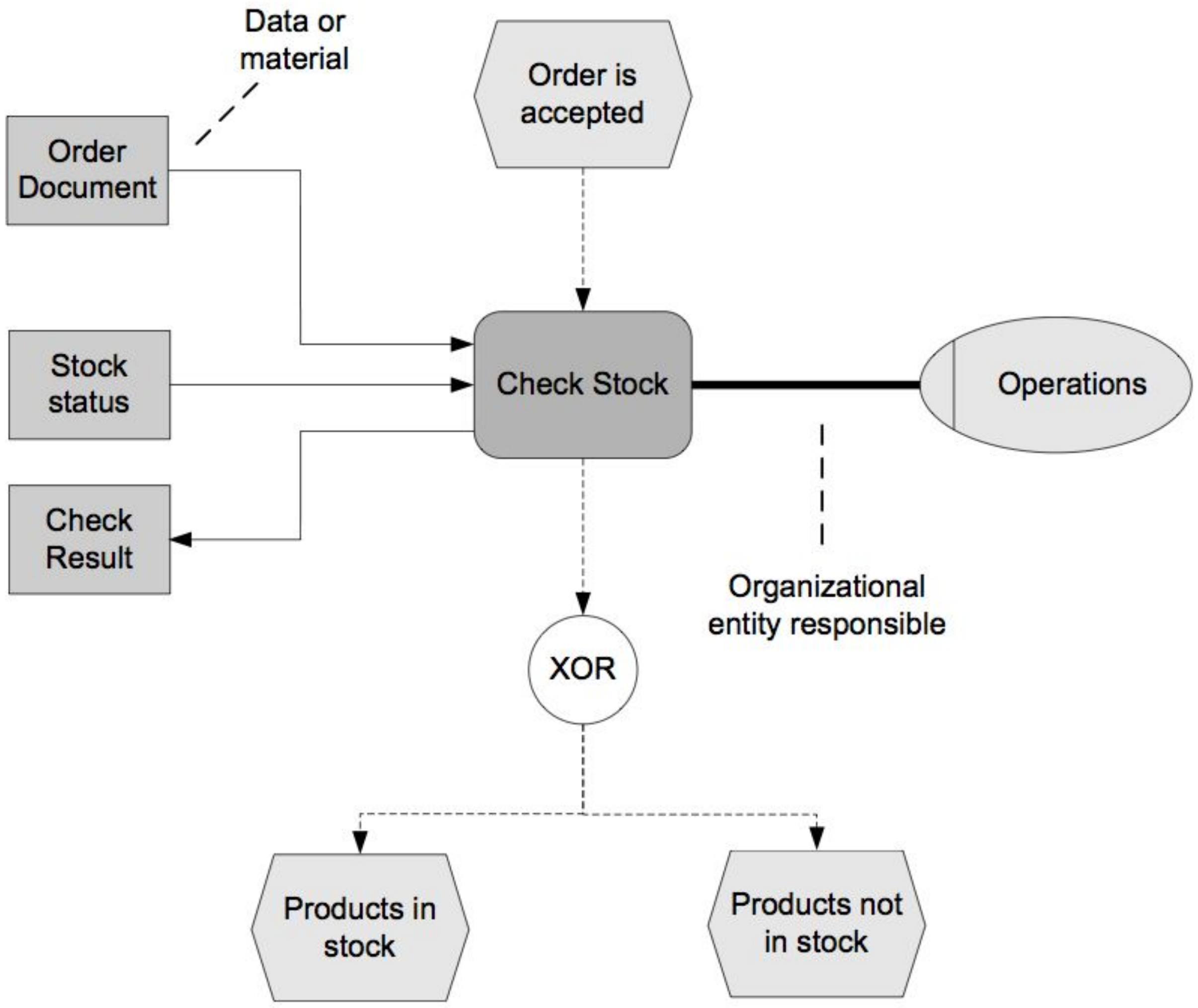

Fig. 4.39. Example of extended event-driven process chain

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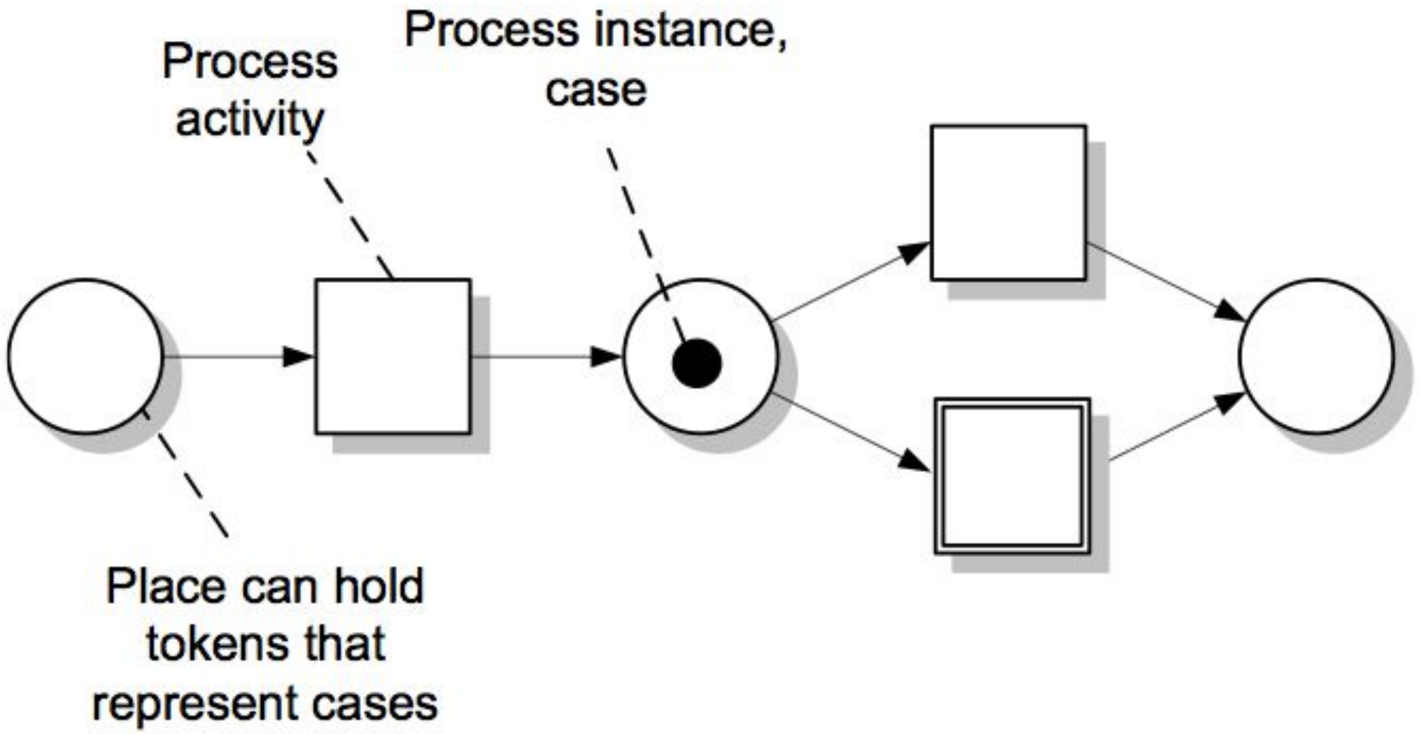

Fig. 4.40. Sample workflow net

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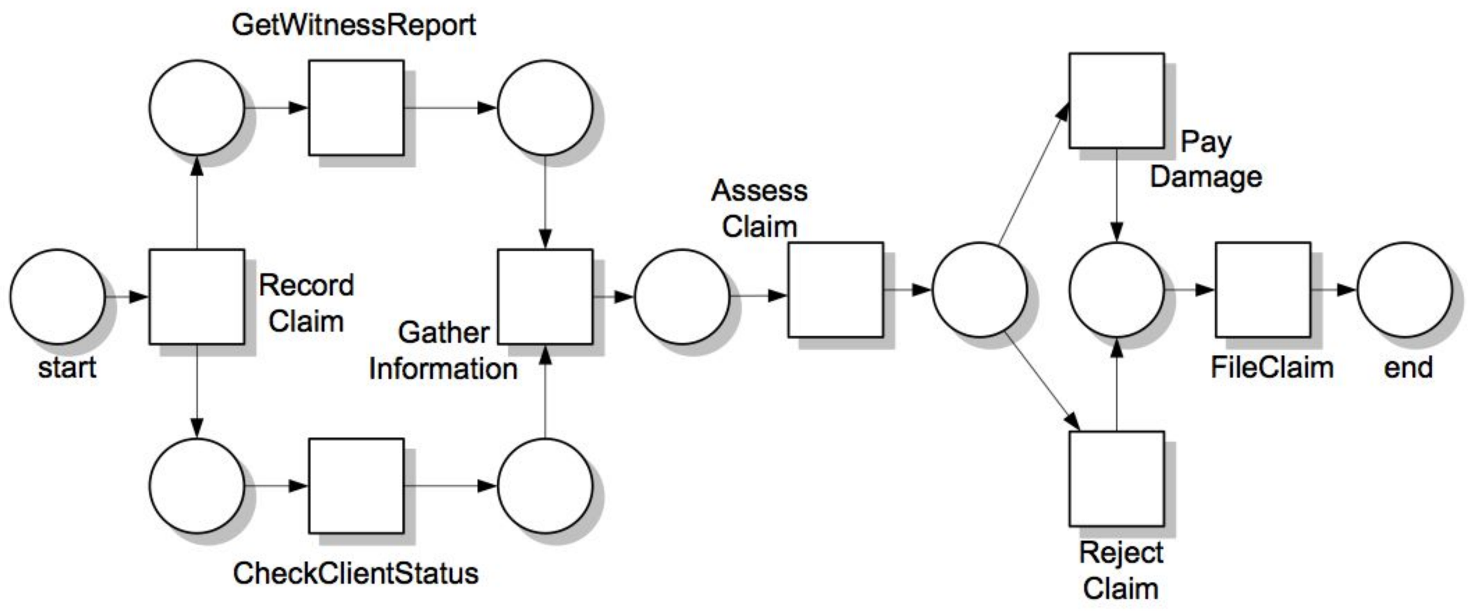

Fig. 4.41. Sample workflow net

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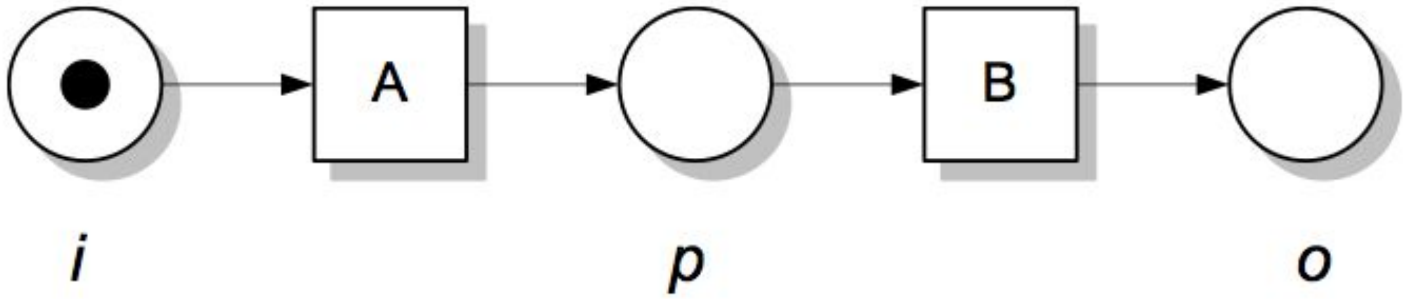

Fig. 4.42. Sequence pattern in workflow net

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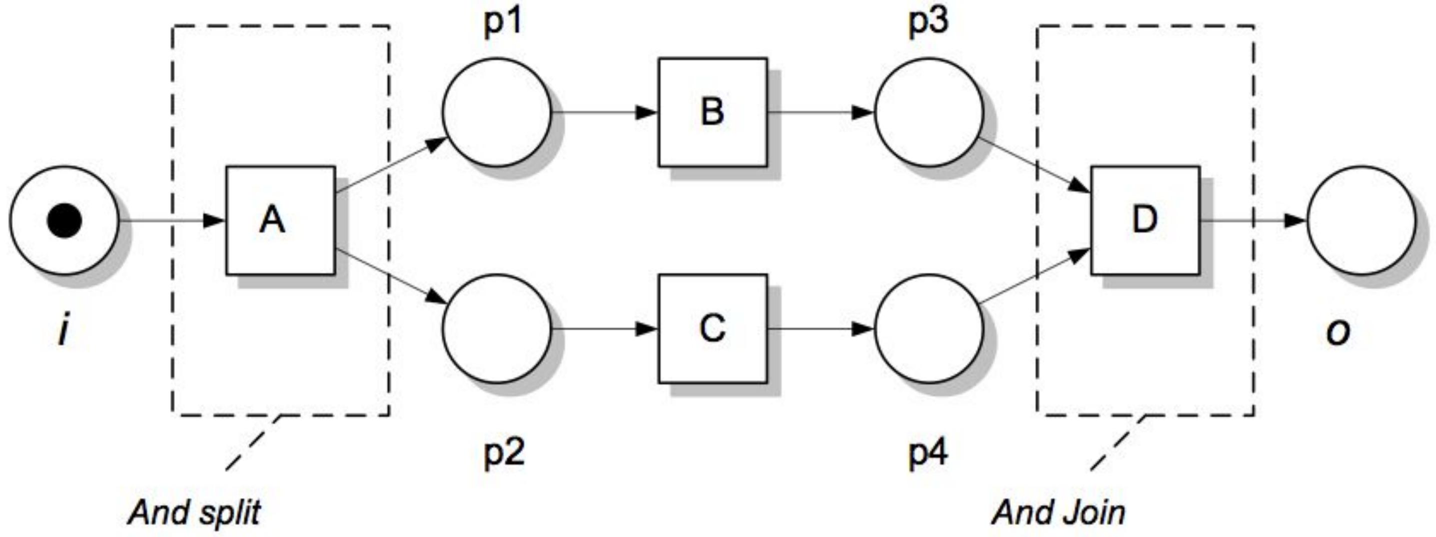

Fig. 4.43. *And split* and *and join* patterns in workflow nets

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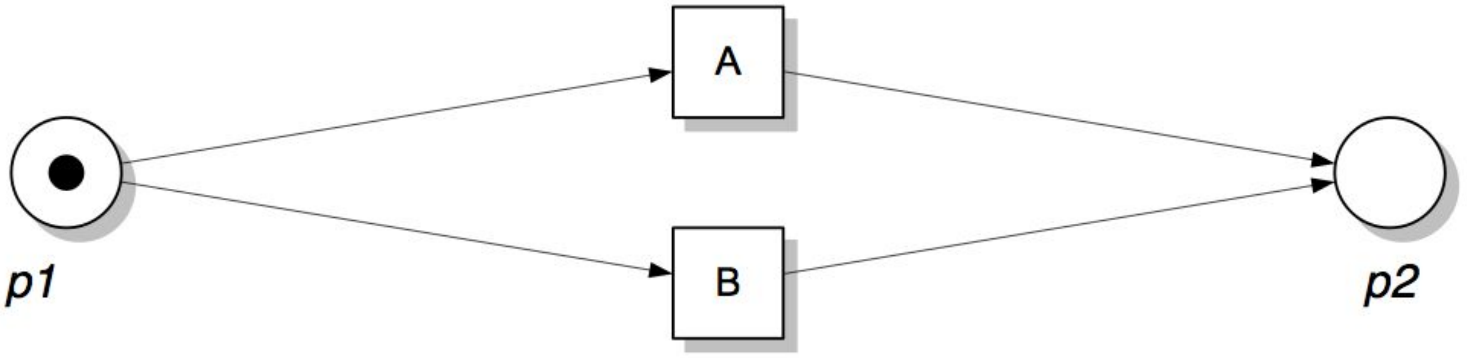

Fig. 4.44. *Implicit exclusive or split* also known as *deferred choice*

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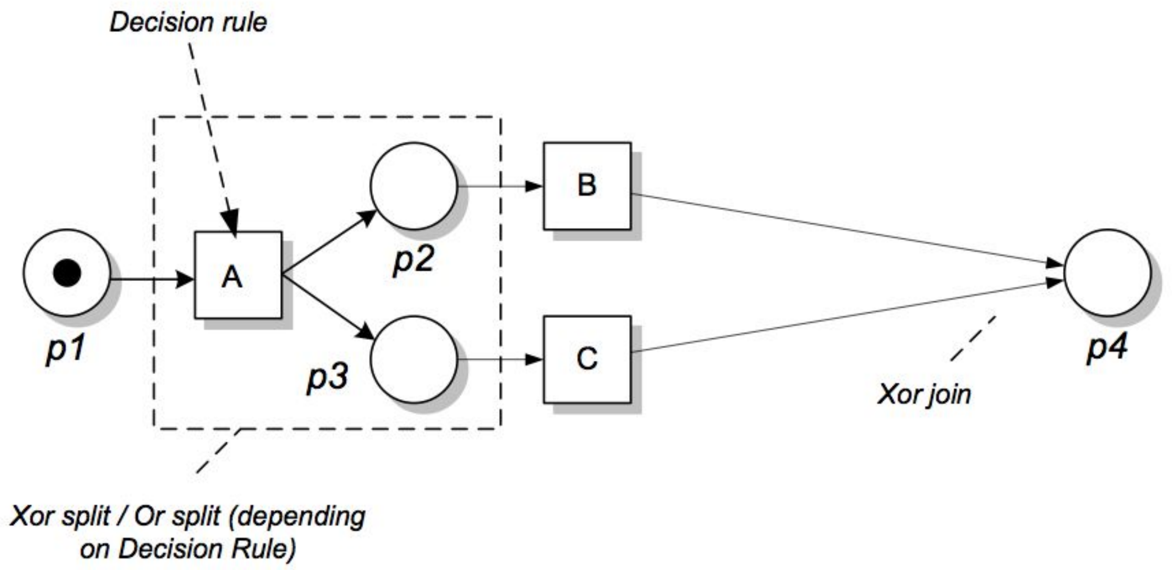

Fig. 4.45. Decision rule based split, can realize *or split*, *exclusive or split*, and *and split*

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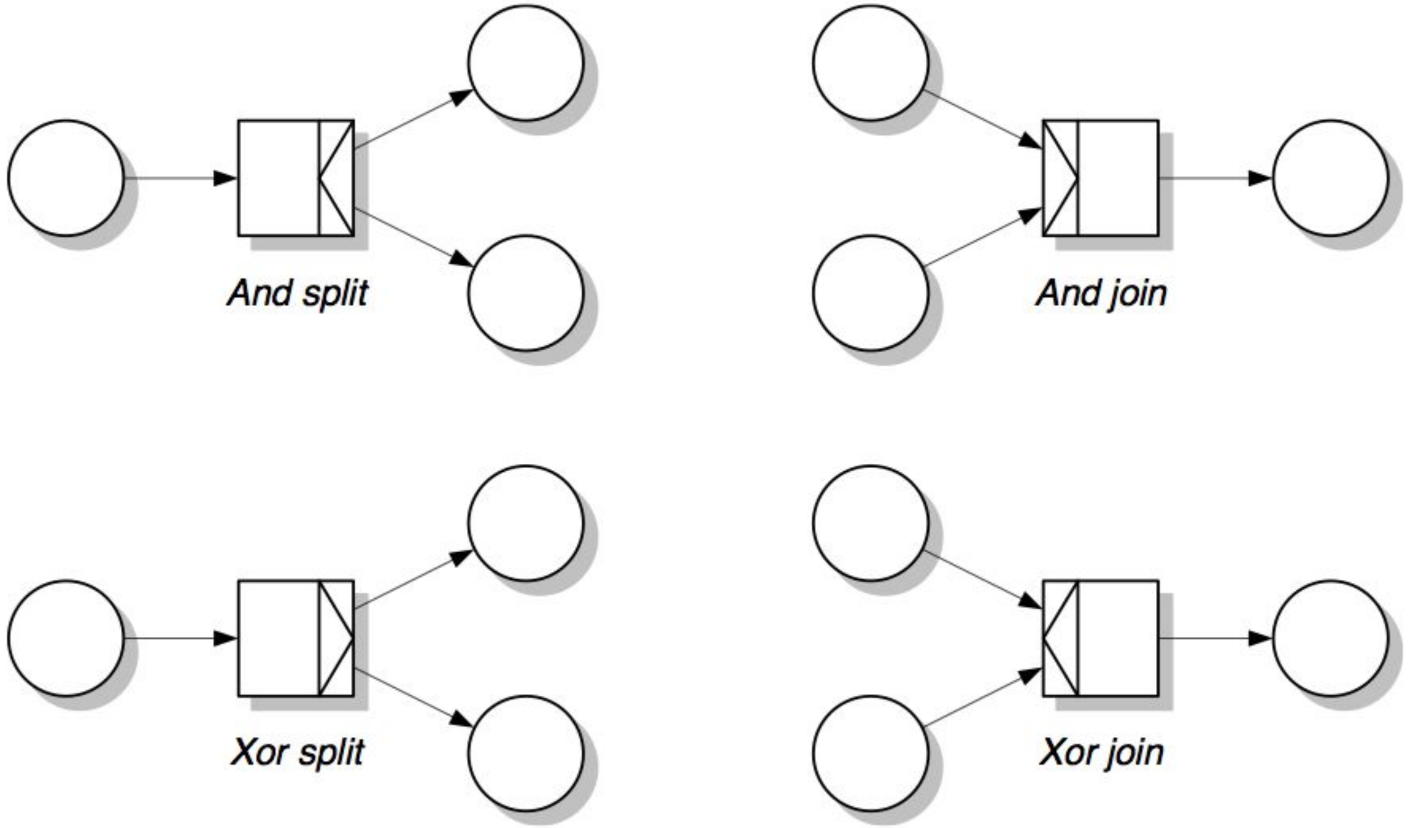

Fig. 4.46. Syntactic sugaring of transitions in workflow nets

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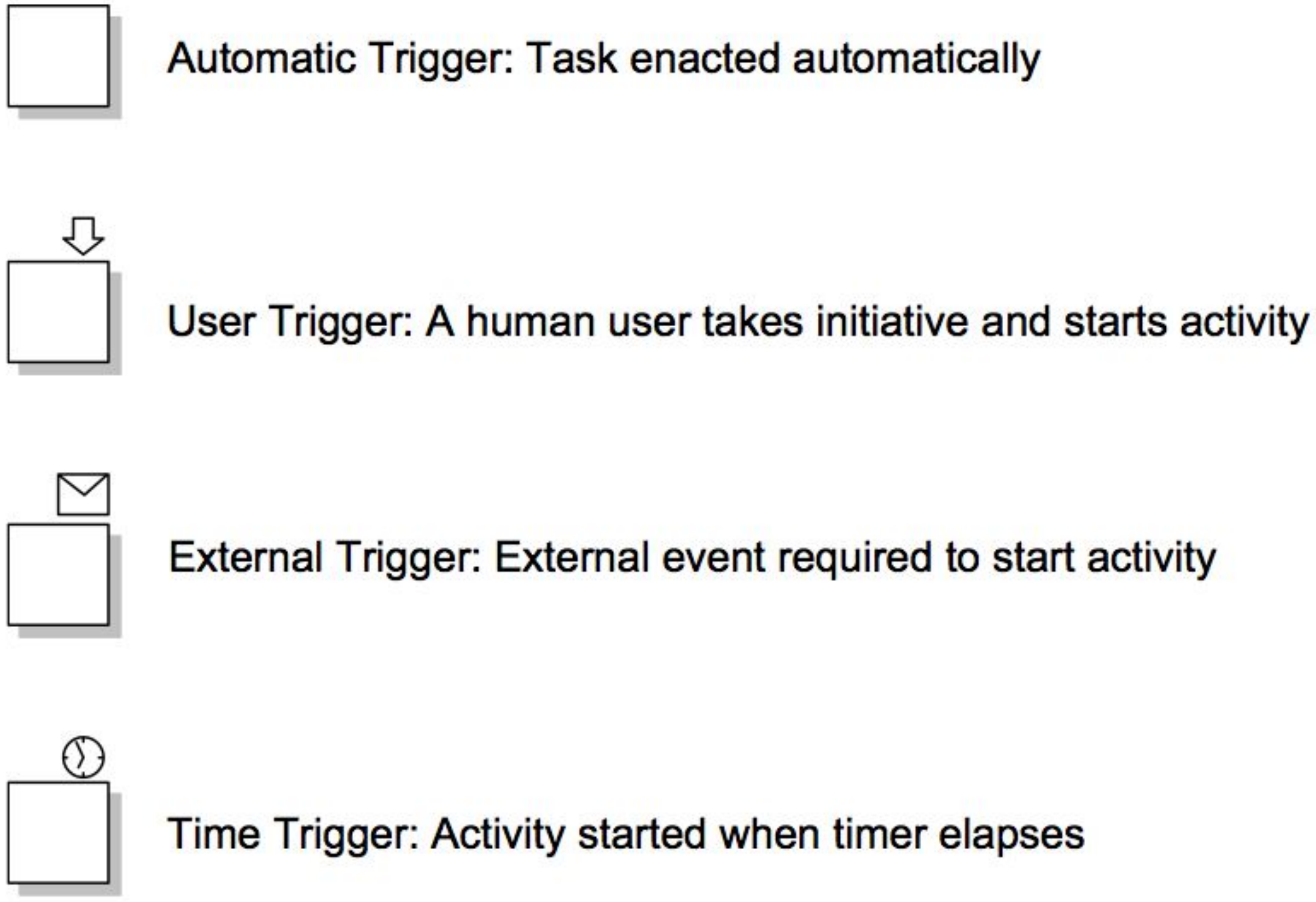

Automatic Trigger: Task enacted automatically

User Trigger: A human user takes initiative and starts activity

External Trigger: External event required to start activity

Time Trigger: Activity started when timer elapses

Fig. 4.47. Triggers in workflow nets

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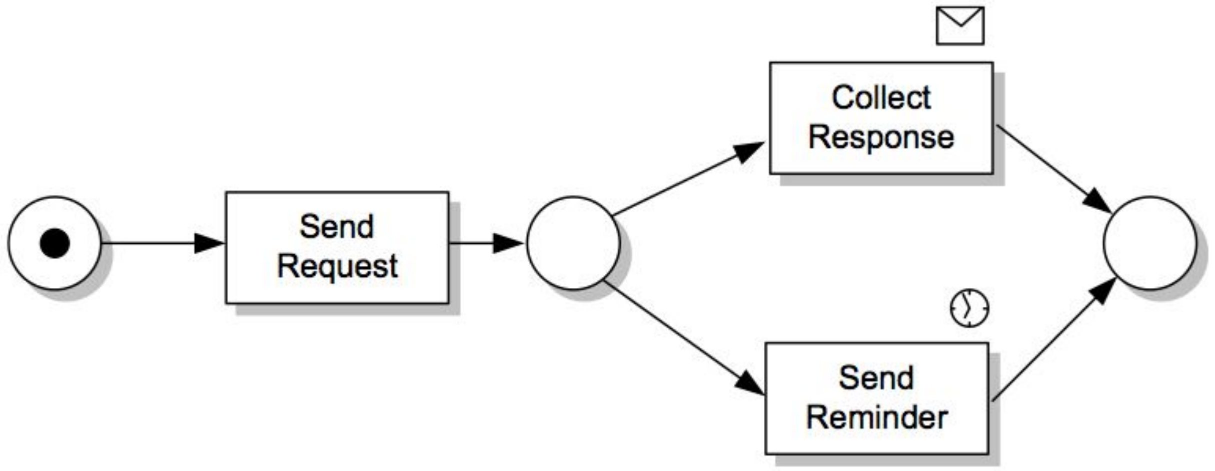

Fig. 4.48. Sample workflow net with external trigger and time trigger

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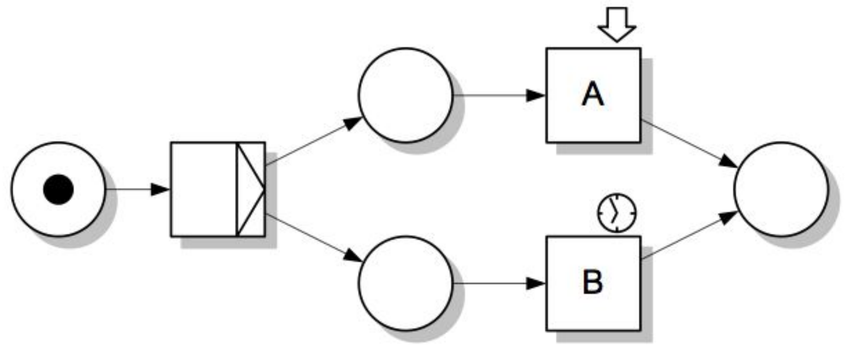
(a) *Explicit xor split* does not enable A and B concurrently

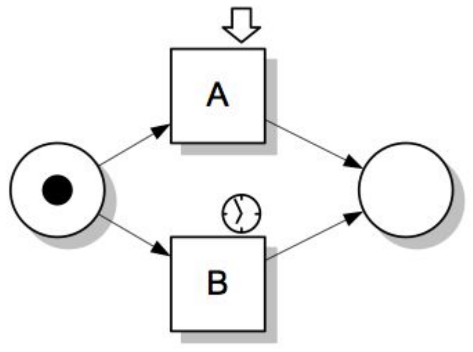
(b) *Implicit xor split* enables A and B concurrently

Fig. 4.49. Sample workflow nets illustrate the difference between *explicit xor split* (a) and *implicit xor split* (b)

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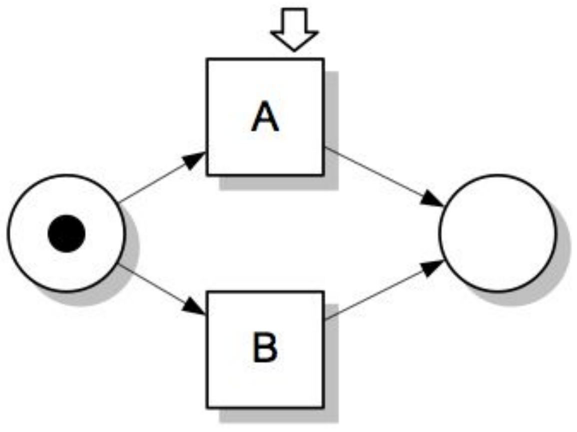
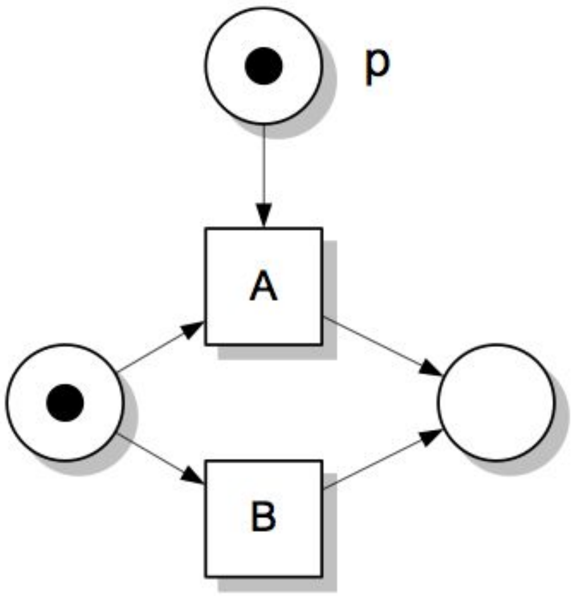


(a) Transition A started by user trigger



(b) Representation of user trigger by additional place and additional arc

Fig. 4.50. Representation of triggers

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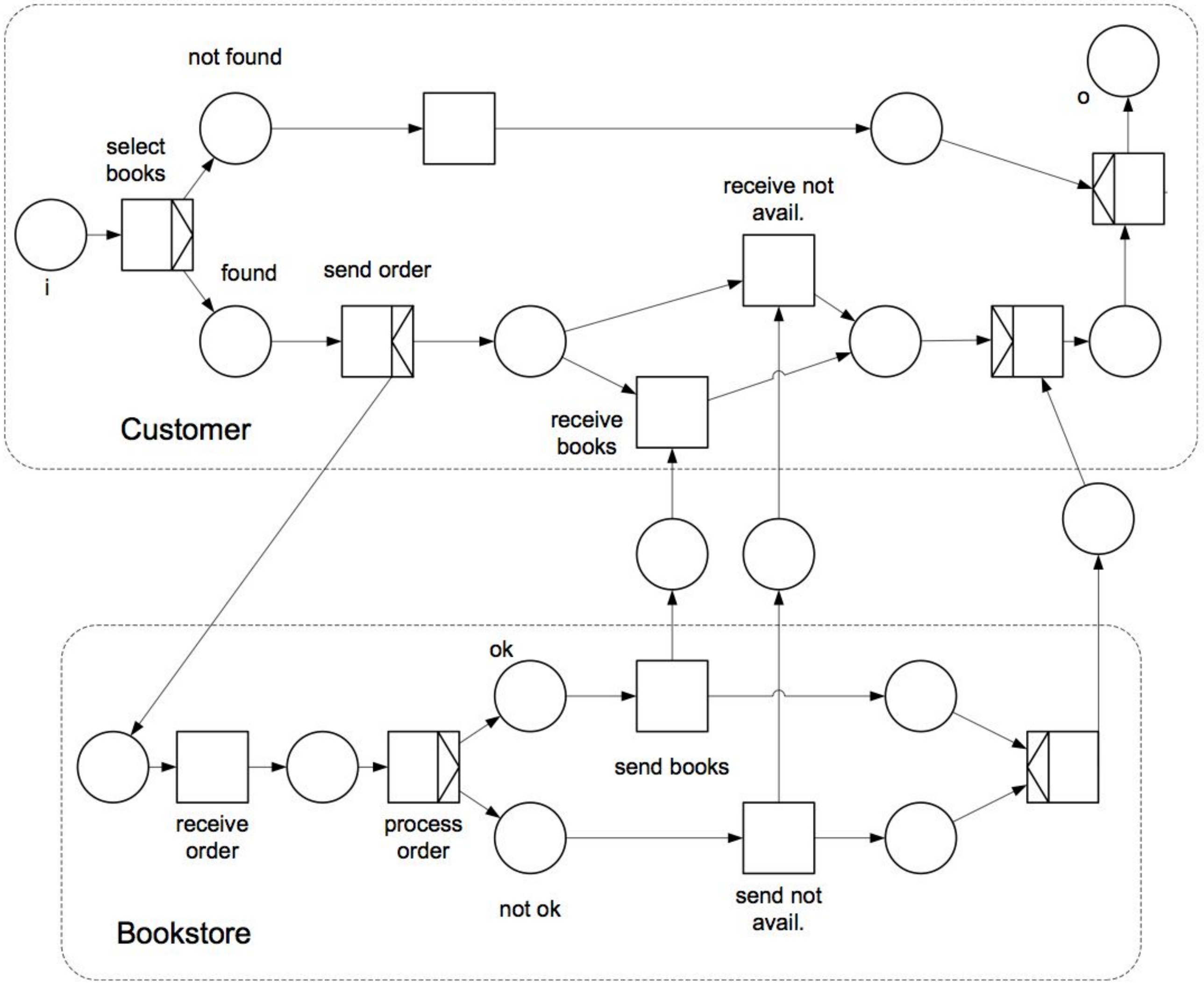

Fig. 4.51. Sample workflow net involving multiple parties

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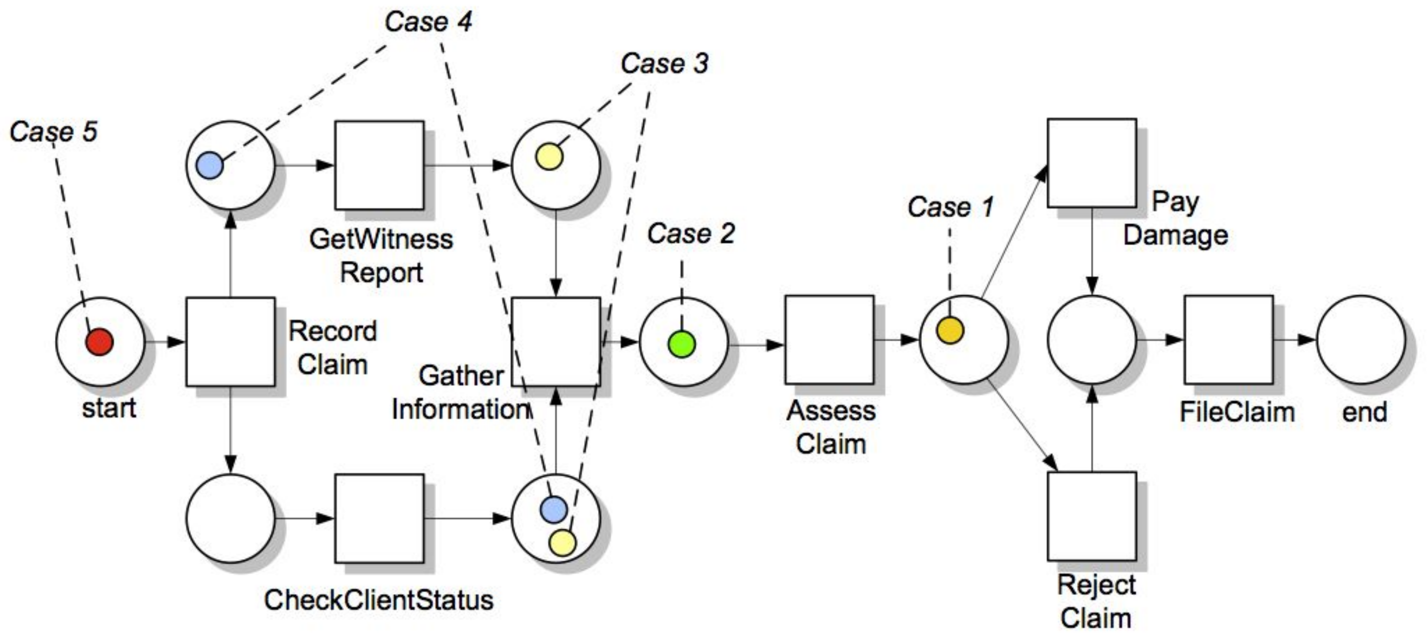

Fig. 4.52. Sample workflow net with coloured tokens representing process instances

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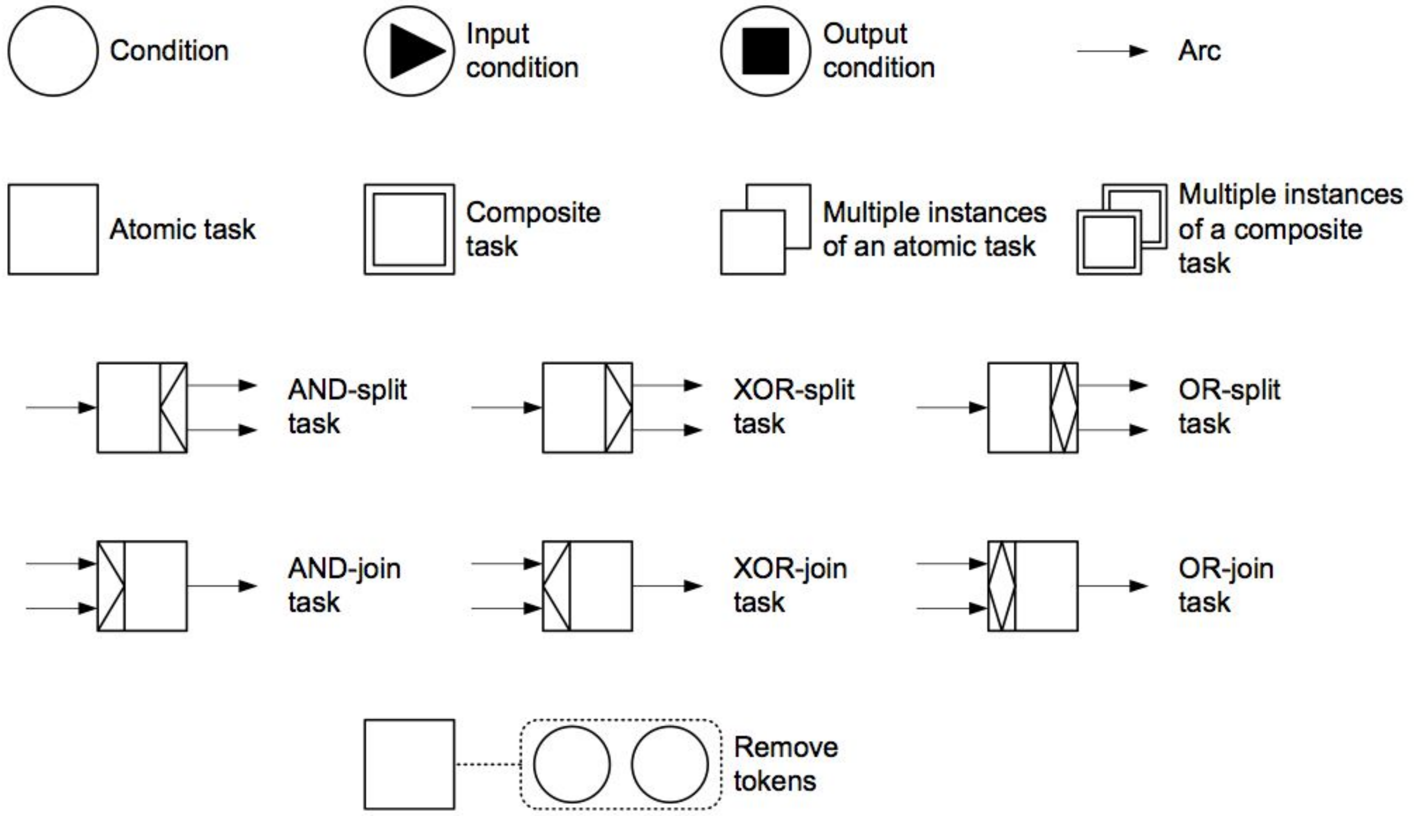

Fig. 4.53. Notational elements of YAWL, van der Aalst and ter Hofstede (2005)

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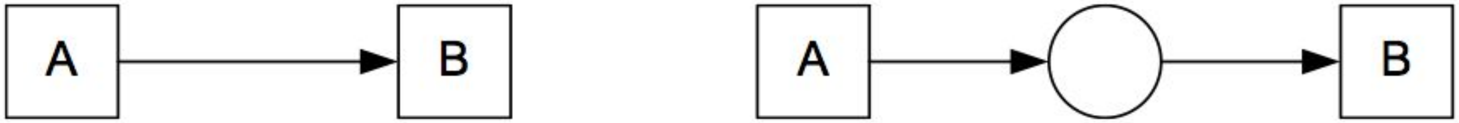

Fig. 4.54. Representations of sequence pattern in YAWL

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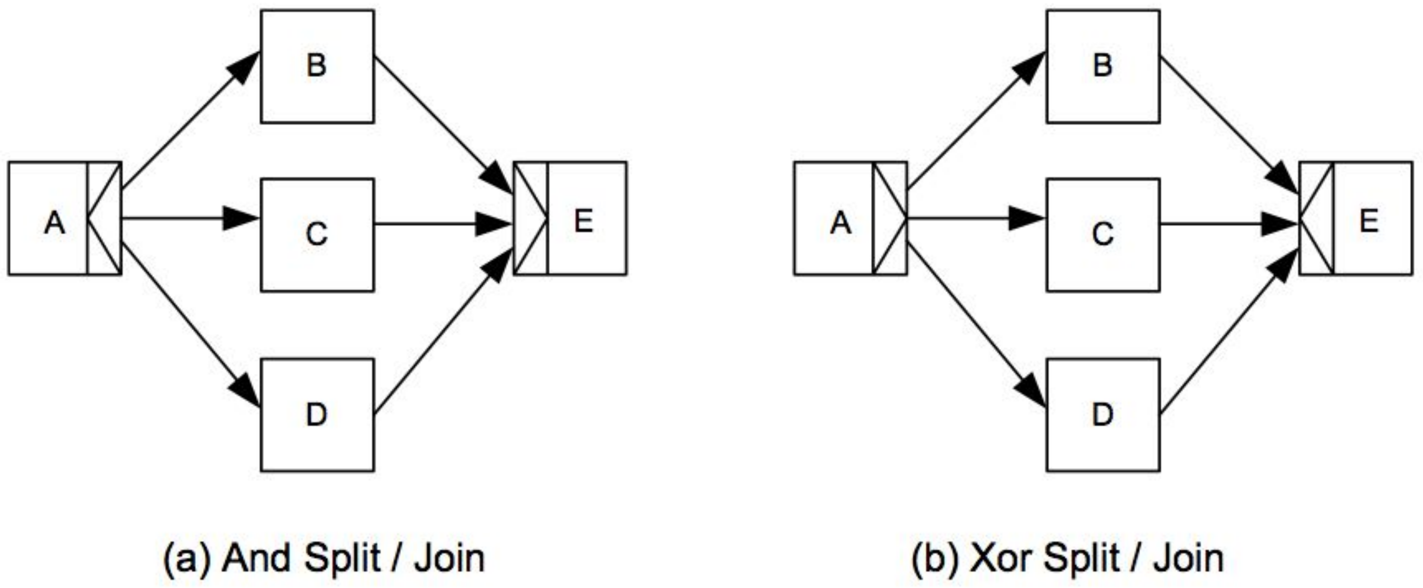

Fig. 4.55. *And split/join* and *xor split/join* patterns

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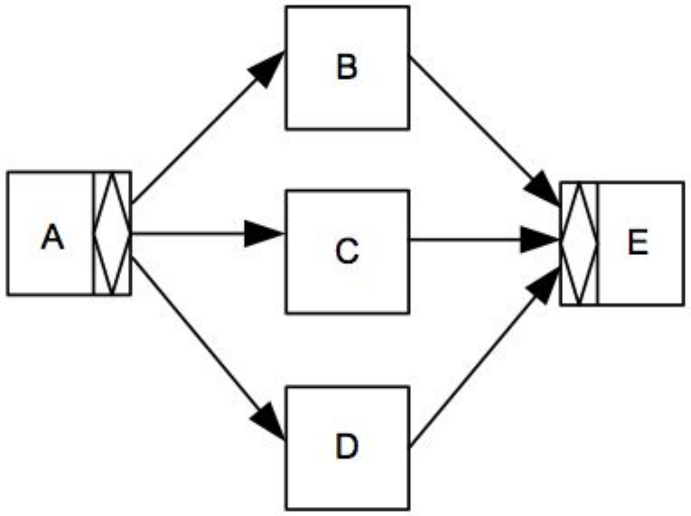

Fig. 4.56. *Inclusive or split* and *inclusive or join* patterns

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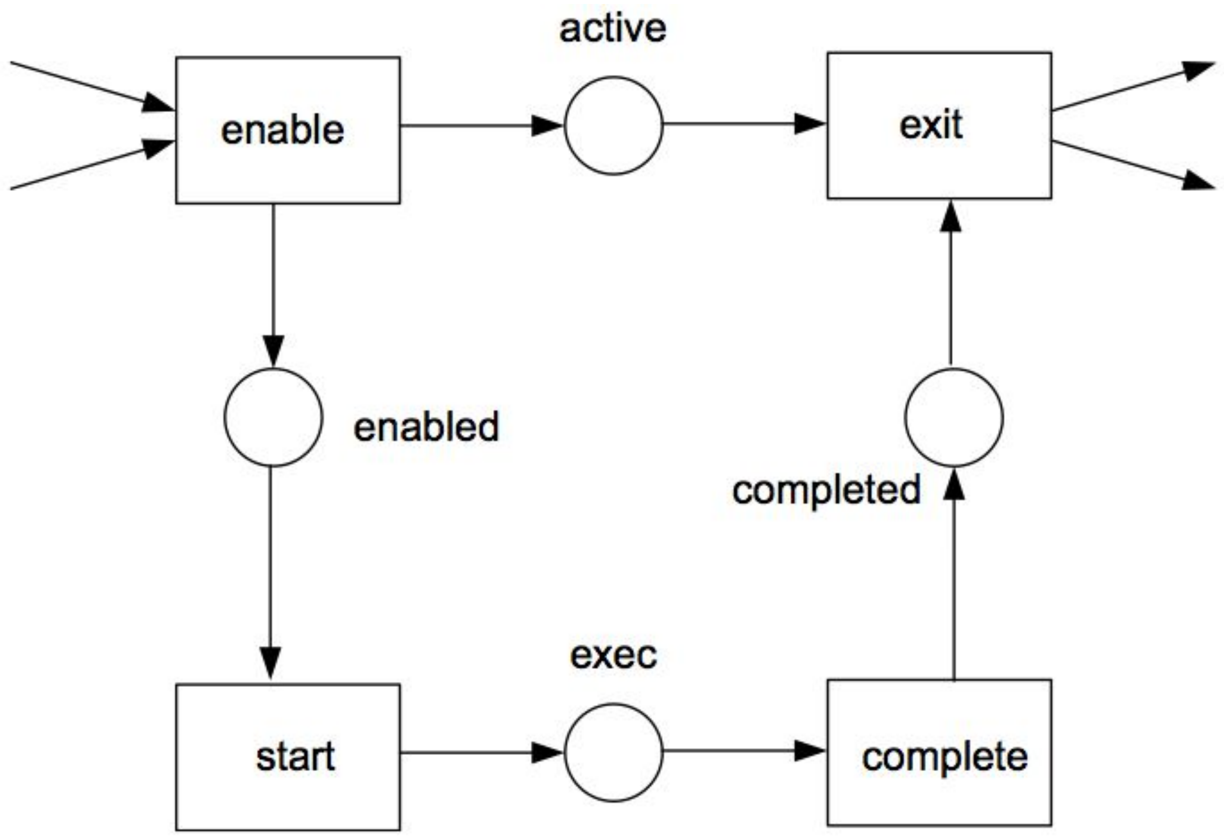

Fig. 4.57. State transition diagrams for single instance tasks

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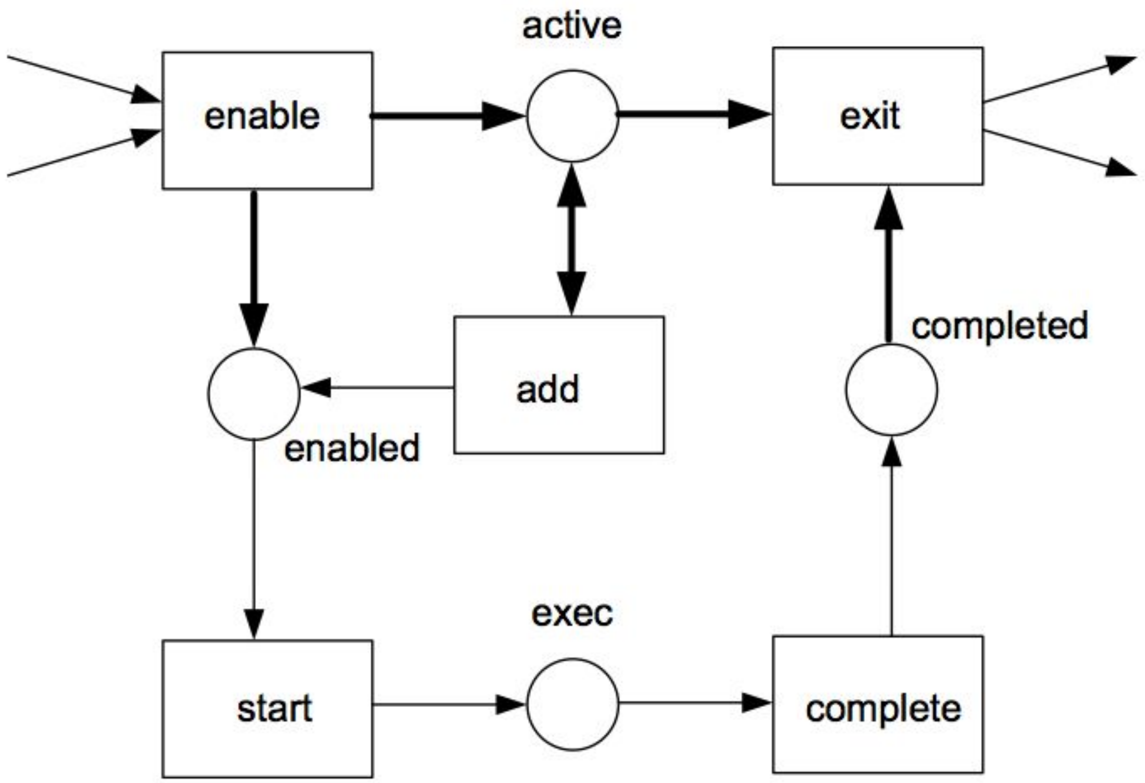

Fig. 4.58. State transition diagram for multiple instances task

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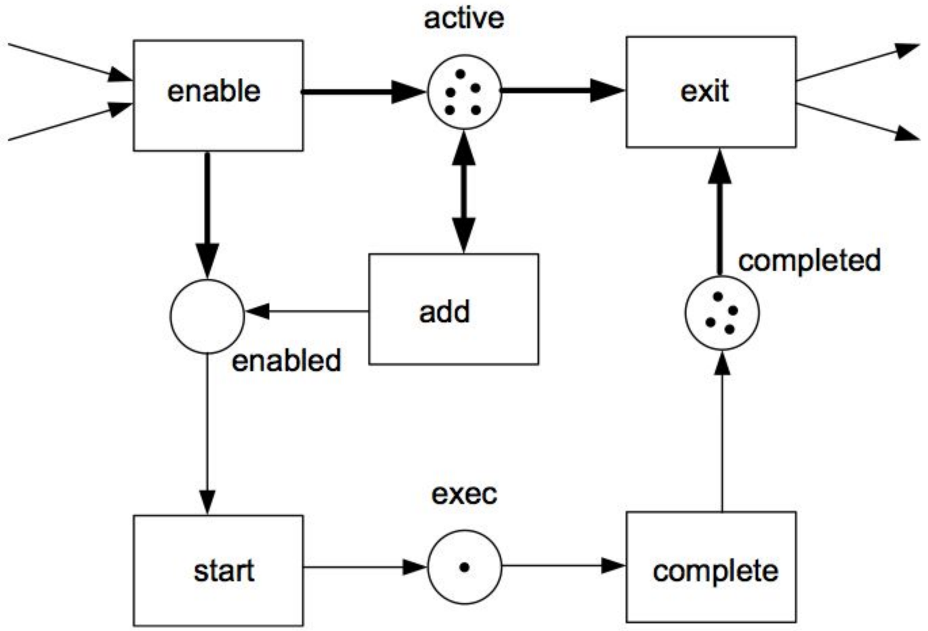

Fig. 4.59. State transition diagram for multiple instances task with five instances, four of which have completed

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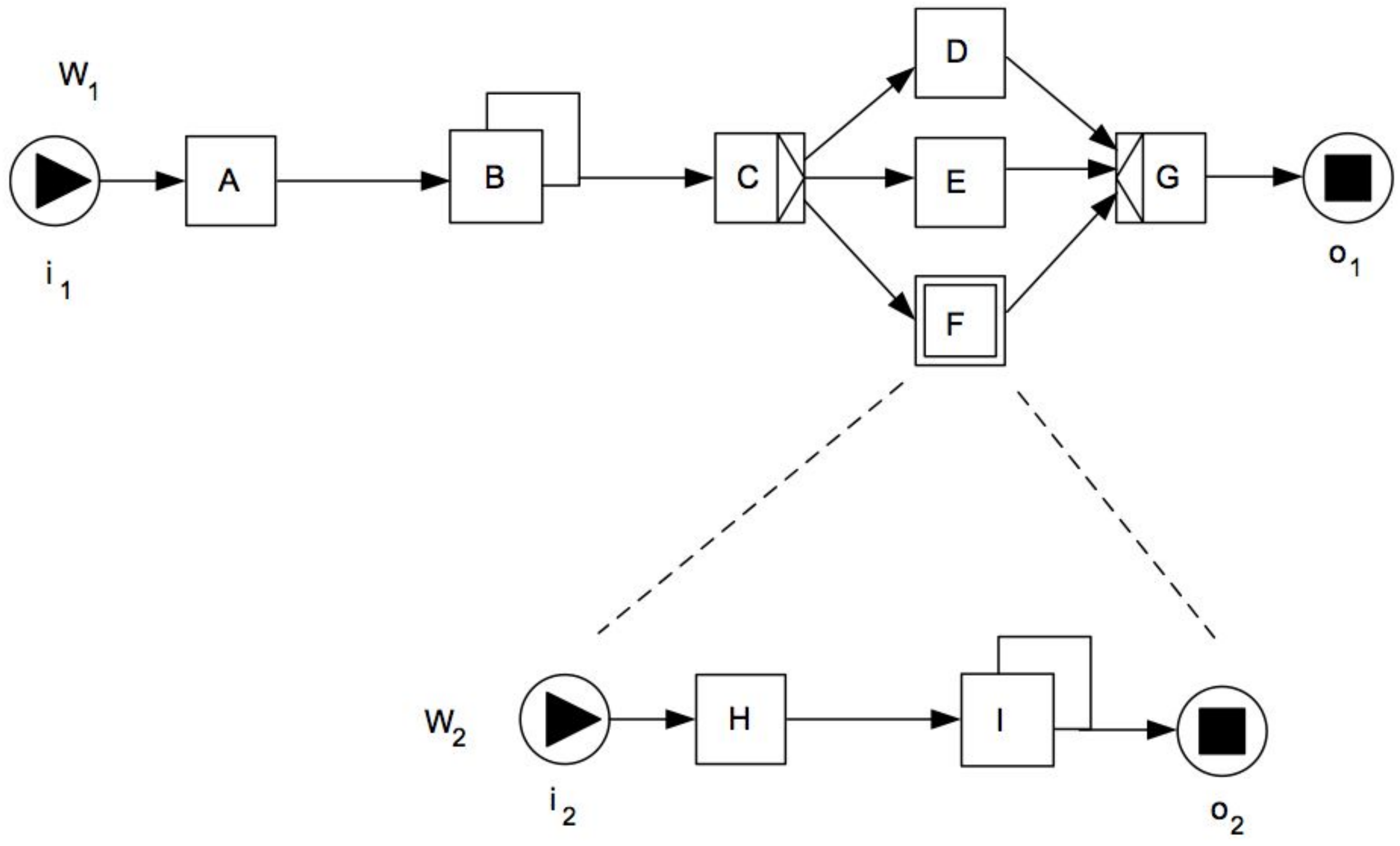

Fig. 4.60. YAWL specification

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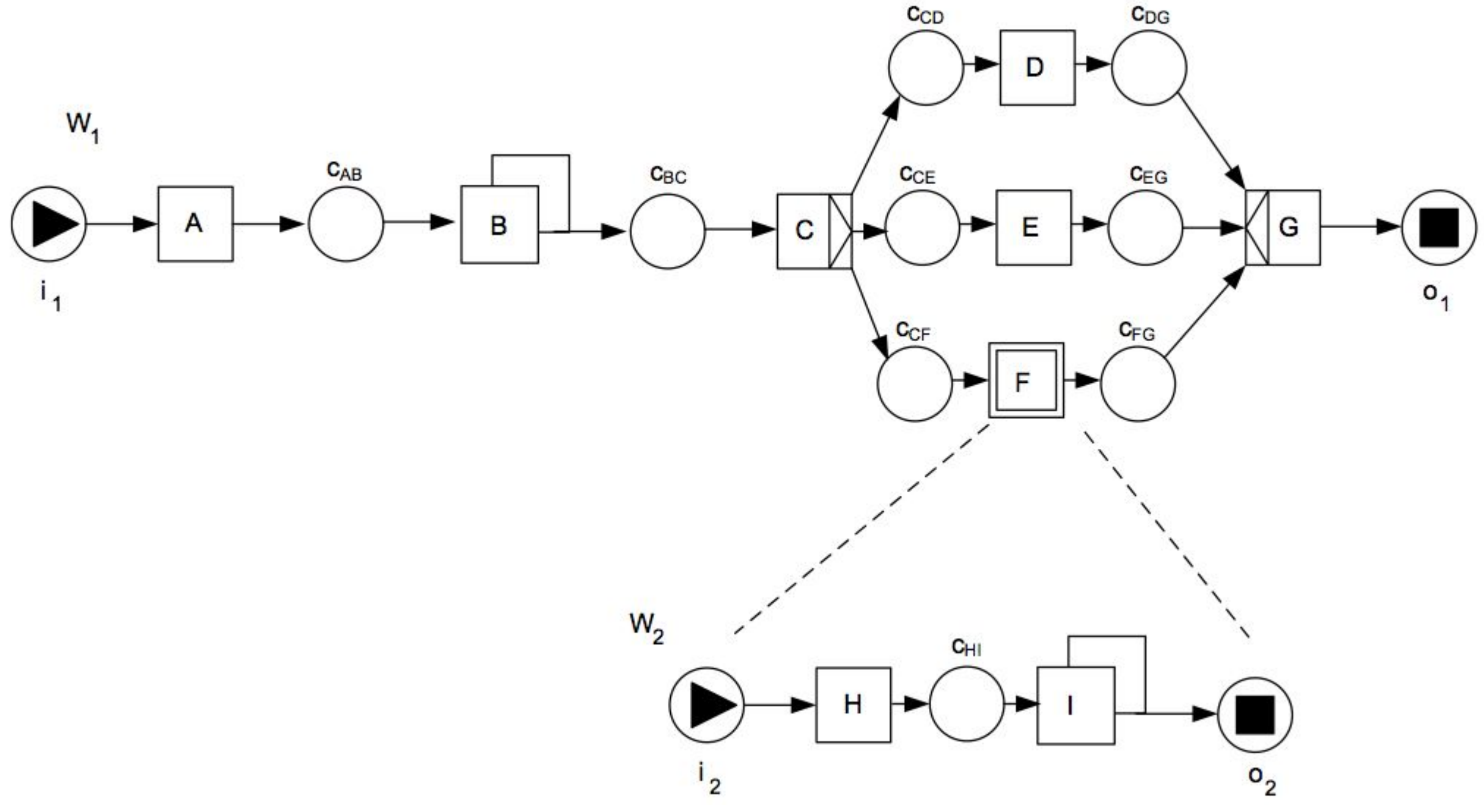

Fig. 4.61. YAWL specification with extended condition set C^{ext}

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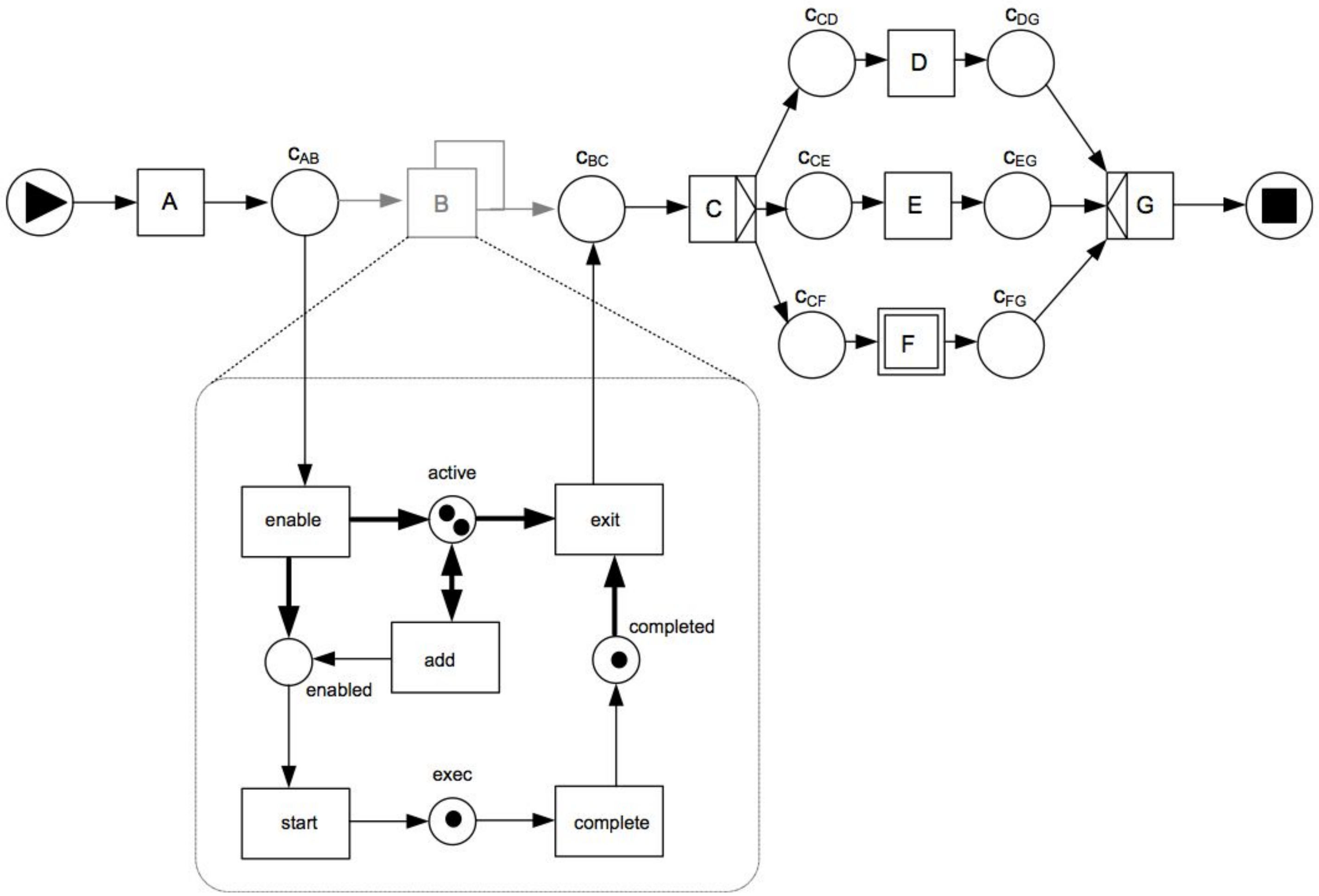

Fig. 4.62. Workflow state with two task instances of *B* active, one is executing and one has completed

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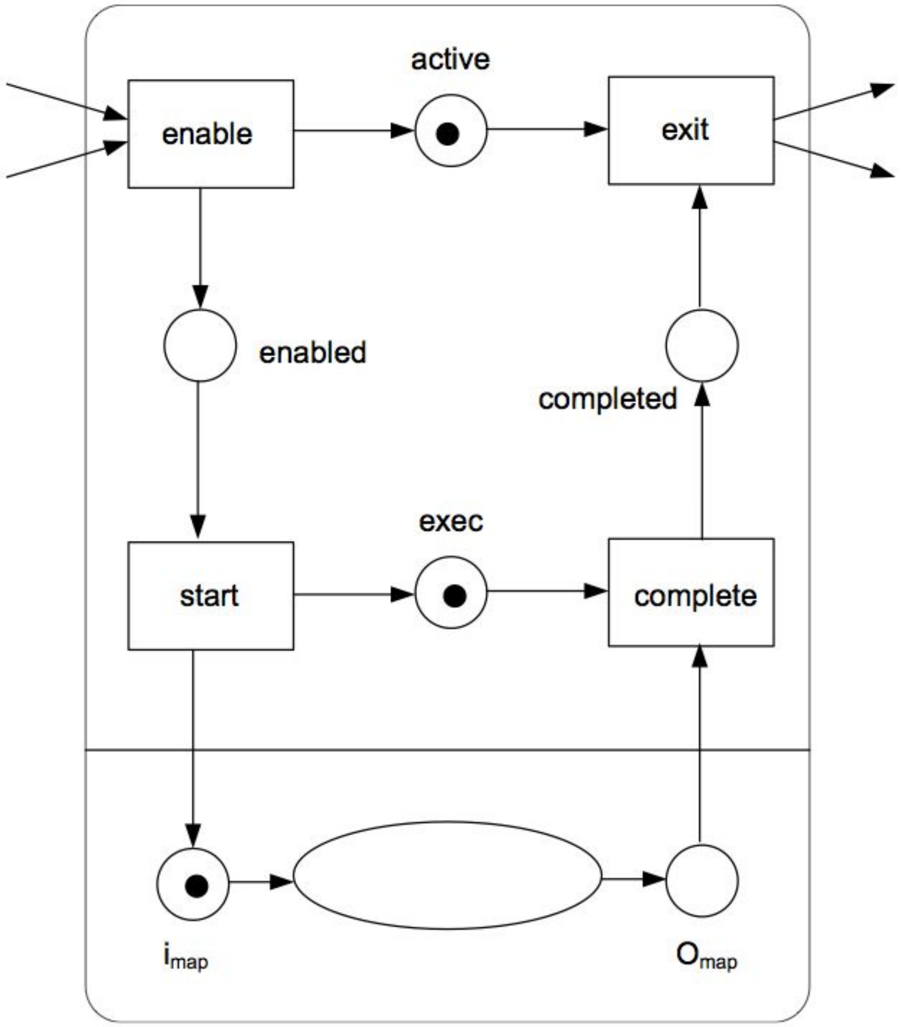

Fig. 4.63. State transition system for composite tasks

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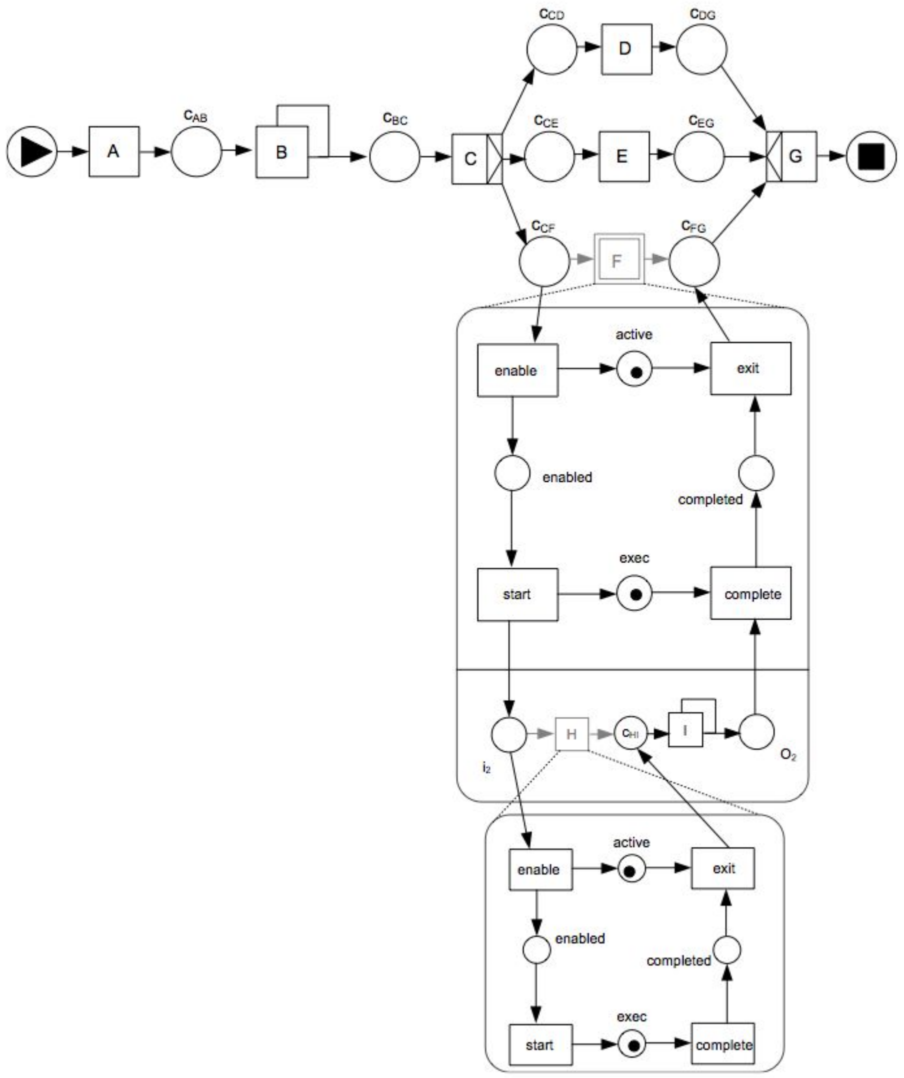

Fig. 4.64. Workflow state, where composite task *F* is currently active

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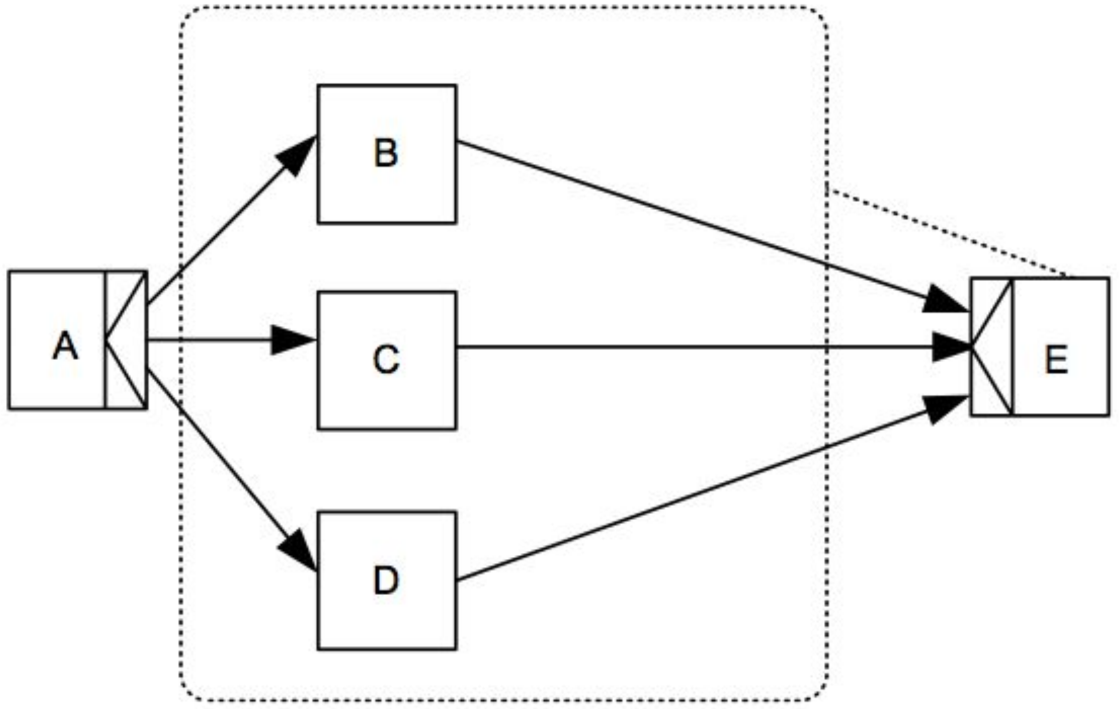

Fig. 4.65. Discriminator in YAWL using cancellation

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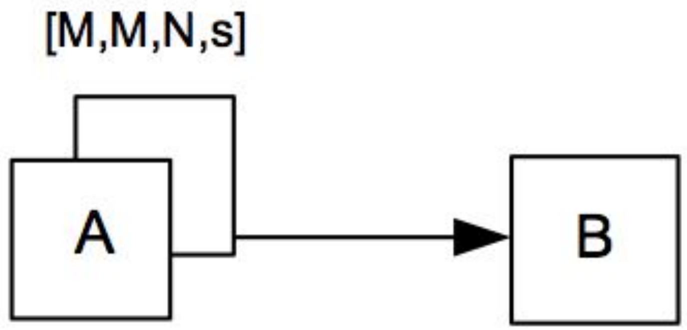

Fig. 4.66. *N-out-of-M join* using multiple instances

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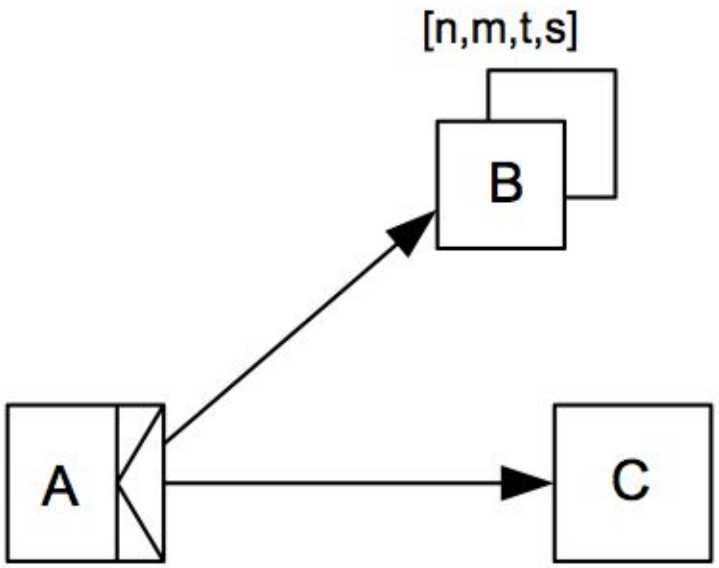

Fig. 4.67. Multiple instances without synchronization

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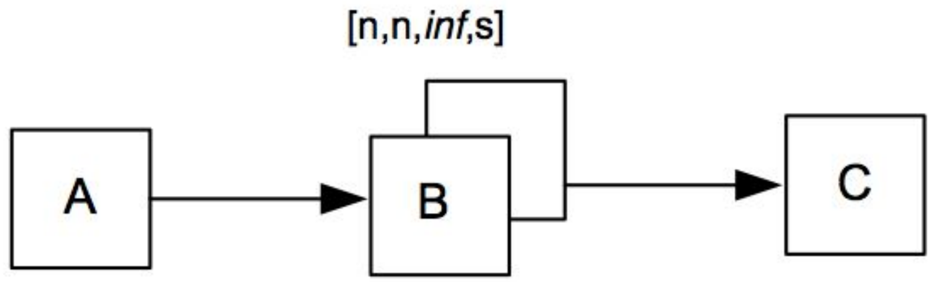

Fig. 4.68. Multiple instances with a priori design time knowledge

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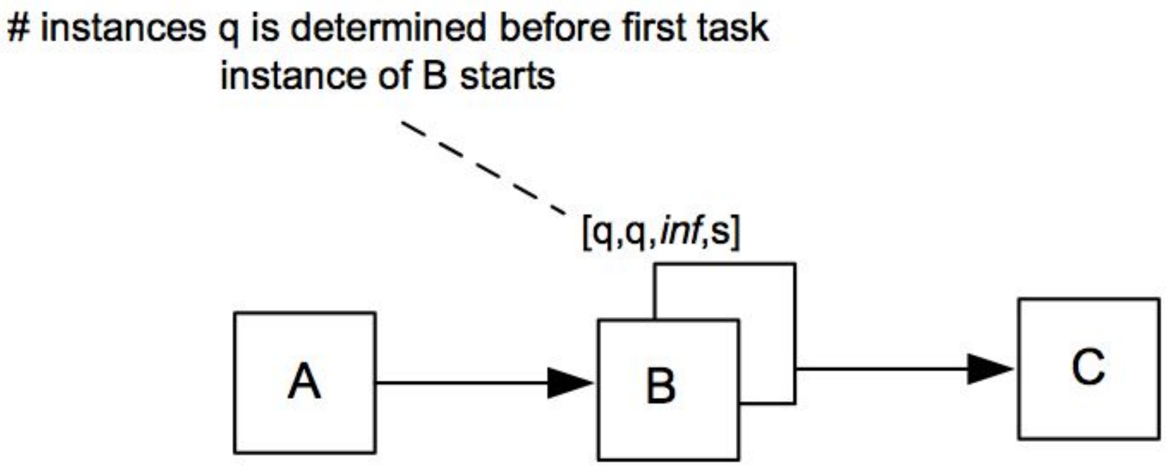

# instances q is determined before first task instance of B starts
[q,q,*inf*,s]
A
B
C

Fig. 4.69. Multiple instances with a priori run time knowledge

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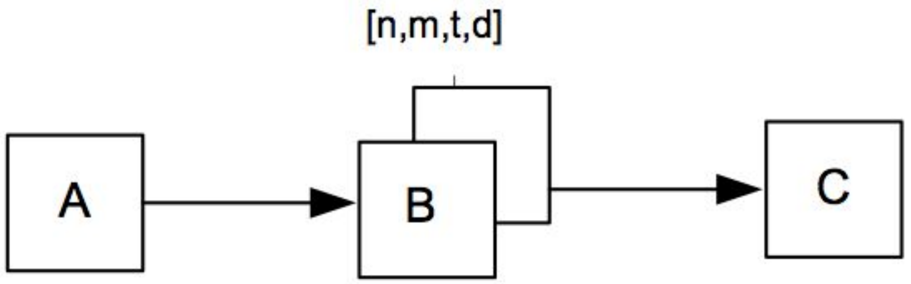

Fig. 4.70. Multiple instances without a priori run time knowledge

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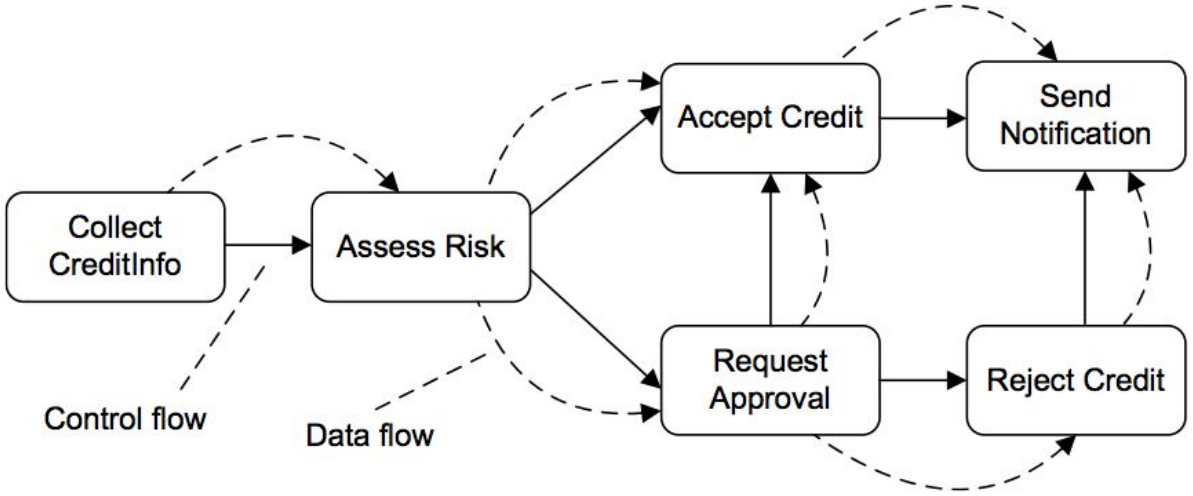

Fig. 4.71. Credit request process model, expressed in graph-based workflow language

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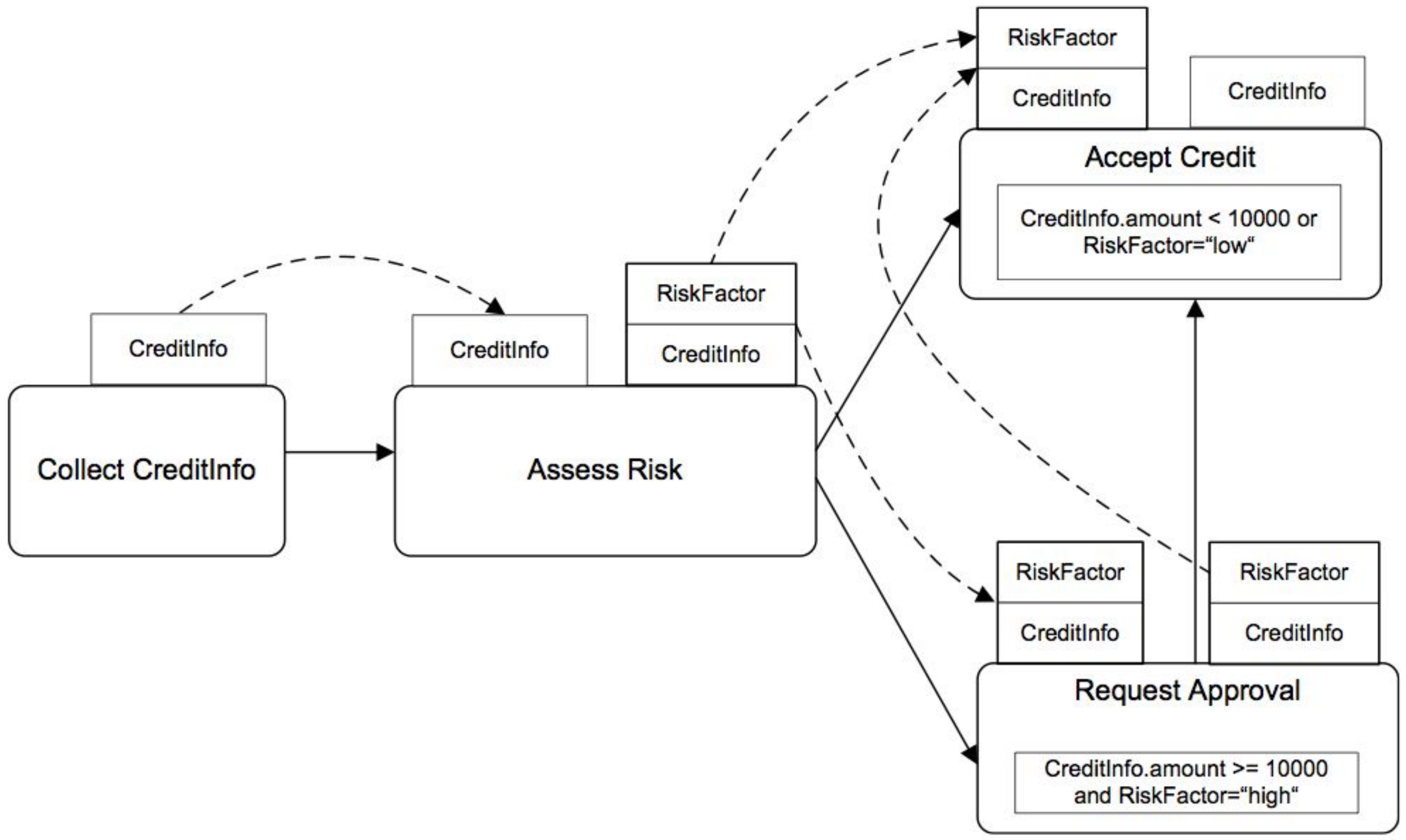

Fig. 4.72. Detailed view on parameters and conditions (partial process)

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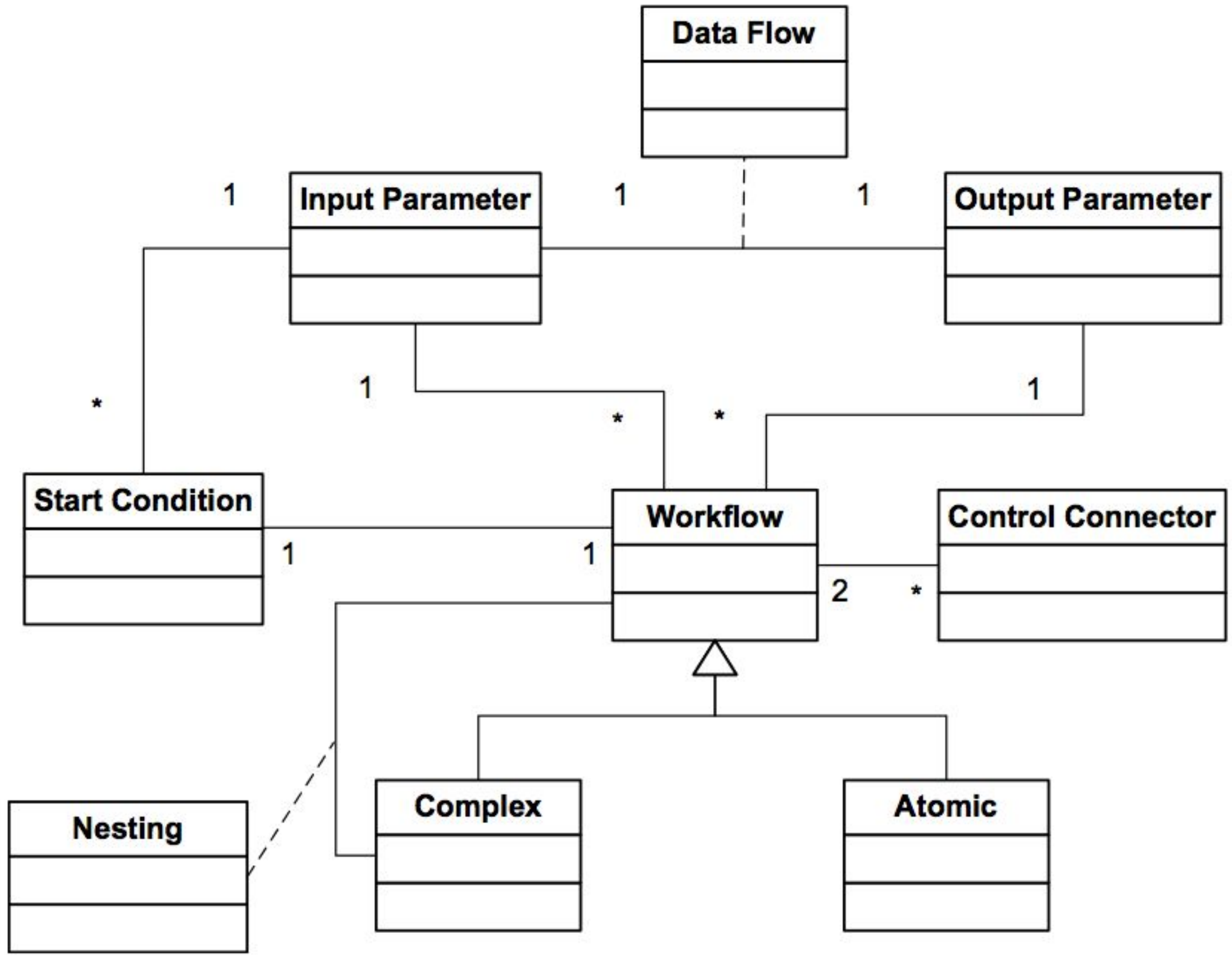

Fig. 4.73. Metamodel of a graph-based workflow language

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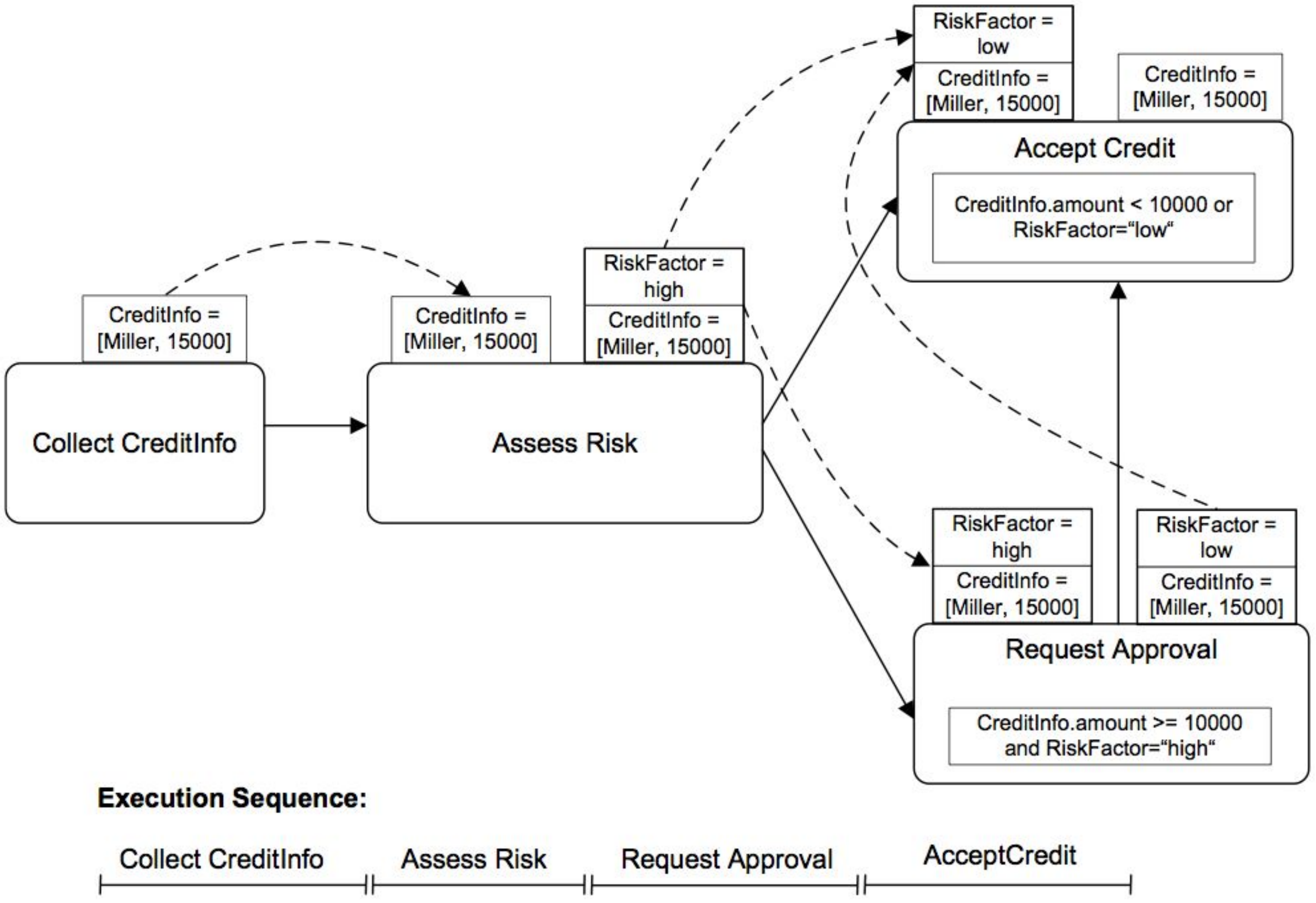
RiskFactor = low
CreditInfo = [Miller, 15000]
CreditInfo = [Miller, 15000]
Accept Credit
CreditInfo.amount < 10000 or RiskFactor="low"
RiskFactor = high
CreditInfo = [Miller, 15000]
CreditInfo = [Miller, 15000]
CreditInfo = [Miller, 15000]
Collect CreditInfo
Assess Risk
RiskFactor = high
CreditInfo = [Miller, 15000]
RiskFactor = low
CreditInfo = [Miller, 15000]
Request Approval
CreditInfo.amount >= 10000 and RiskFactor="high"
Execution Sequence:
Collect CreditInfo
Assess Risk
Request Approval
AcceptCredit

Fig. 4.74. Process instance based on process model shown in Figure 4.72

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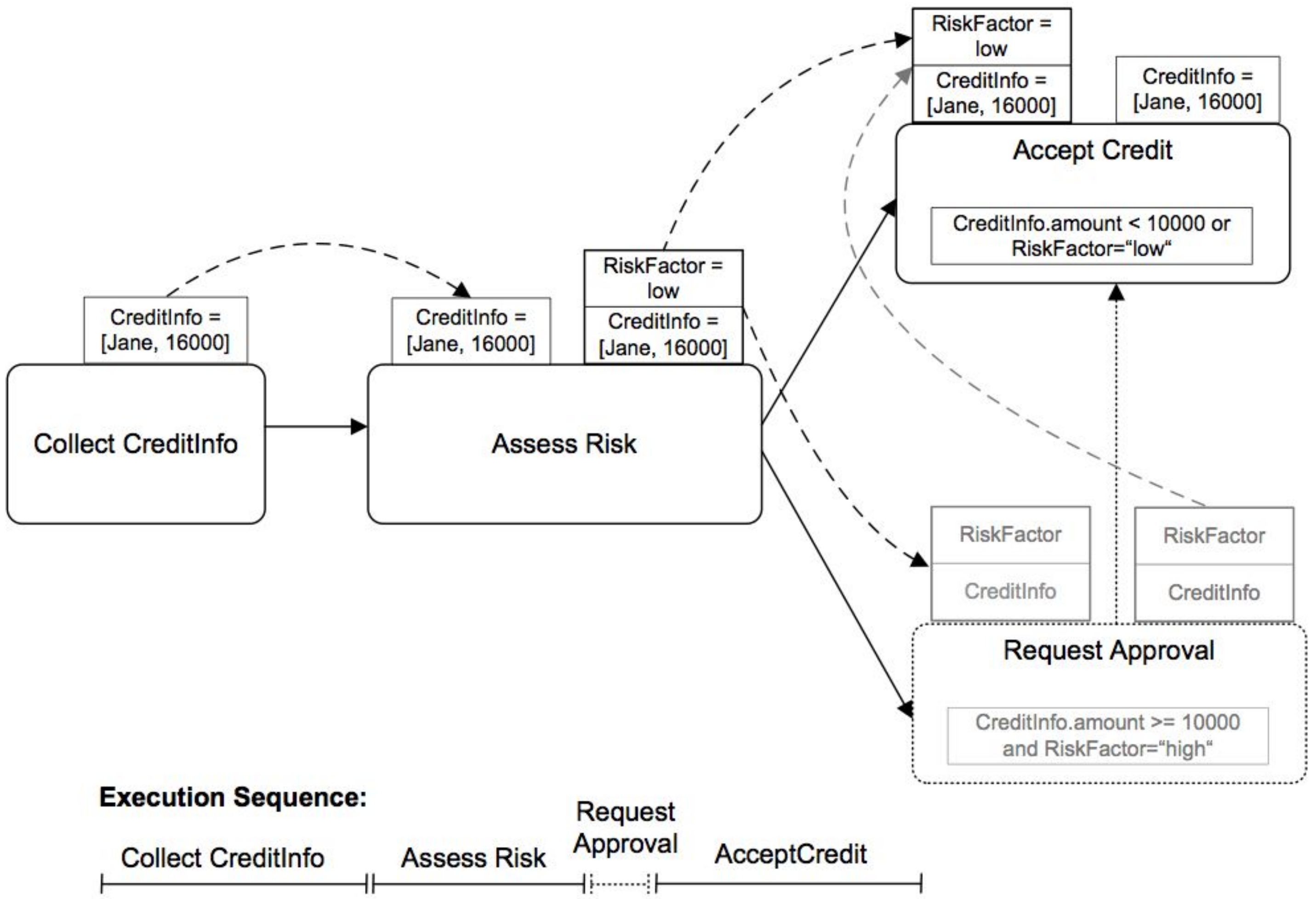
RiskFactor = low
CreditInfo = [Jane, 16000]
CreditInfo = [Jane, 16000]
Accept Credit
CreditInfo.amount < 10000 or RiskFactor="low"
RiskFactor = low
CreditInfo = [Jane, 16000]
CreditInfo = [Jane, 16000]
CreditInfo = [Jane, 16000]
Collect CreditInfo
Assess Risk
RiskFactor
CreditInfo
RiskFactor
CreditInfo
Request Approval
CreditInfo.amount >= 10000 and RiskFactor="high"
Execution Sequence:
Collect CreditInfo
Assess Risk
Request Approval
AcceptCredit

Fig. 4.75. Process instance where request approval activity is not required

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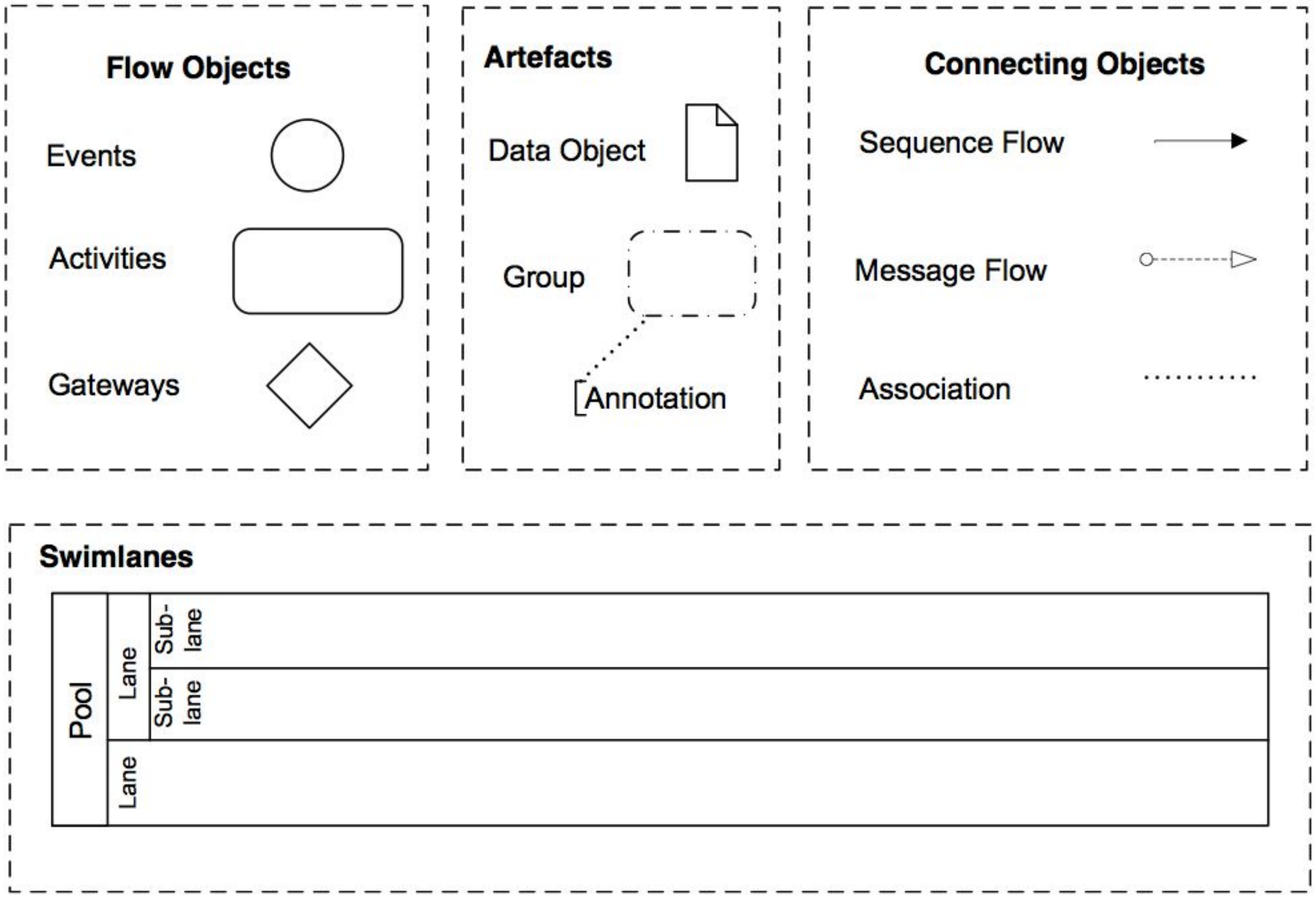

Fig. 4.76. BPMN: categories of elements

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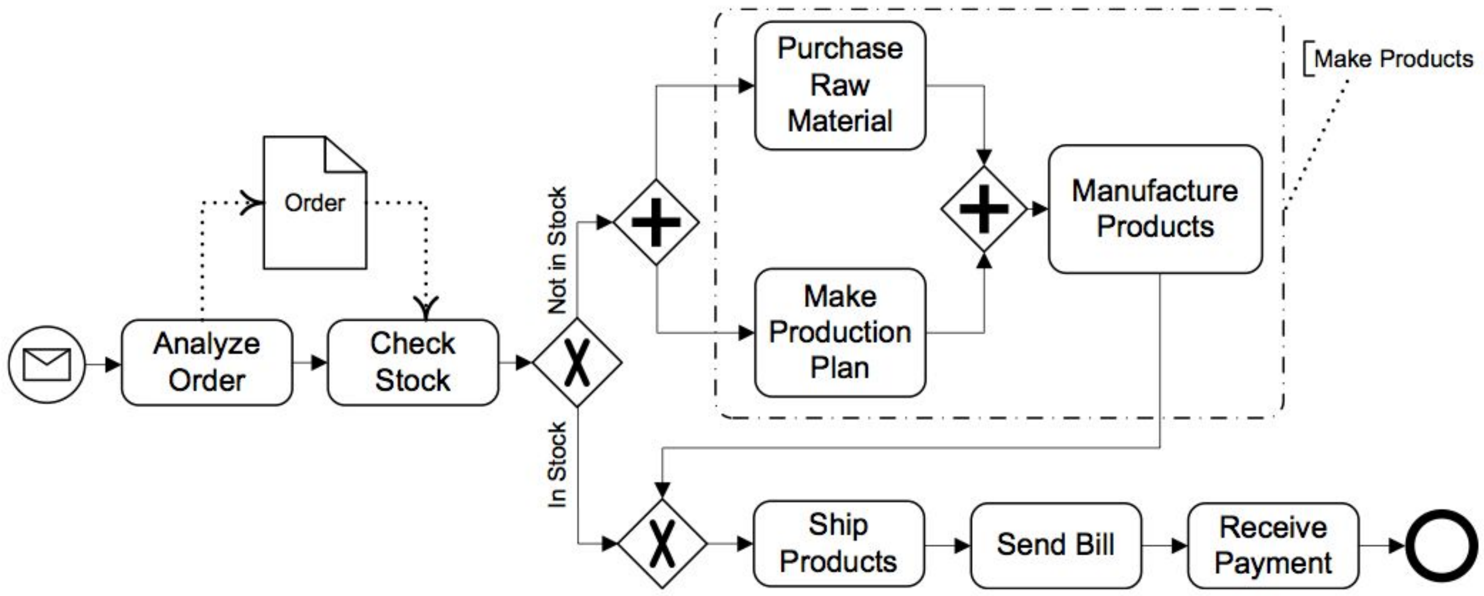

Fig. 4.77. Business process diagram expressed in BPMN

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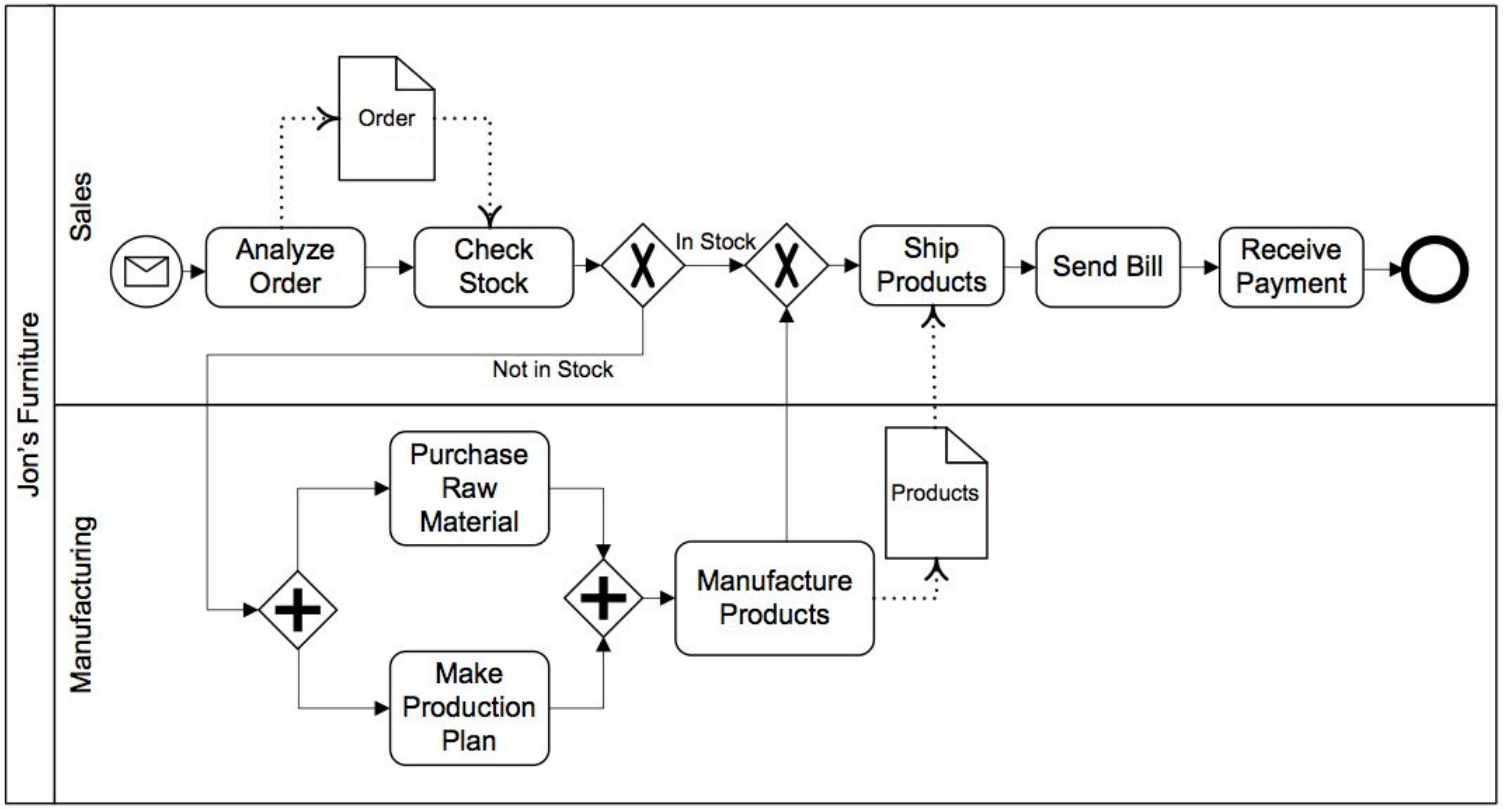

Fig. 4.78. Business process diagram with role information

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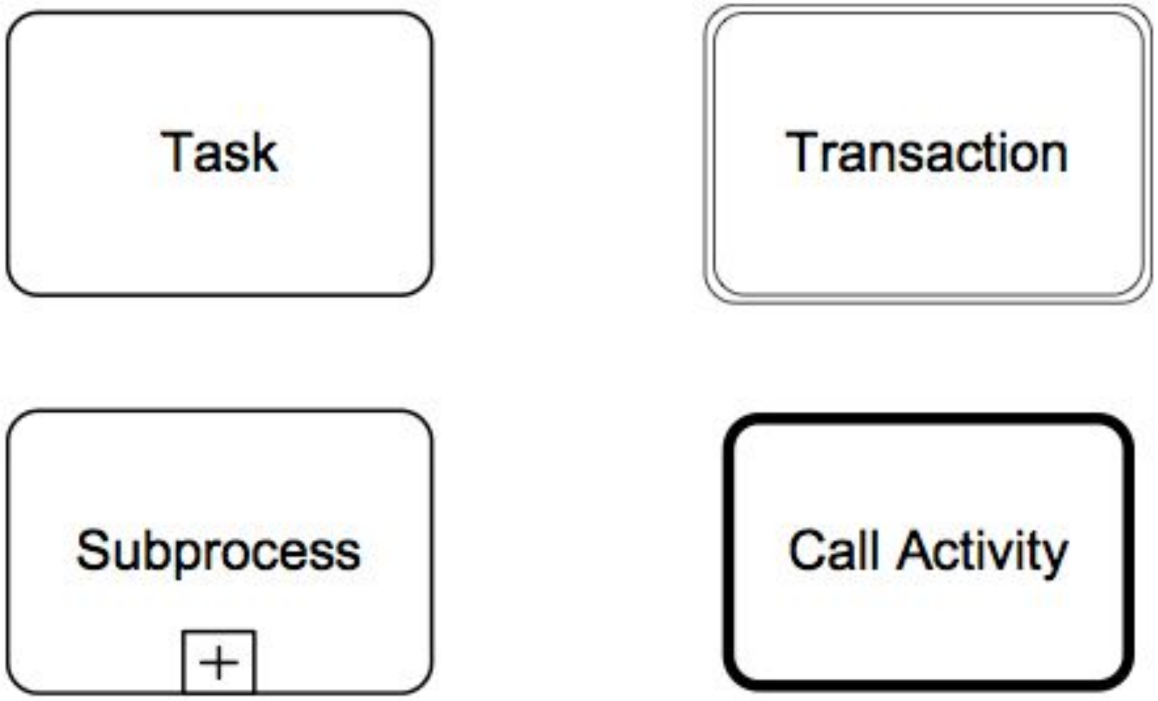

Fig. 4.79. Activity types in the BPMN

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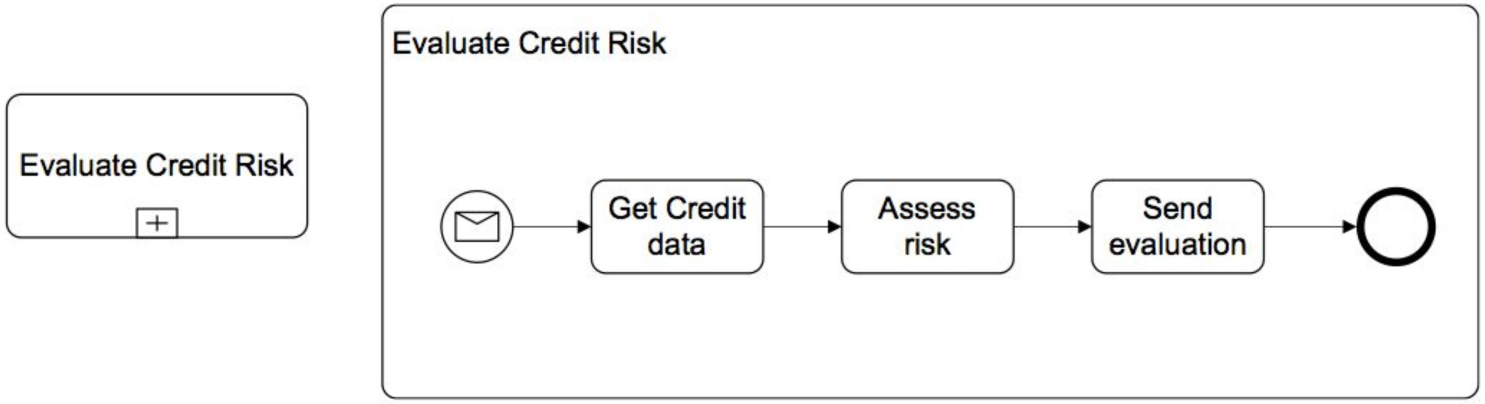

Fig. 4.80. Collapsed and expanded subprocess

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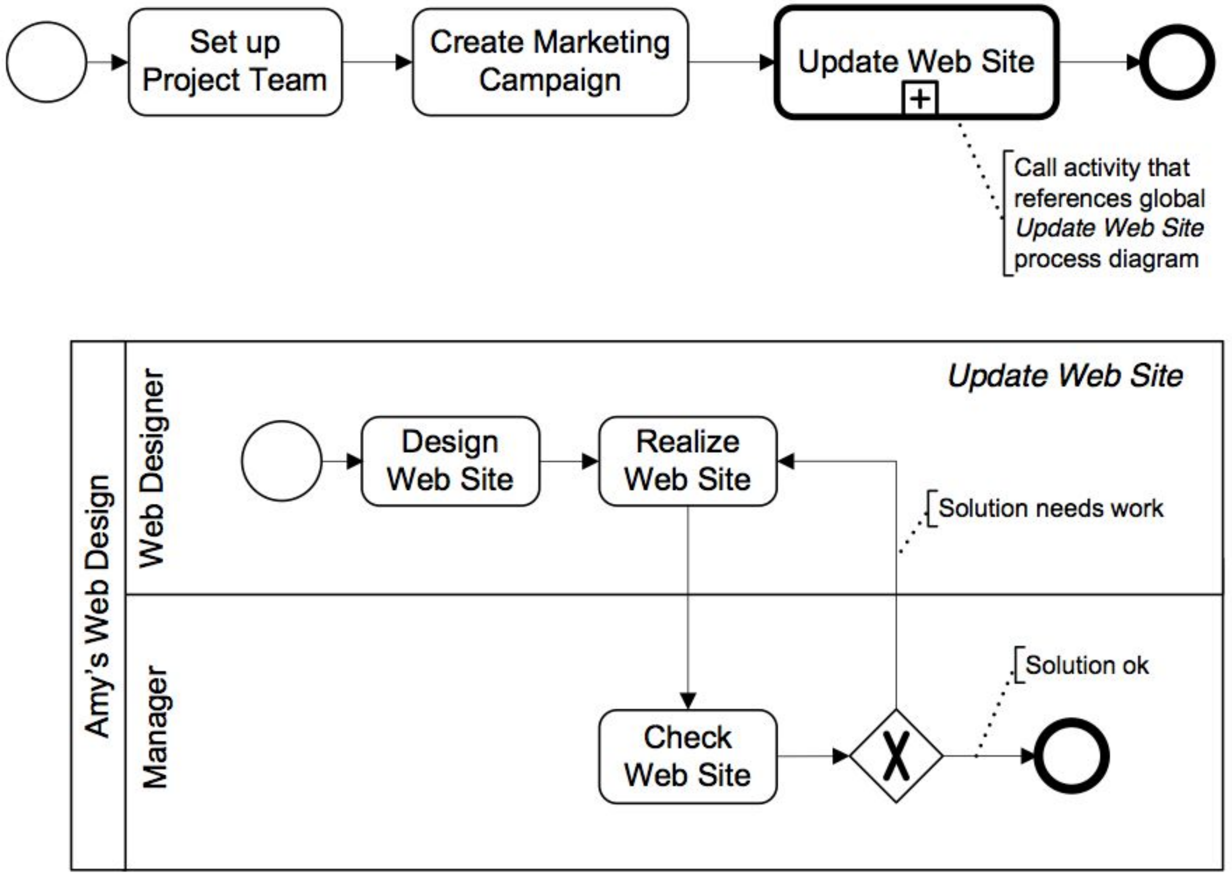

Fig. 4.81. Process diagram with a call activity that references a global process diagram; the reference is maintained in the respective attribute of the call activity

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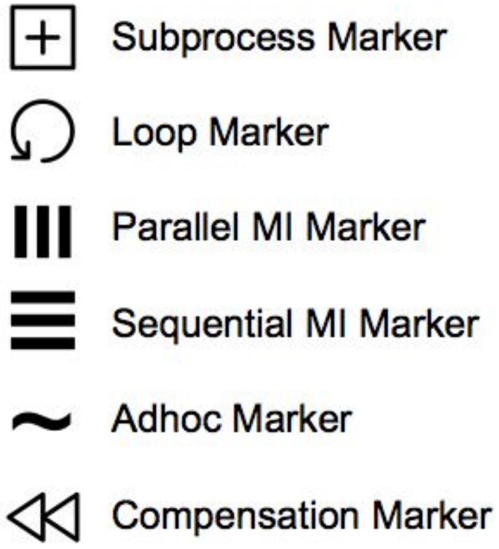

Fig. 4.82. Activity markers refine the behaviour of activities

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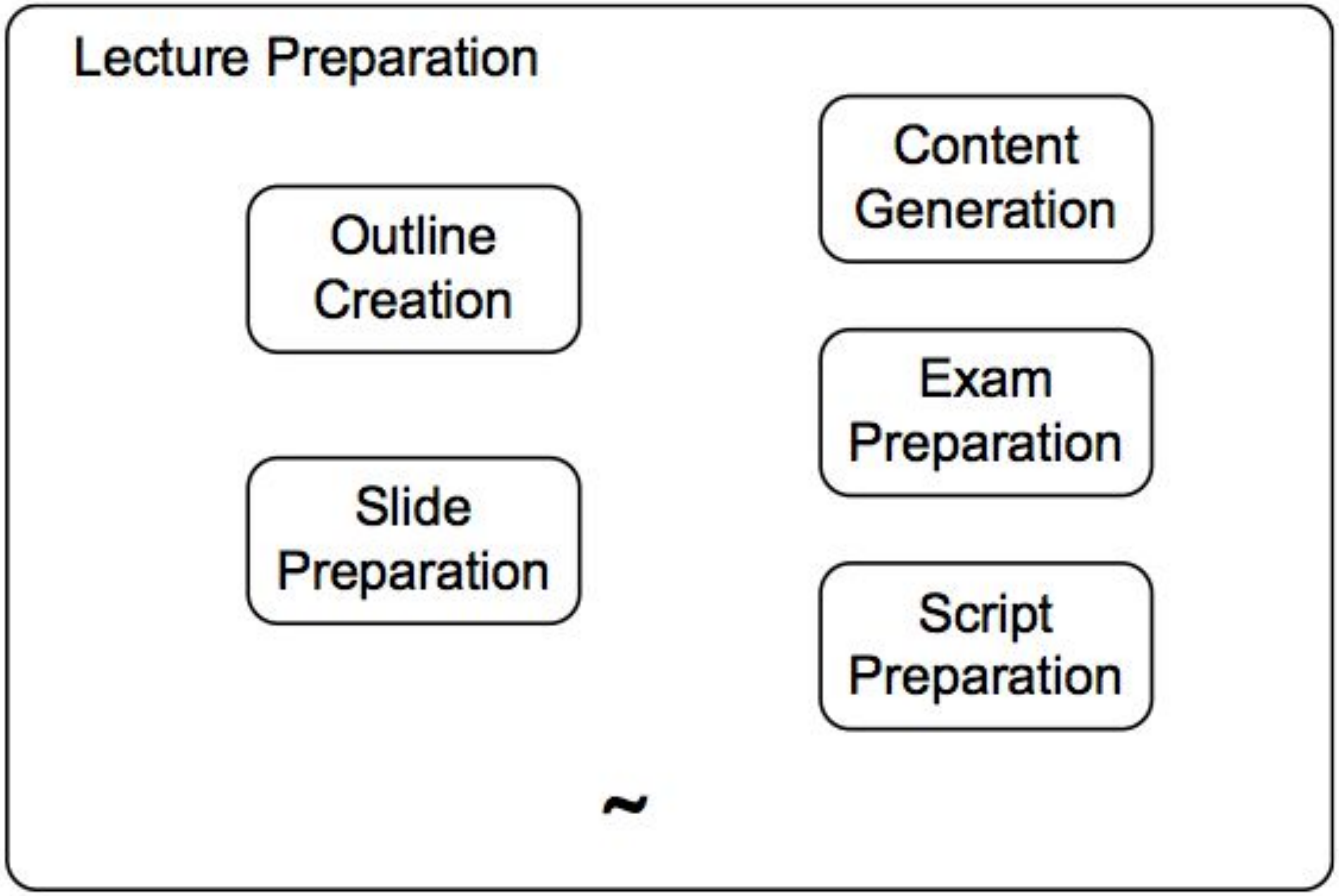

Fig. 4.83. Sample adhoc process

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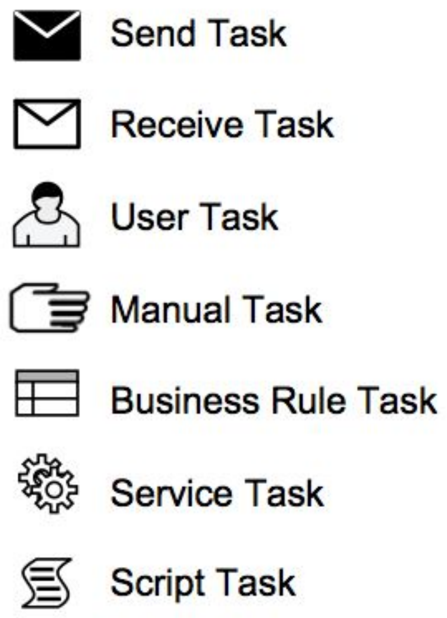

Fig. 4.84. Task types specify the kind of task that is represented

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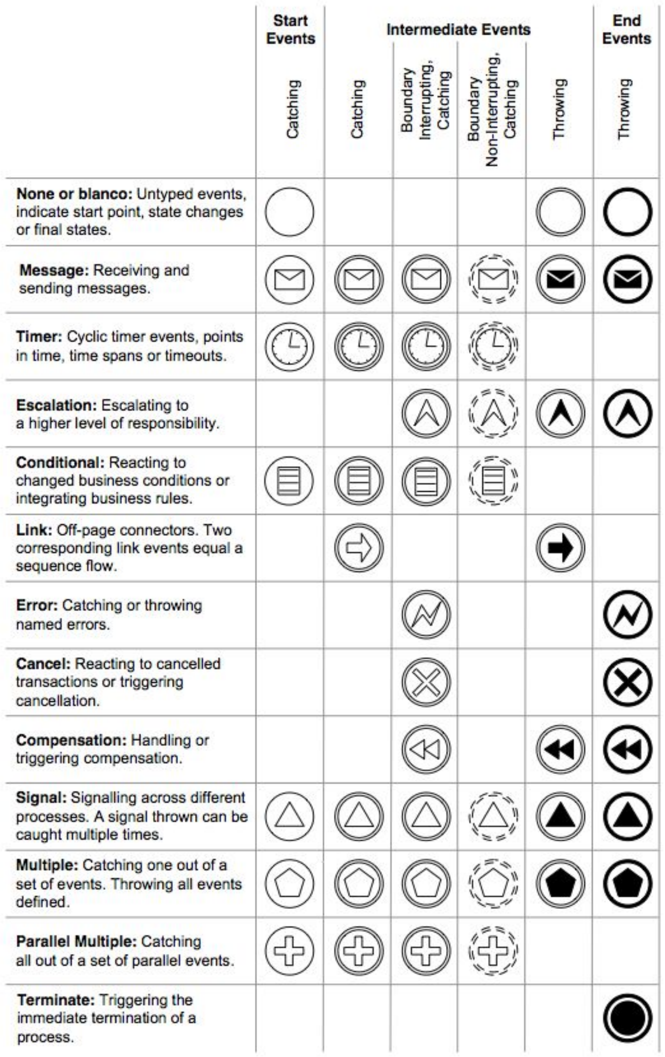

	Start Events	Intermediate Events				End Events
	Catching	Catching	Boundary Interrupting, Catching	Boundary Non-Interrupting, Catching	Throwing	Throwing
None or blanco: Untyped events, indicate start point, state changes or final states.	○				○	○
Message: Receiving and sending messages.	✉	✉	✉	✉	✉	✉
Timer: Cyclic timer events, points in time, time spans or timeouts.	◷	◷	◷	◷		
Escalation: Escalating to a higher level of responsibility.			⮝	⮝	⮝	⮝
Conditional: Reacting to changed business conditions or integrating business rules.	≡	≡	≡	≡		
Link: Off-page connectors. Two corresponding link events equal a sequence flow.		⇨			➡	
Error: Catching or throwing named errors.			ϟ			ϟ
Cancel: Reacting to cancelled transactions or triggering cancellation.			✕			✕
Compensation: Handling or triggering compensation.			⏪		⏪	⏪
Signal: Signalling across different processes. A signal thrown can be caught multiple times.	△	△	△	△	▲	▲
Multiple: Catching one out of a set of events. Throwing all events defined.	⬠	⬠	⬠	⬠	⬟	⬟
Parallel Multiple: Catching all out of a set of parallel events.	✚	✚	✚	✚		
Terminate: Triggering the immediate termination of a process.						●

Fig. 4.85. Common event types in the BPMN, adapted from the BPMN Poster, BPM Offensive Berlin (2011)

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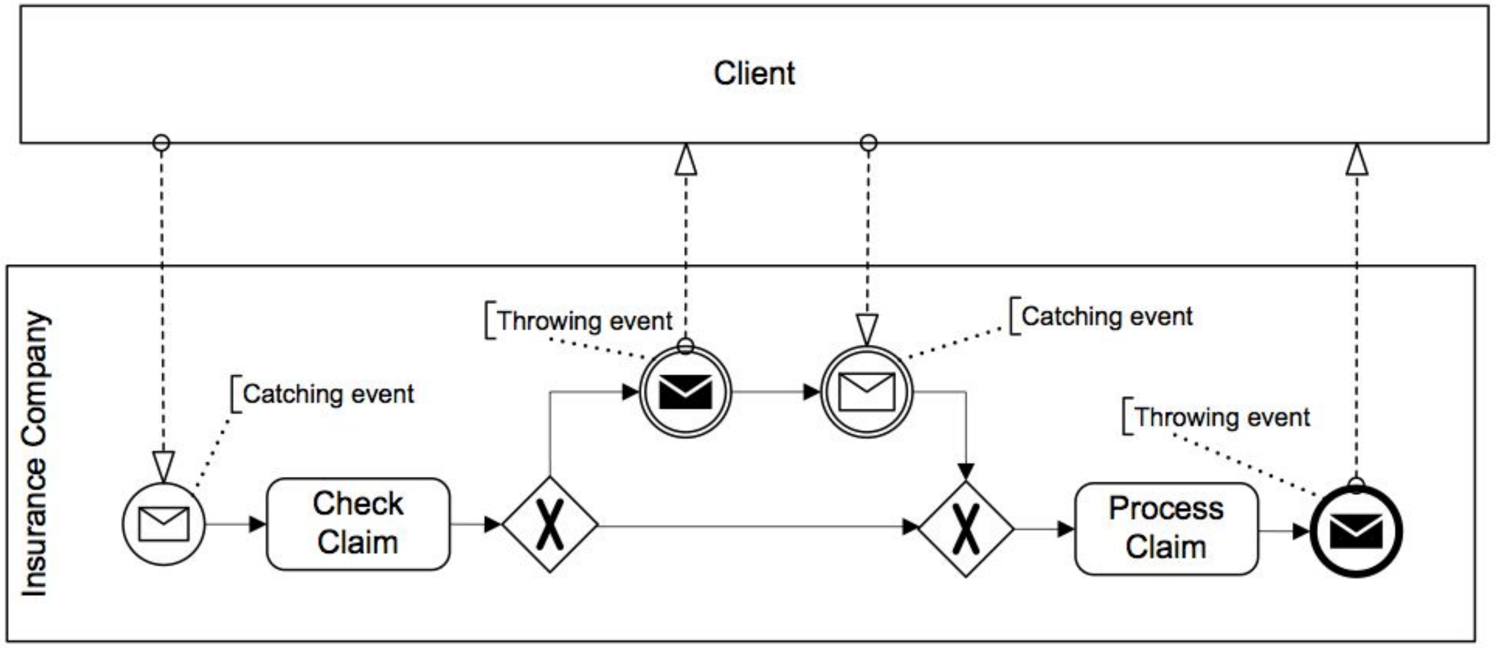

Fig. 4.86. Throwing and catching events

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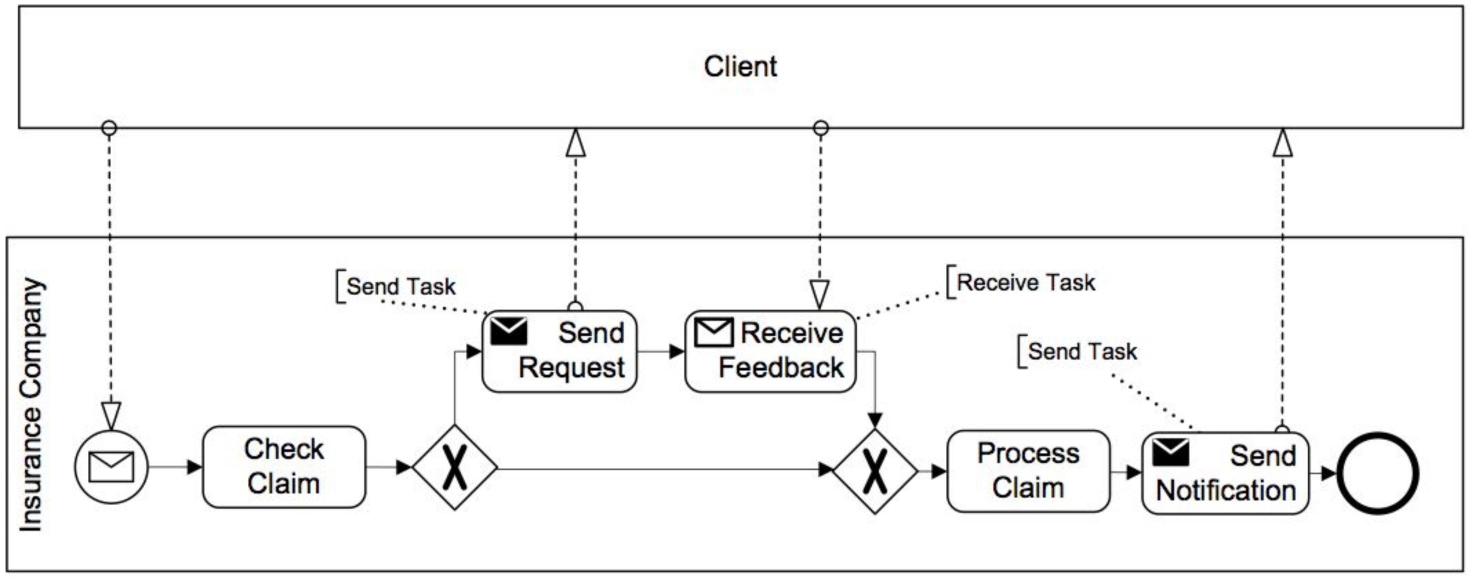

Fig. 4.87. Using markers to identify send tasks and receive tasks

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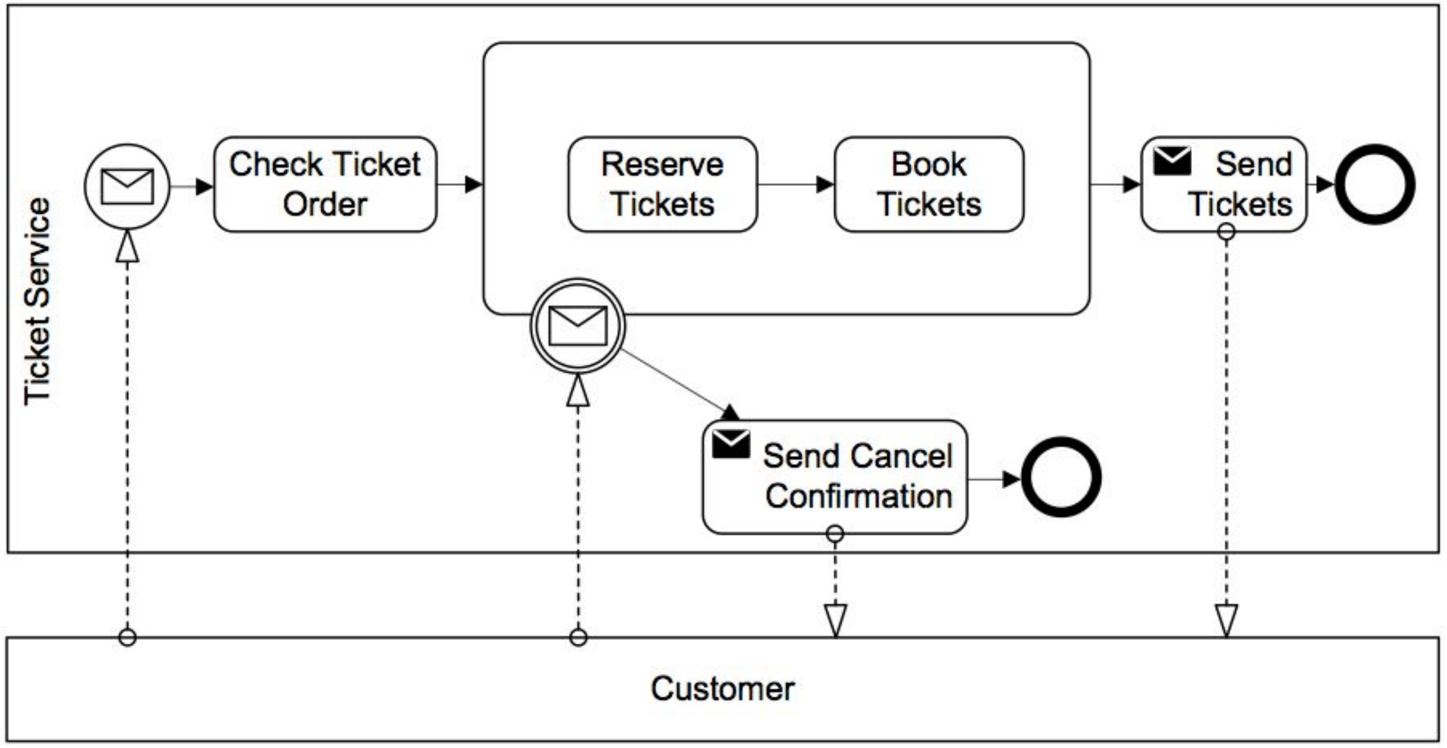

Fig. 4.88. Process diagram with interrupting boundary event

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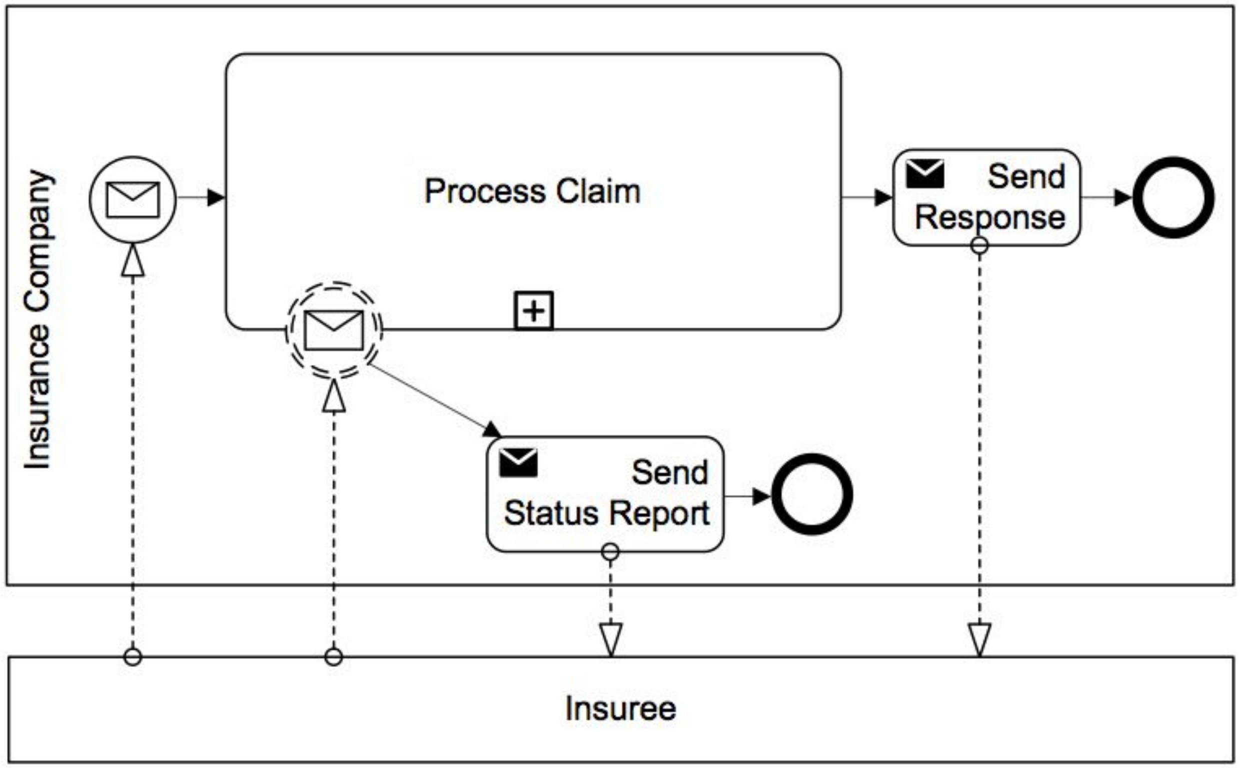

Fig. 4.89. Process diagram with non-interrupting boundary event

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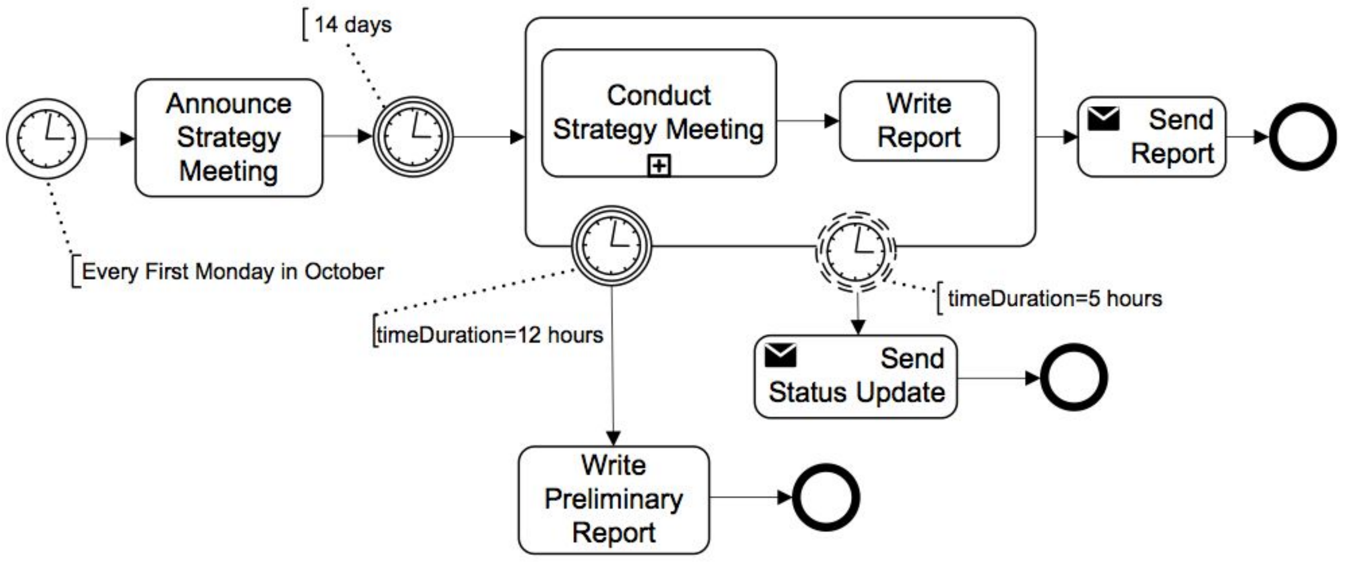

Fig. 4.90. Process diagram with interrupting and non-interrupting boundary timer events

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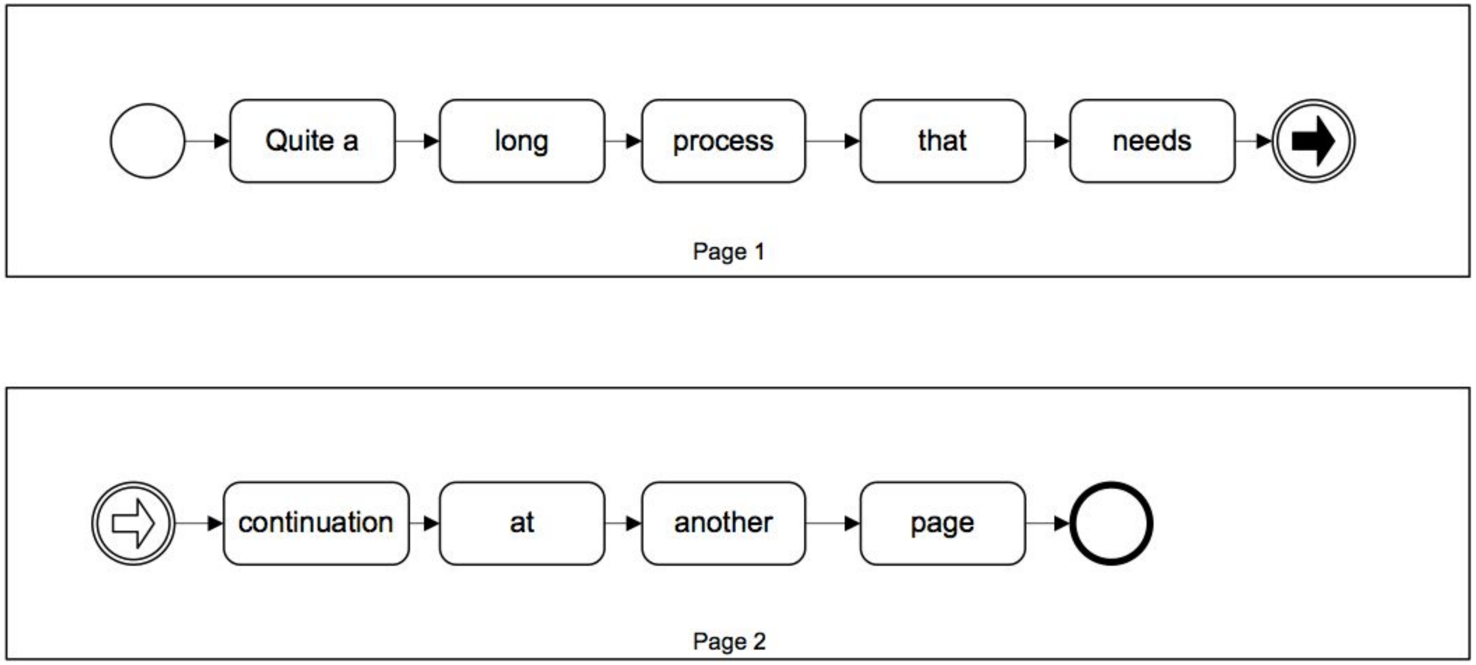

Fig. 4.91. Link events connect different parts of one process

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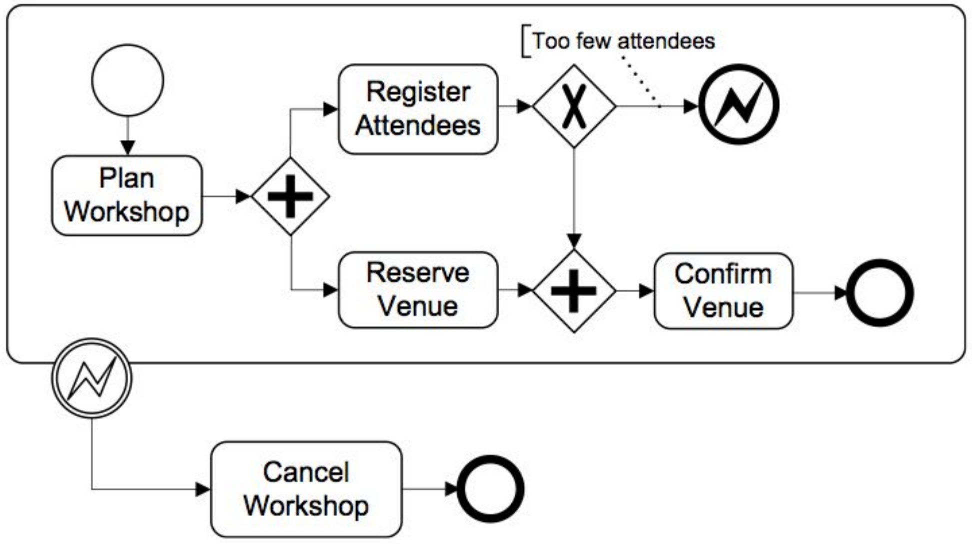

Fig. 4.92. An error is thrown in a subprocess; it is caught by an error boundary event attached to that subprocess

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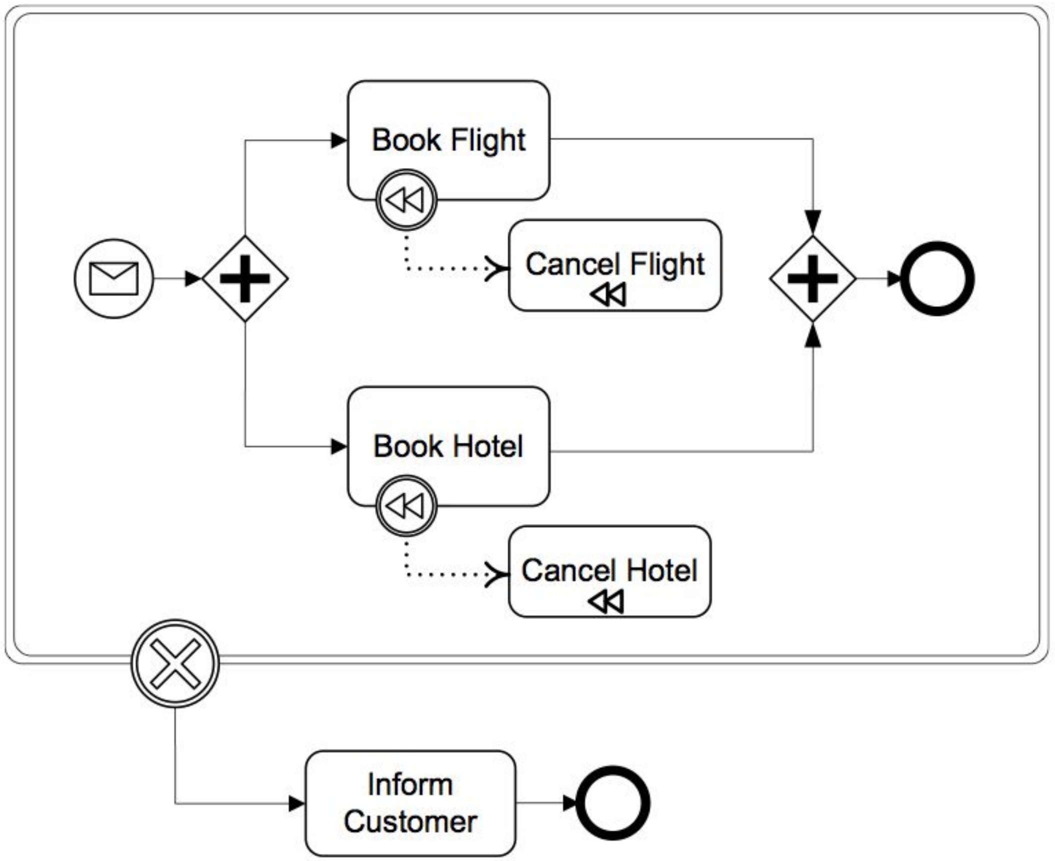

Fig. 4.93. Business process diagram with transaction and compensation elements, adapted from Object Management Group (2011)

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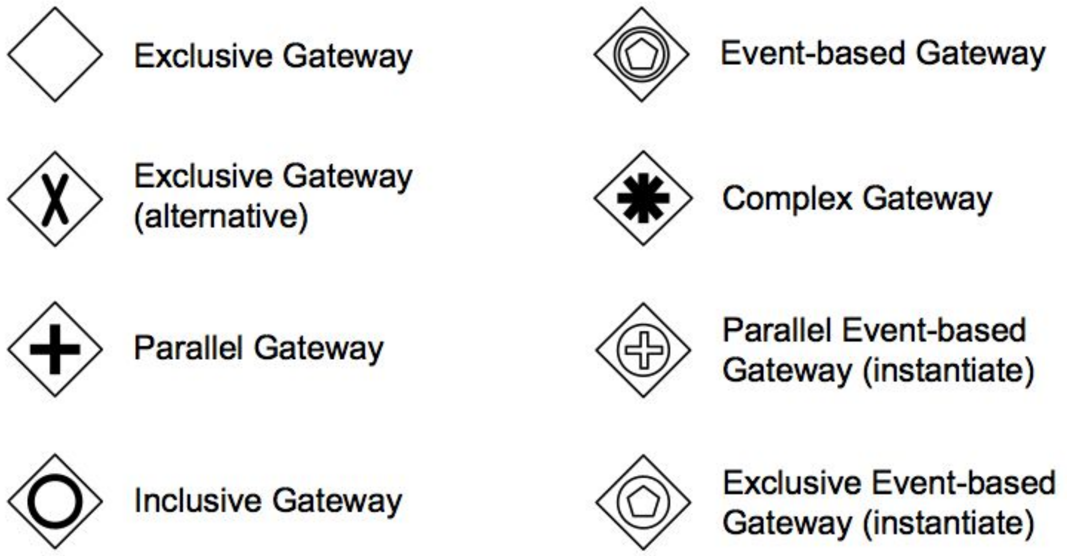
Exclusive Gateway
Exclusive Gateway (alternative)
Parallel Gateway
Inclusive Gateway
Event-based Gateway
Complex Gateway
Parallel Event-based Gateway (instantiate)
Exclusive Event-based Gateway (instantiate)

Fig. 4.94. Gateway types in the BPMN, Object Management Group (2011)

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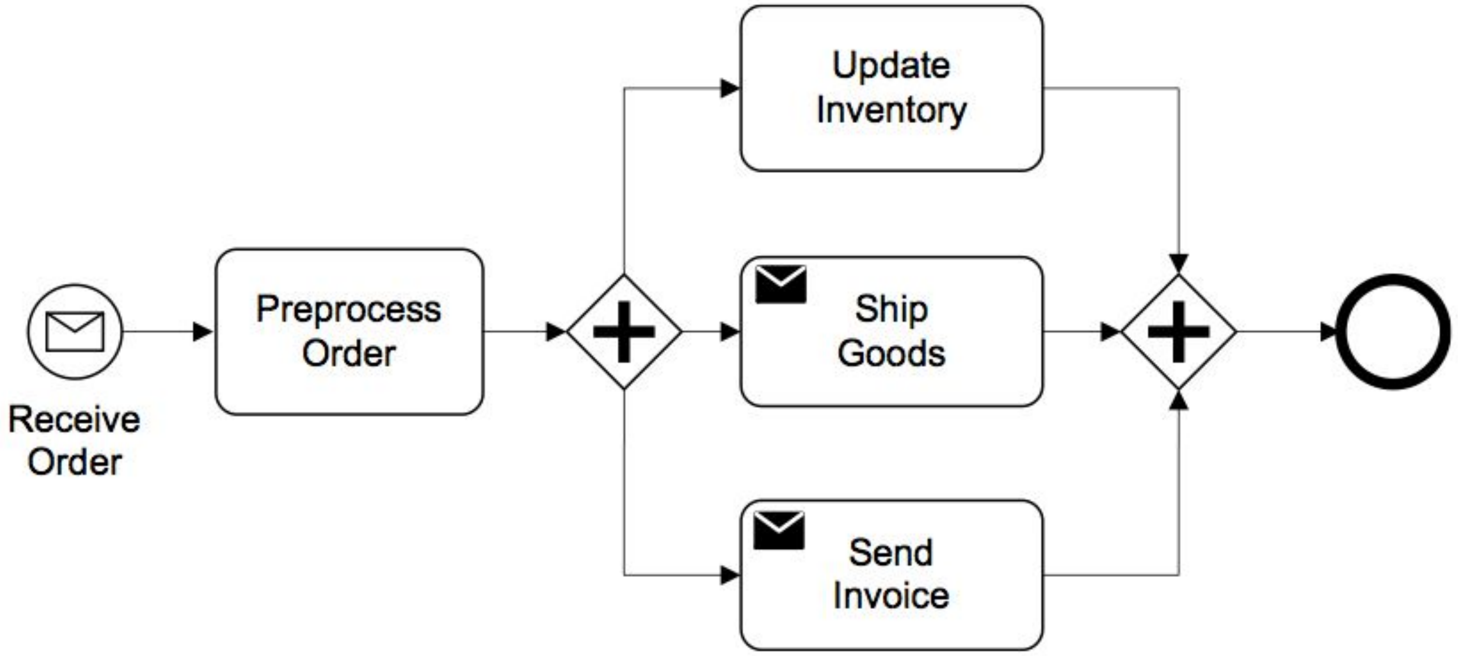

Fig. 4.95. Example involving the parallel gateway

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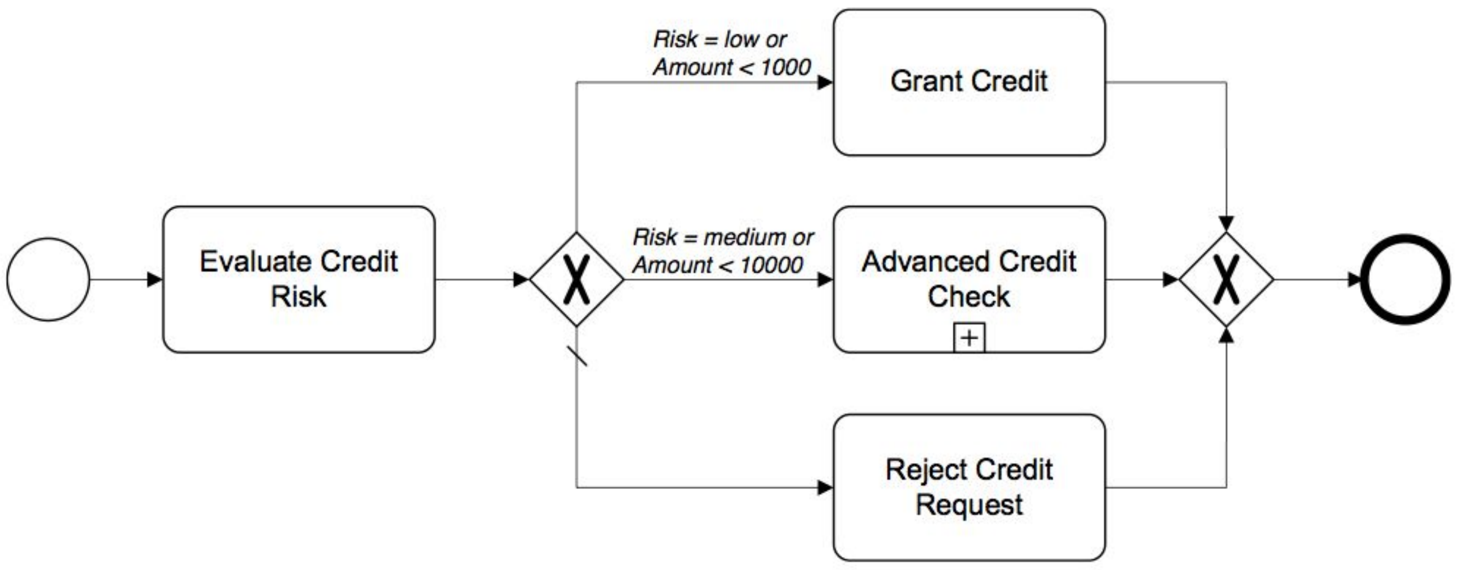

Fig. 4.96. Exclusive gateway with conditions and default flow

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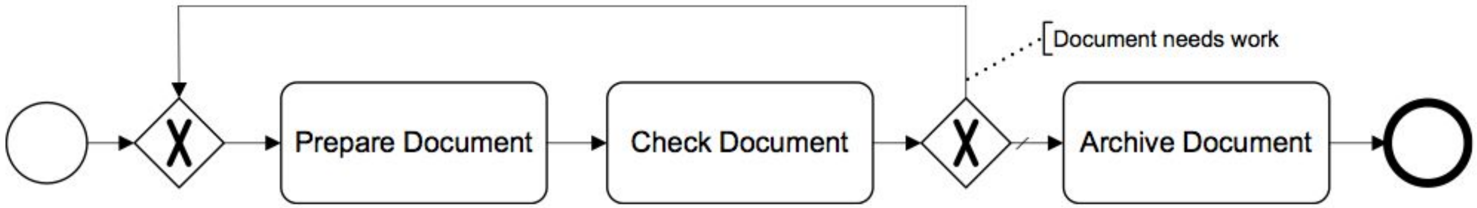

Fig. 4.97. Exclusive gateways realizing a loop

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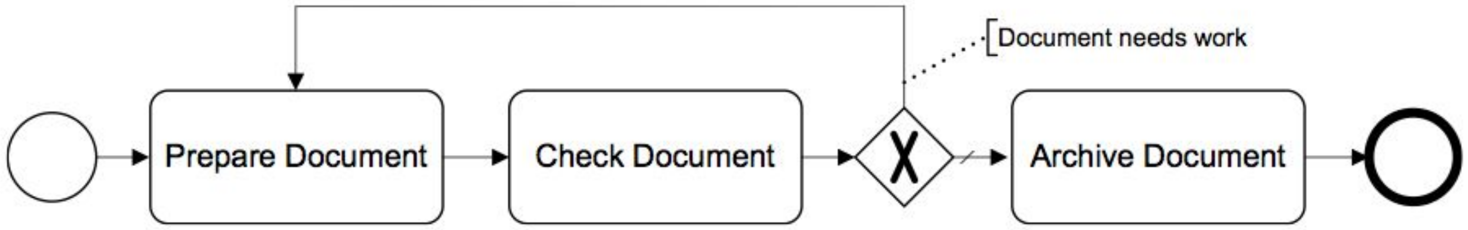

Fig. 4.98. Process diagram with uncontrolled flow

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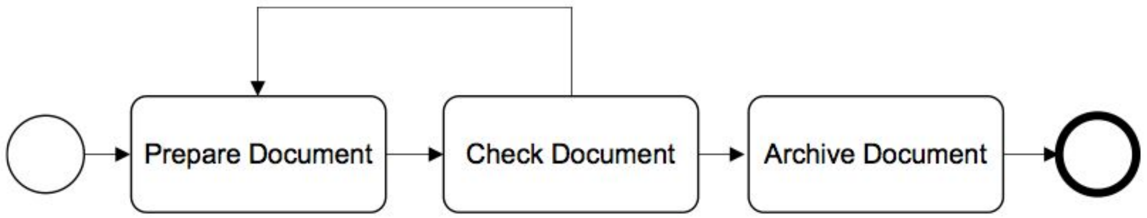

Fig. 4.99. Process diagram with split and join activities, representing a livelock

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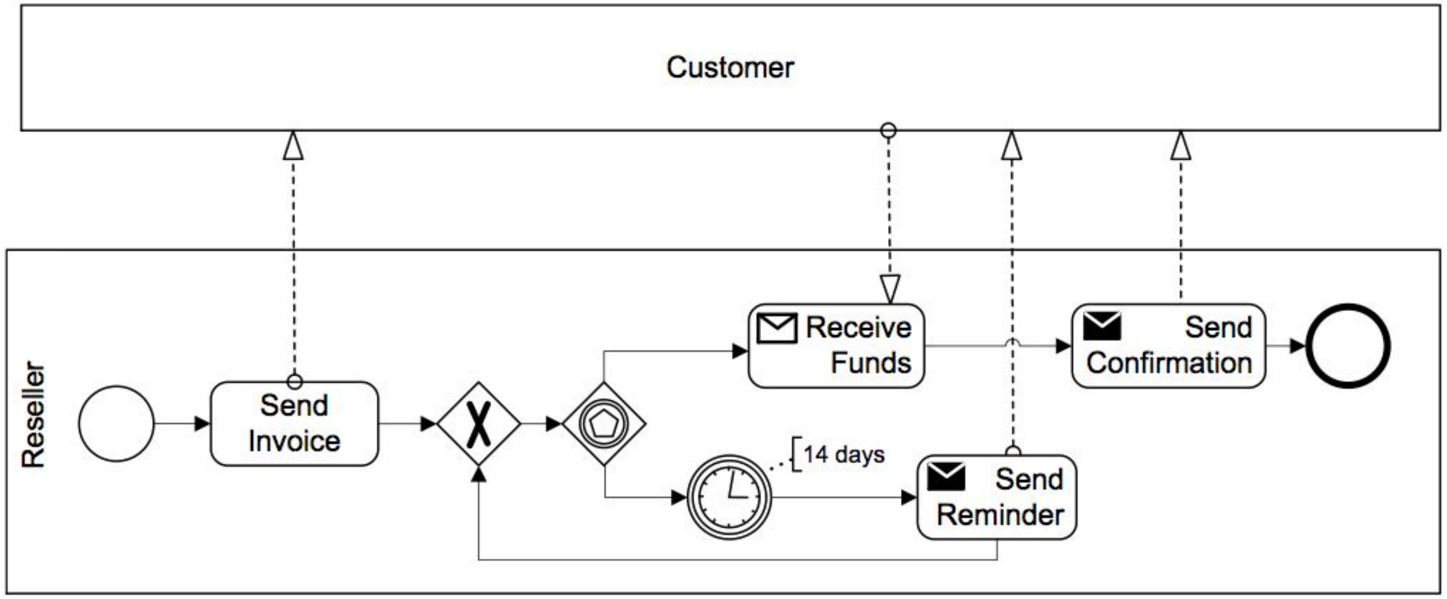

Fig. 4.100. Example of an *event-based* gateway

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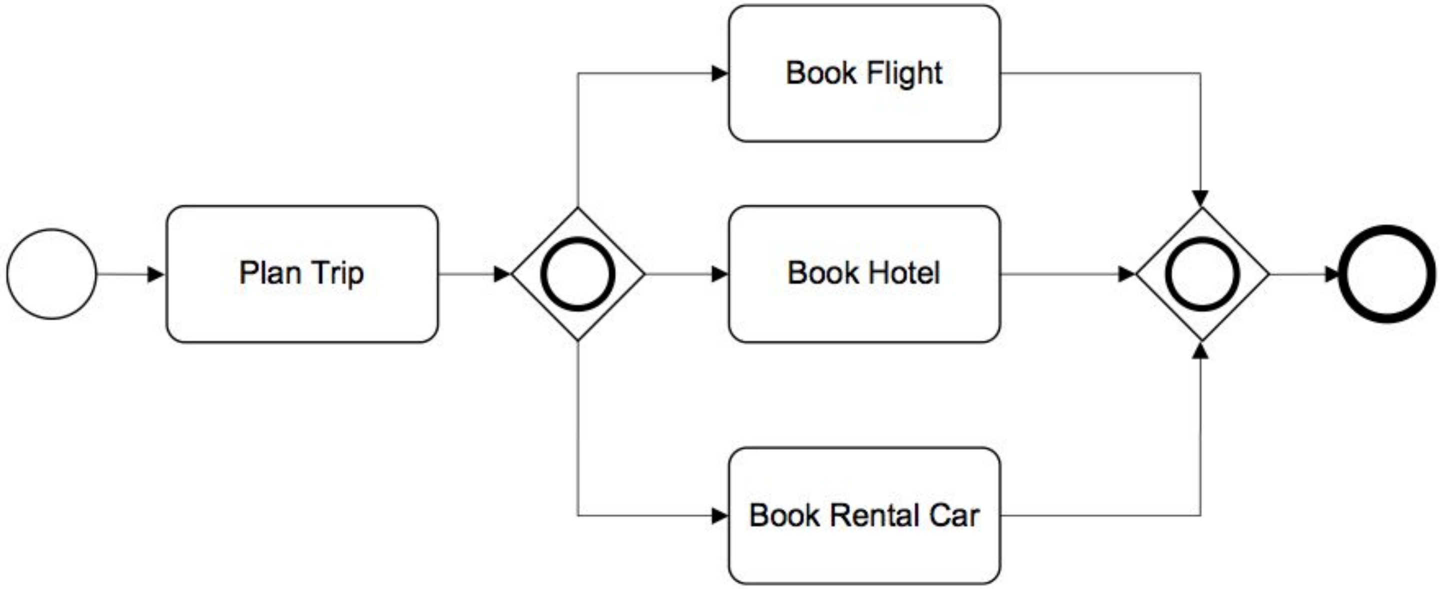

Fig. 4.101. Example of an *inclusive or* gateway

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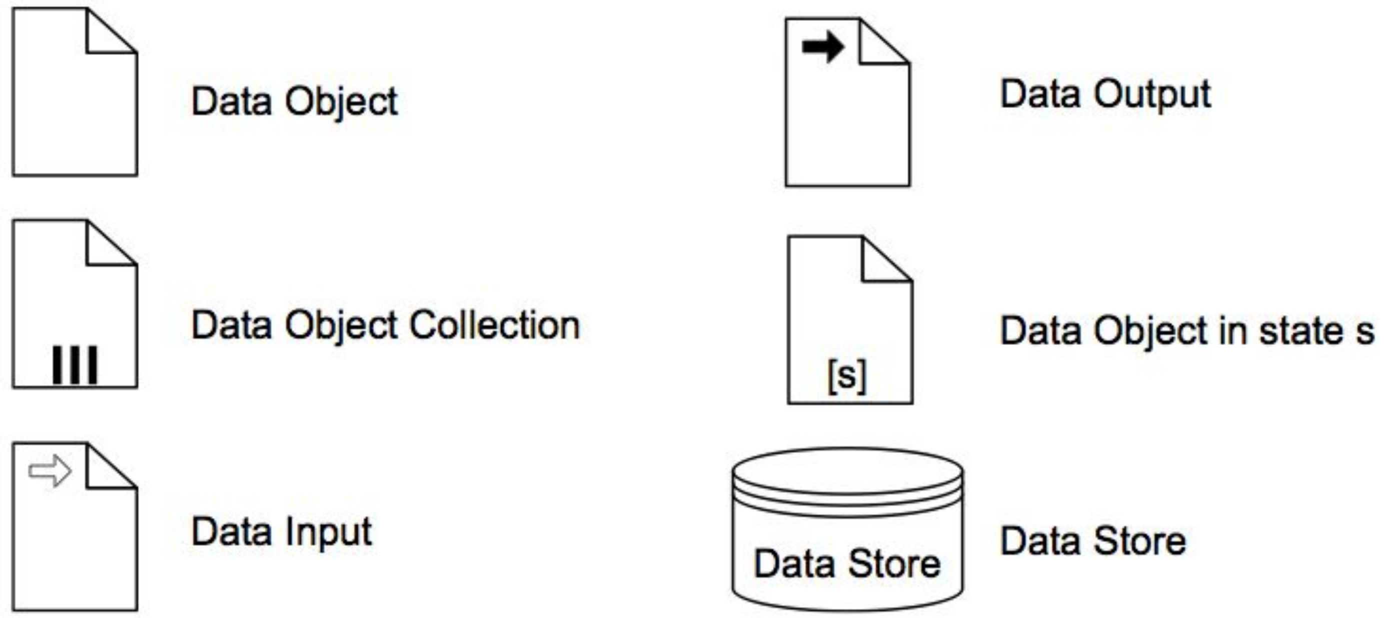

Fig. 4.102. Notational elements regarding data

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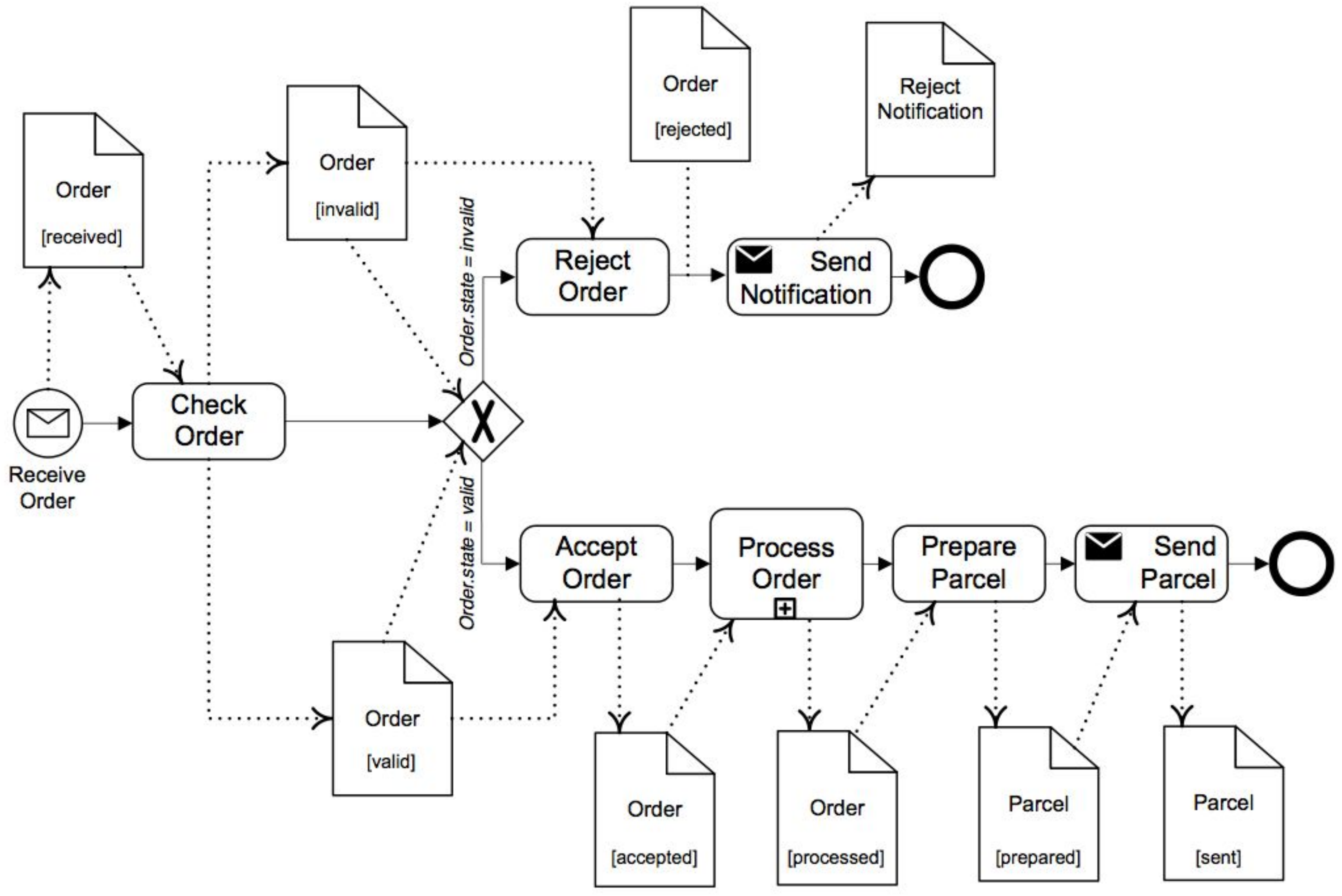

Fig. 4.103. Process diagram involving data objects

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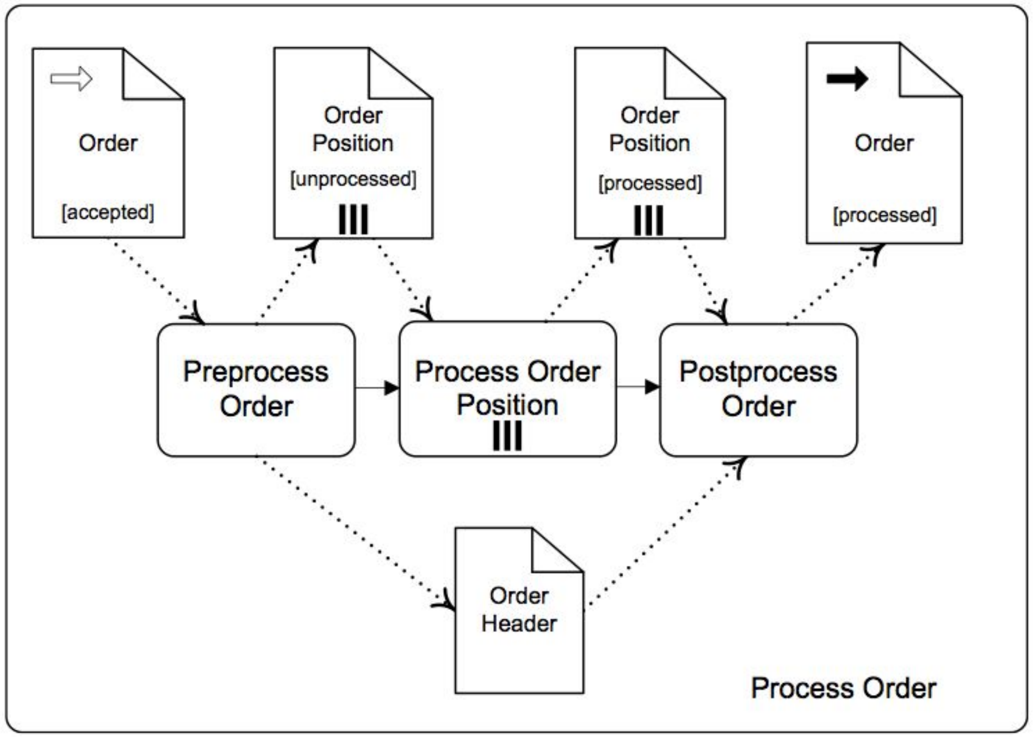

Fig. 4.104. Diagram of the *Process Order* subprocess from Figure 4.103, involving data object collections

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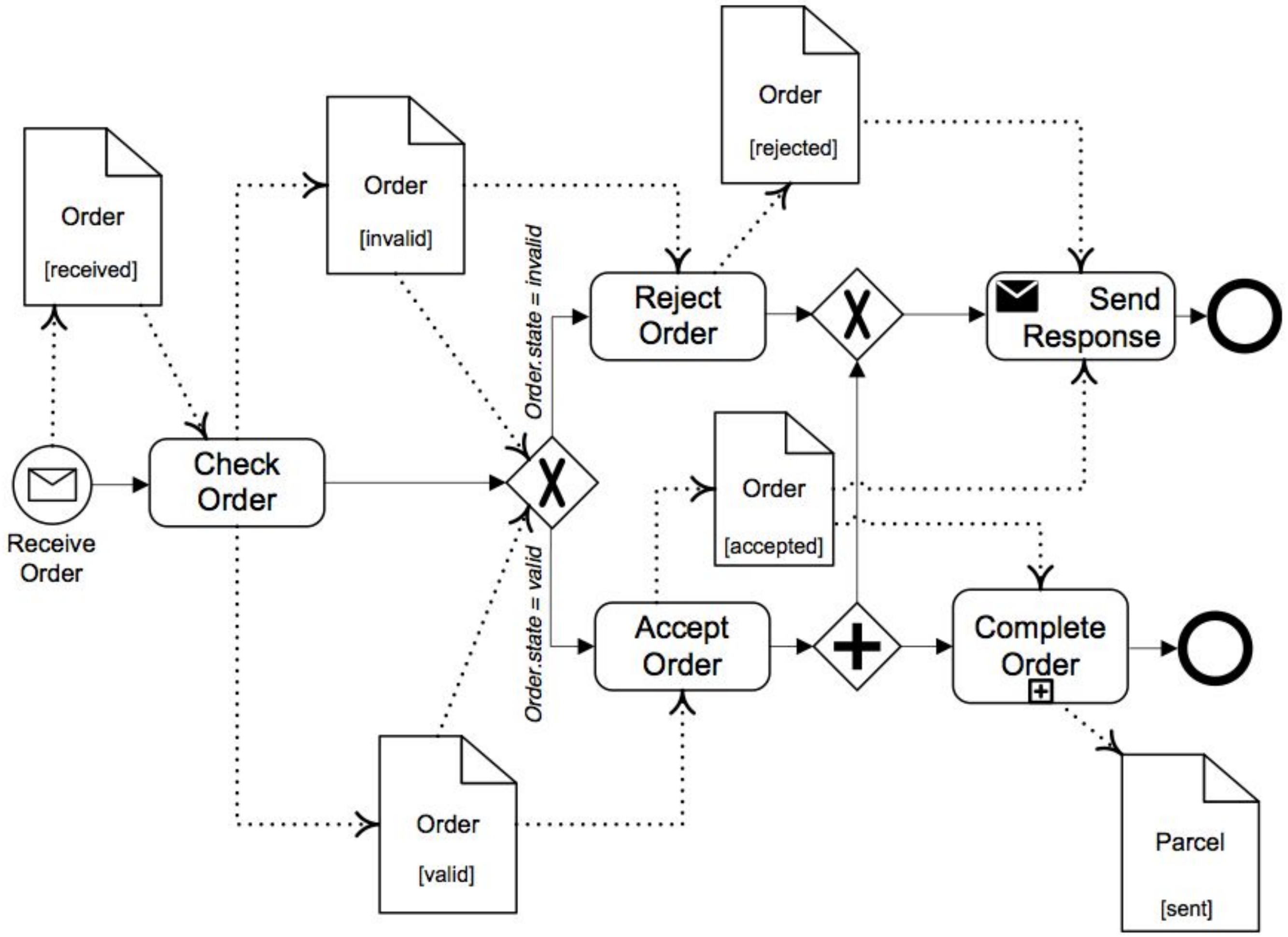

Fig. 4.105. Process diagram involving multiple input sets of an activity

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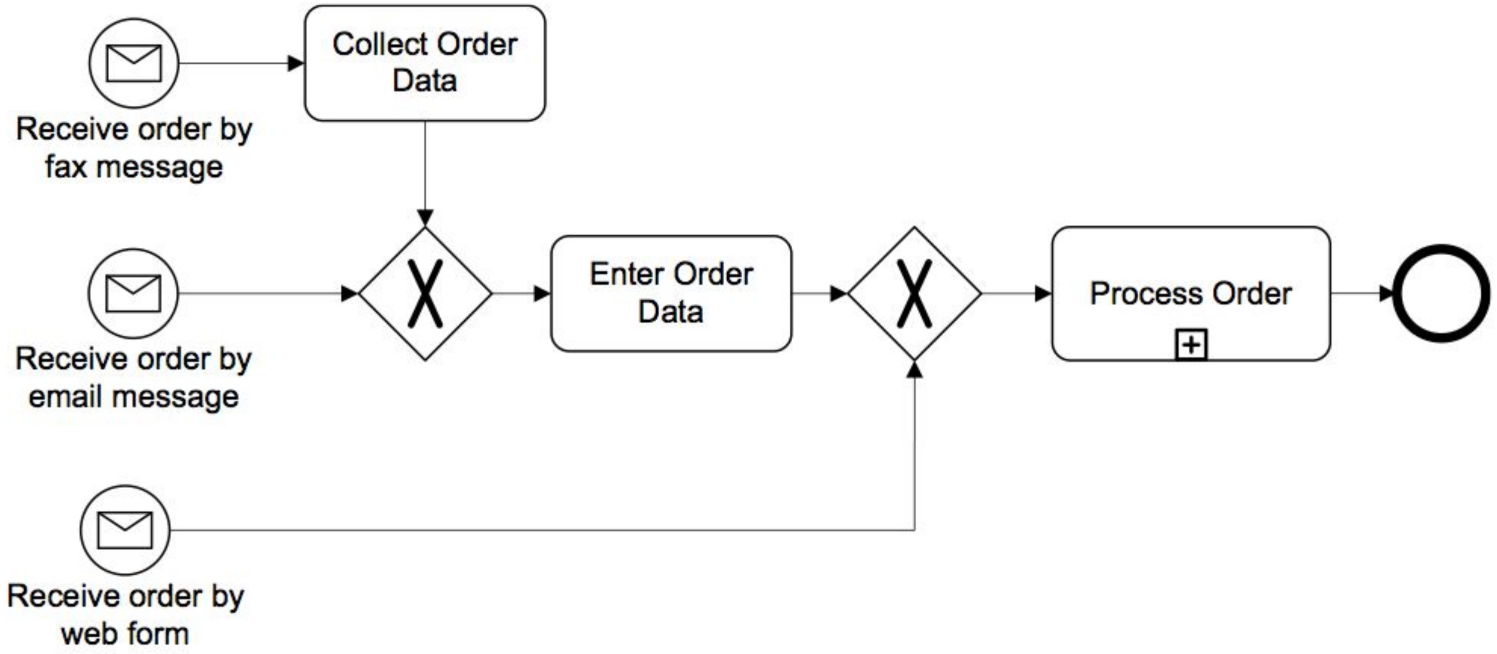

Receive order by fax message
Collect Order Data
Receive order by email message
Enter Order Data
Process Order
Receive order by web form

Fig. 4.106. Process diagram with multiple alternative start events

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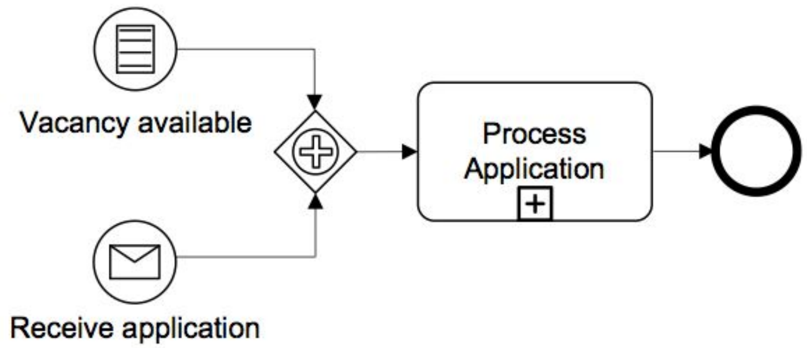

Fig. 4.107. Process diagram with two start events, both of which need to occur to instantiate the process

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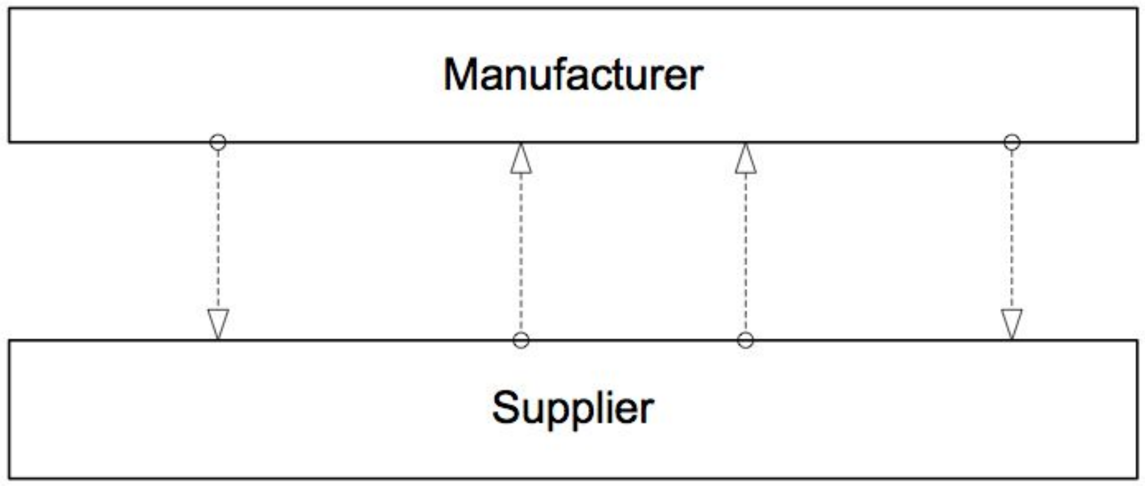

Fig. 4.108. Business processes collaborating through message flow

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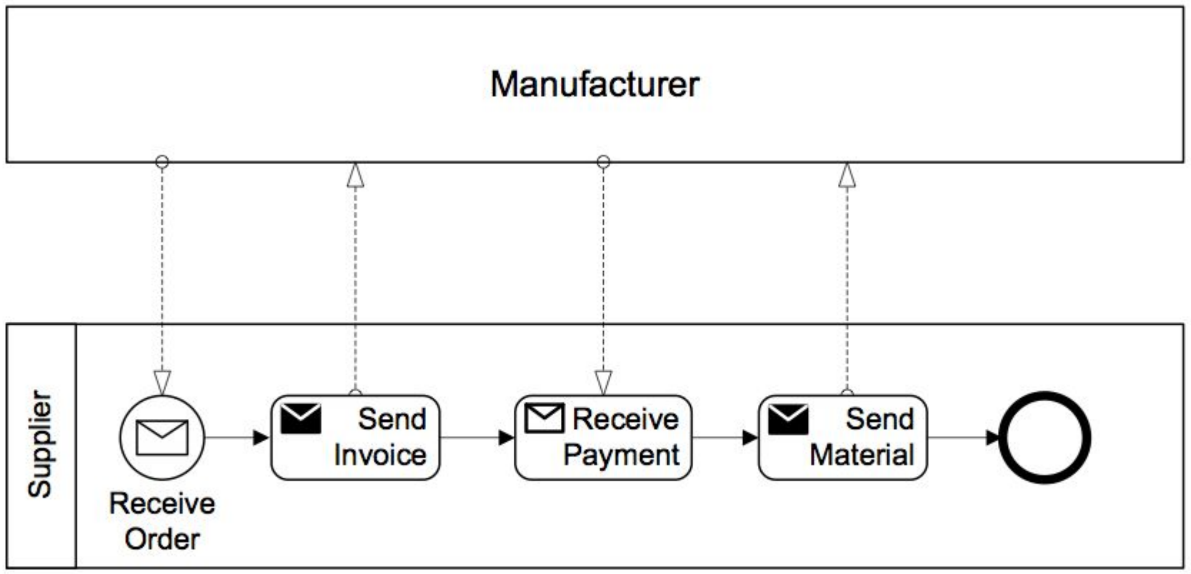

Fig. 4.109. Collaborating business processes with public process of the *Supplier*

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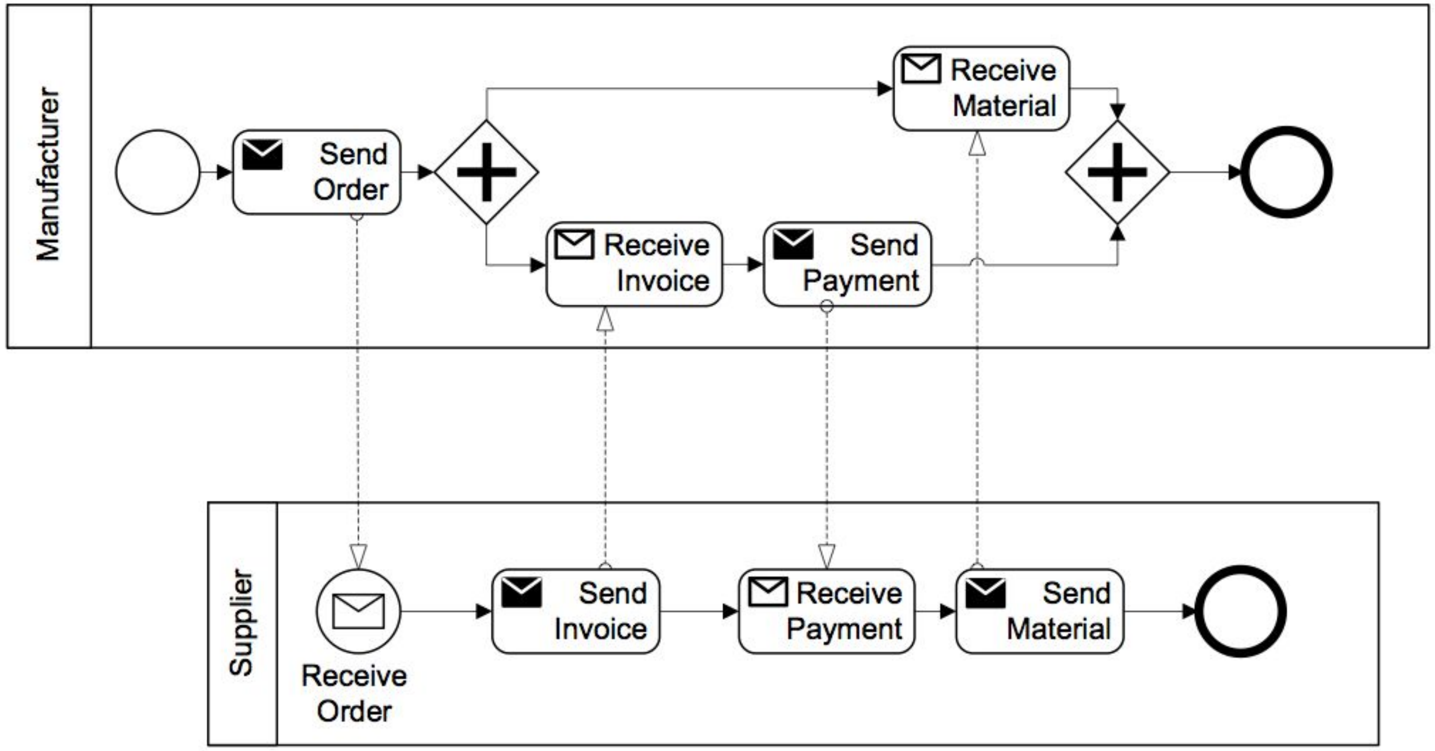

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Fig. 4.110. Collaborating business processes with public processes of both partners

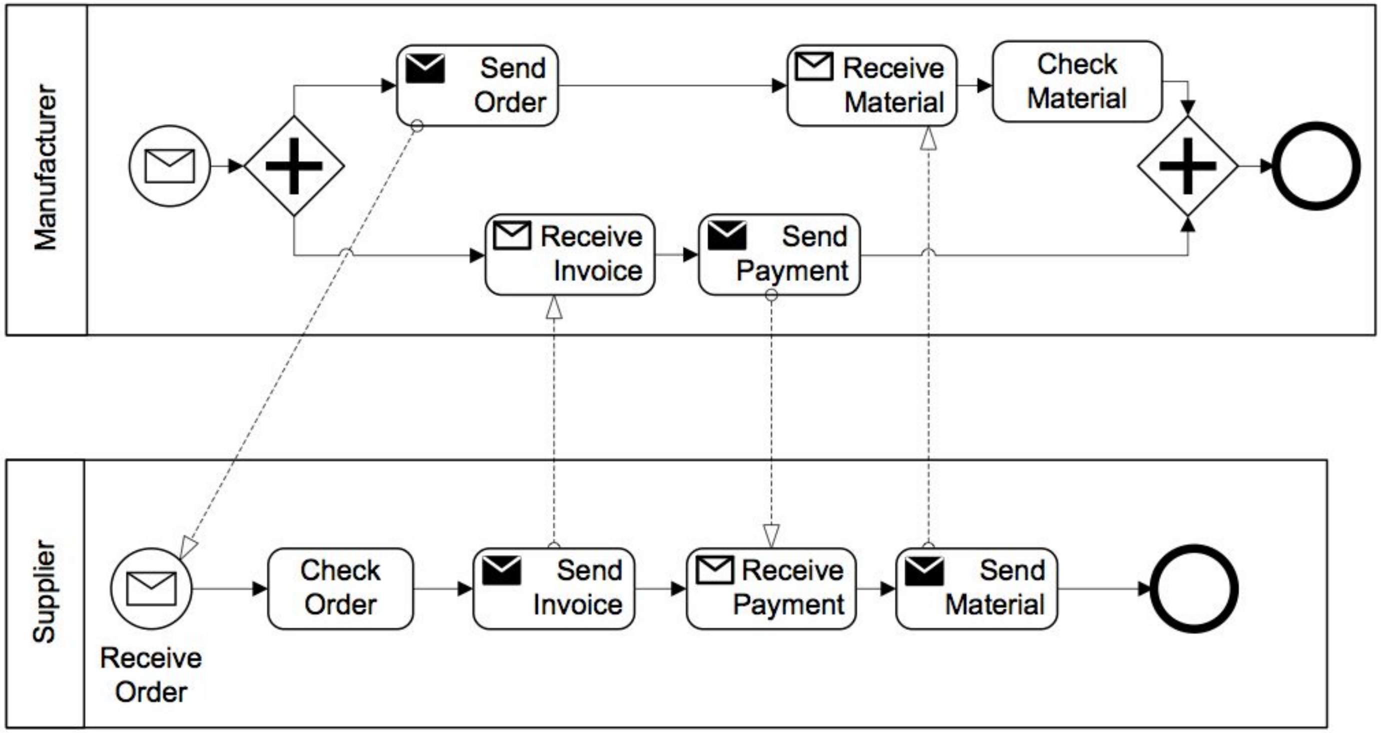

Fig. 4.111. Collaborating business processes with private processes of both partners

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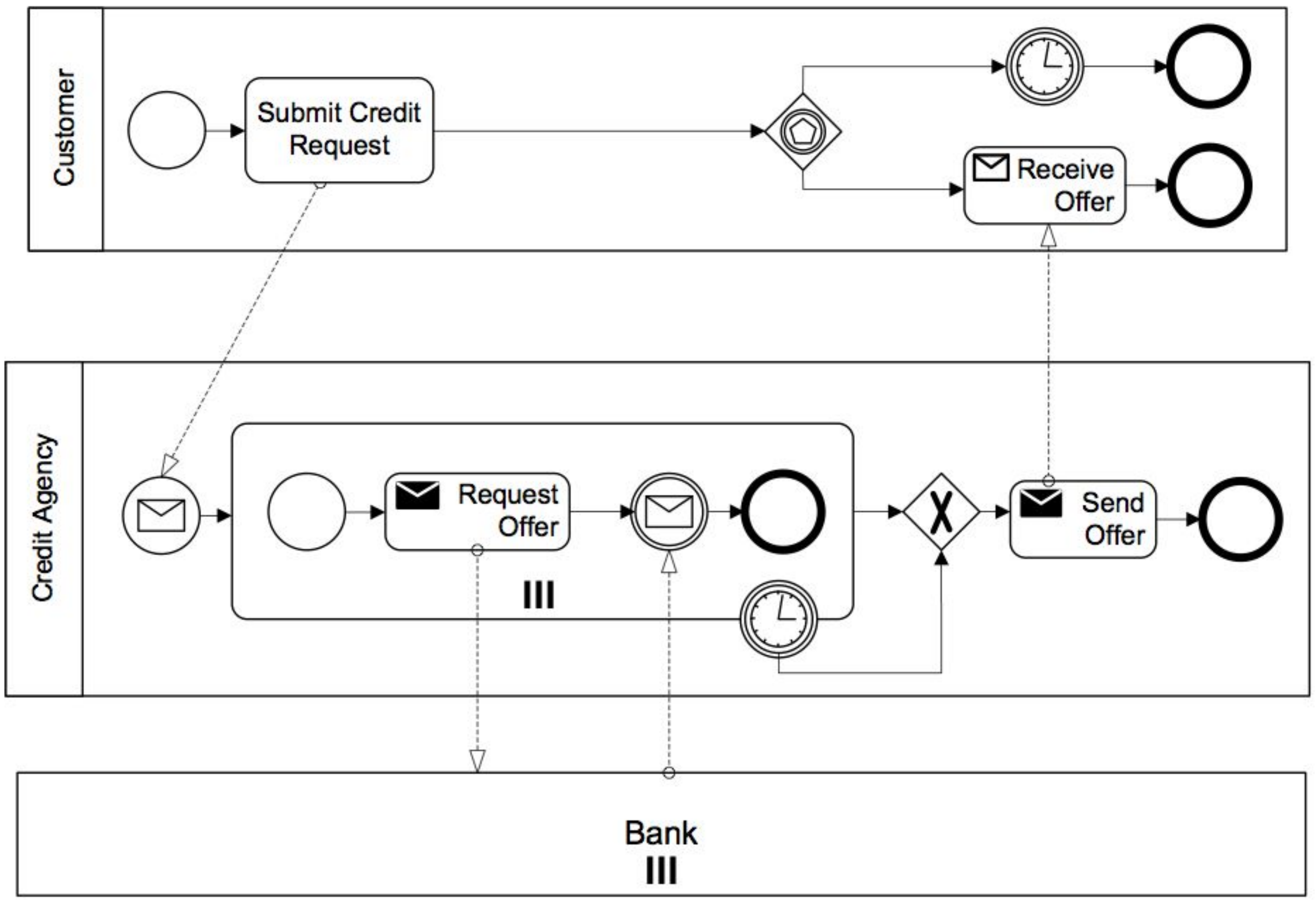

Fig. 4.112. Collaborating processes with a multiple instances pool

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