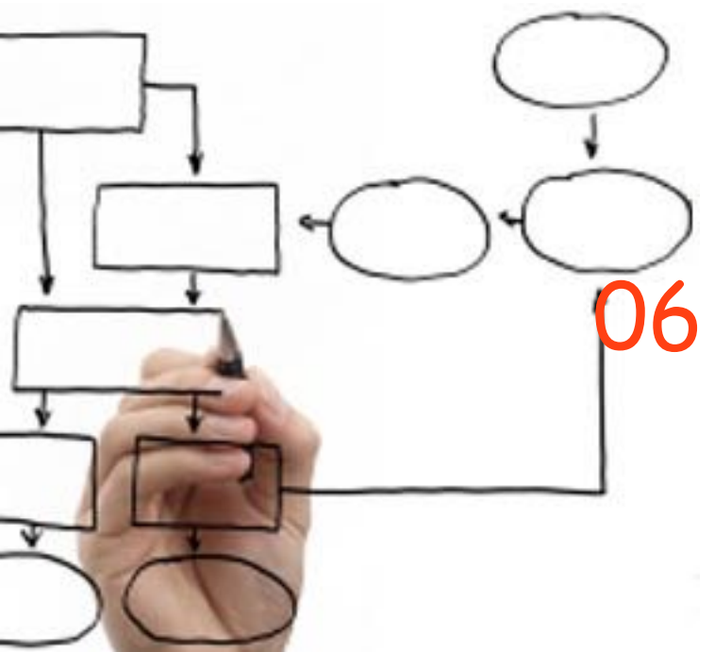
Business Processes Modelling

MPB (6 cfu, 295AA)

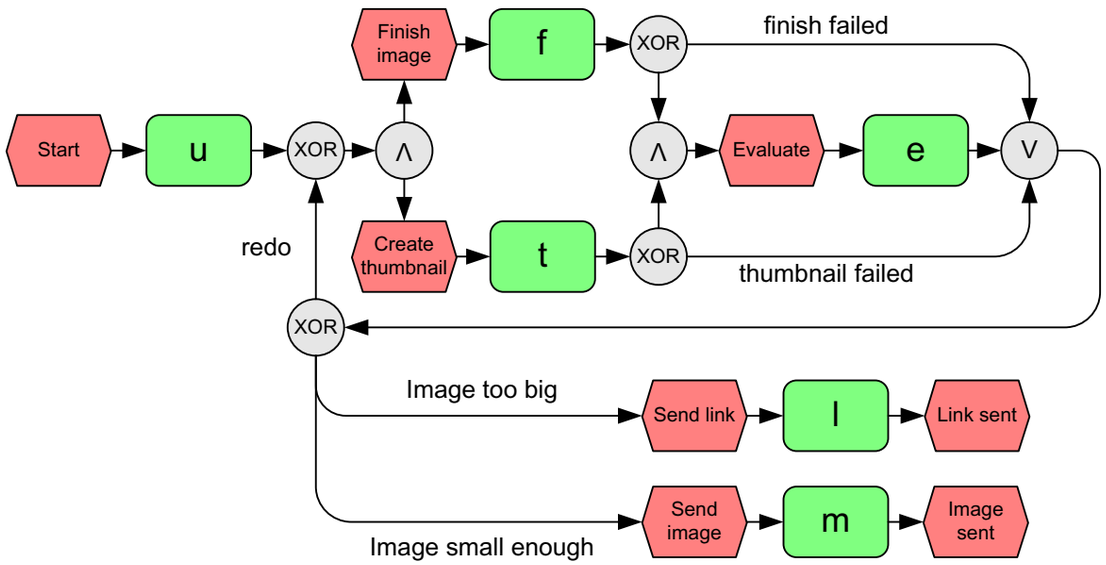
Roberto Bruni

http://www.di.unipi.it/~bruni



06 - Event-driven Process Chains

Object



We overview the EPC notation

Ch.4.3 of Business Process Management: Concepts, Languages, Architectures

Event-driven Process Chain

An **Event-driven Process Chain** (EPC)
is a flow-chart that can be used:
to configure an Enterprise Resource Planning implementation
to drive the modelling, analysis, redesign of business process

Informal notation: simple, intuitive and easy-to-understand

EPC represents domain concepts and processes
(neither their formal aspects nor their technical realization)

EPC Markup Language (EPML): XML interchange format

EPC origin (early 1990's)

EPC method originally developed as part of a holistic modelling approach called **ARIS framework** (Architecture of Integrated Information Systems) by Wilhelm-August Scheer

EPC Diagrams

Why do we need diagrams?

Graphical languages **communicate** concepts

Careful selection of symbols
shapes, colors, arrows
(the alphabet is necessary for communication)

Greatest common denominator of the people involved

Intuitive meaning
(verbal description, no math involved)

EPC informally

An EPC is a graph of **events** and **functions**

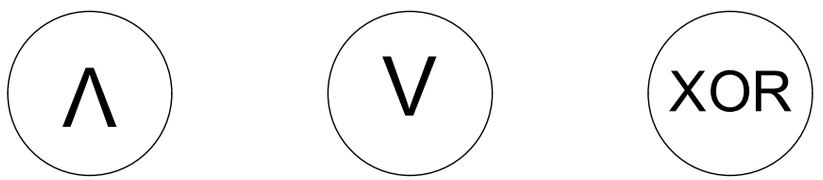
It provides some logical **connectors** that allow alternative and parallel execution of processes (AND, XOR, OR)

EPC ingredients at a glance

Event

Function

Connectors

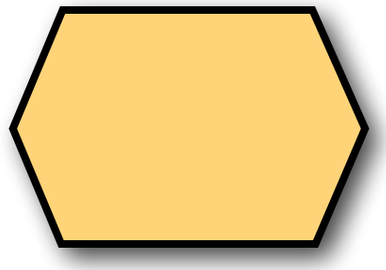


Control Flow

Events

Any EPC diagram must start / end with **event(s)**

Graphical representation: hexagons



Passive elements used to describe
under which circumstances a process (or a function) works
or which state a process (or a function) results in
(like pre- / post-conditions)

Functions

Any EPC diagram may involve several **functions**

Graphical representation: rounded rectangles

Active elements used to describe
the tasks or activities of a business process

Functions can be refined to other EPC diagrams

Logical connectors

Any EPC diagram may involve several **connectors**

Graphical representation: circles (or also octagons)

Elements used to describe
the logical relationships between split/join branches

Control flow

Any EPC diagram may involve several **connections**

Graphical representation: dashed arrows

Control flow is used to connect
events with functions and connectors
by expressing causal dependencies

EPC diagrams: requirements

EPC elements can be combined in a fairly free manner (possibly including cycles)

The graph is **weakly connected** (e.g., no isolated nodes)

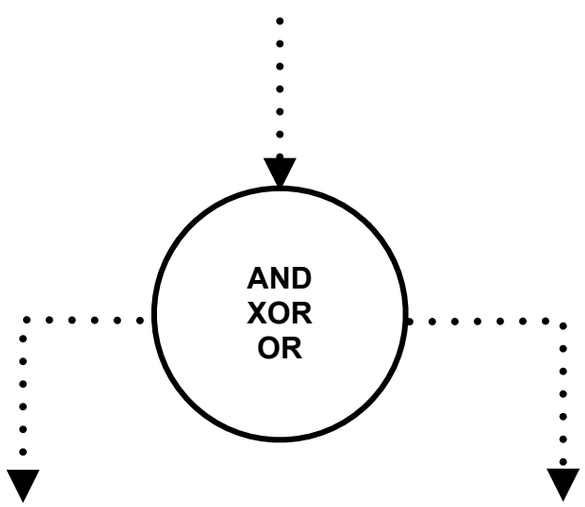
Events have at most one incoming and one outgoing arc
Events have at least one incident arc
There must be at least one start event and one end event

Functions have exactly one incoming and one outgoing arc

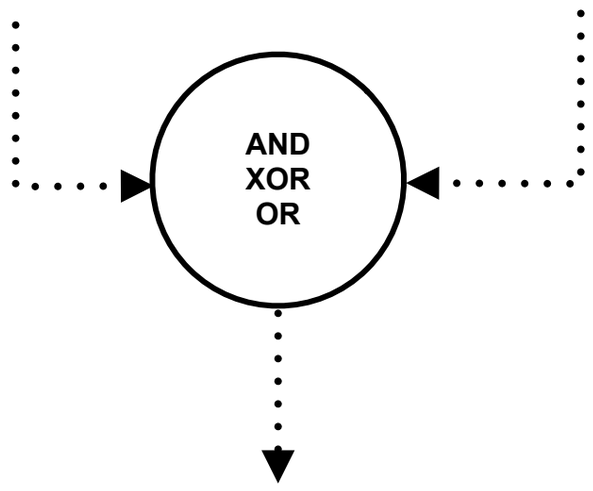
Connectors have either one incoming arc and multiple outgoing arcs or viceversa (multiple incoming arcs and one outgoing arc)

Logical connectors: splits and joins

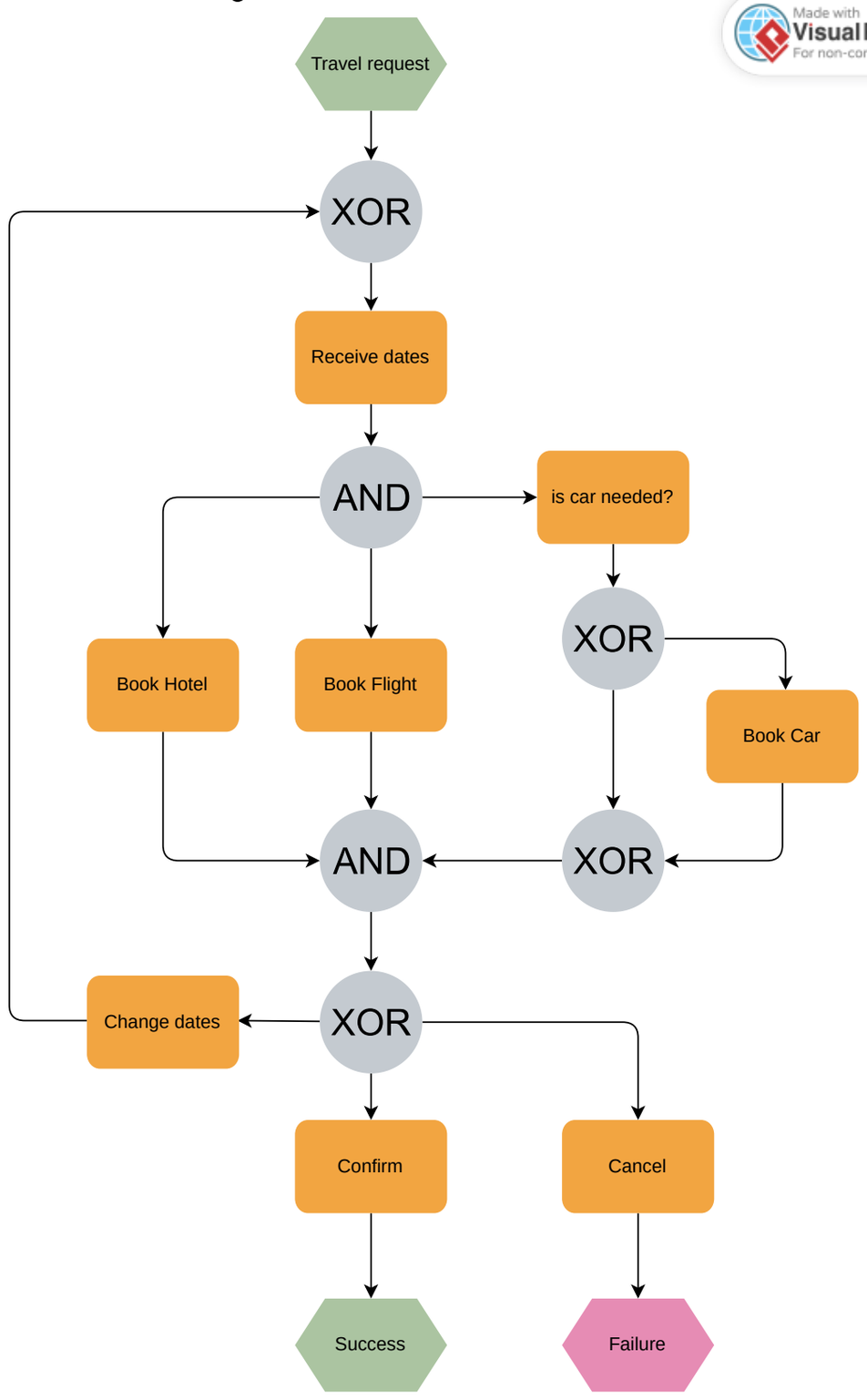
Splits



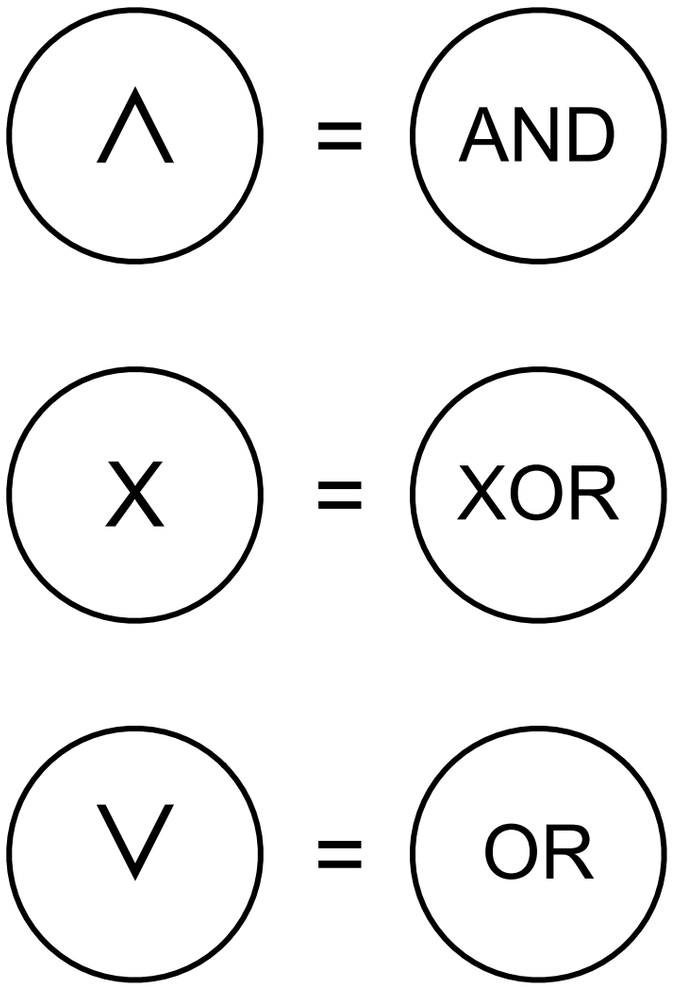
Joins

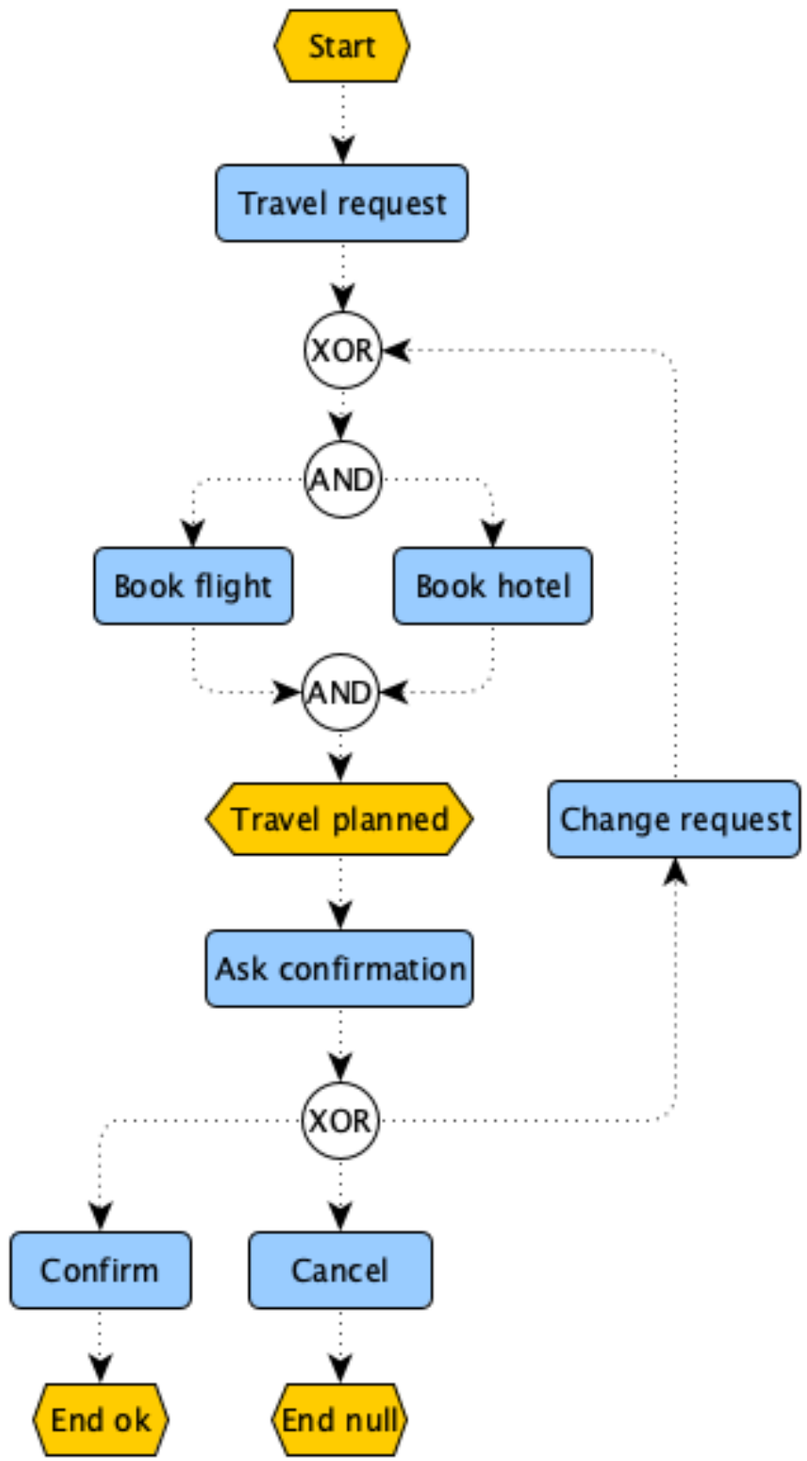


EPC: Example (VP online)



EPC: Example (yEd)





EPC Diagrams: guidelines

Other constraints are sometimes imposed

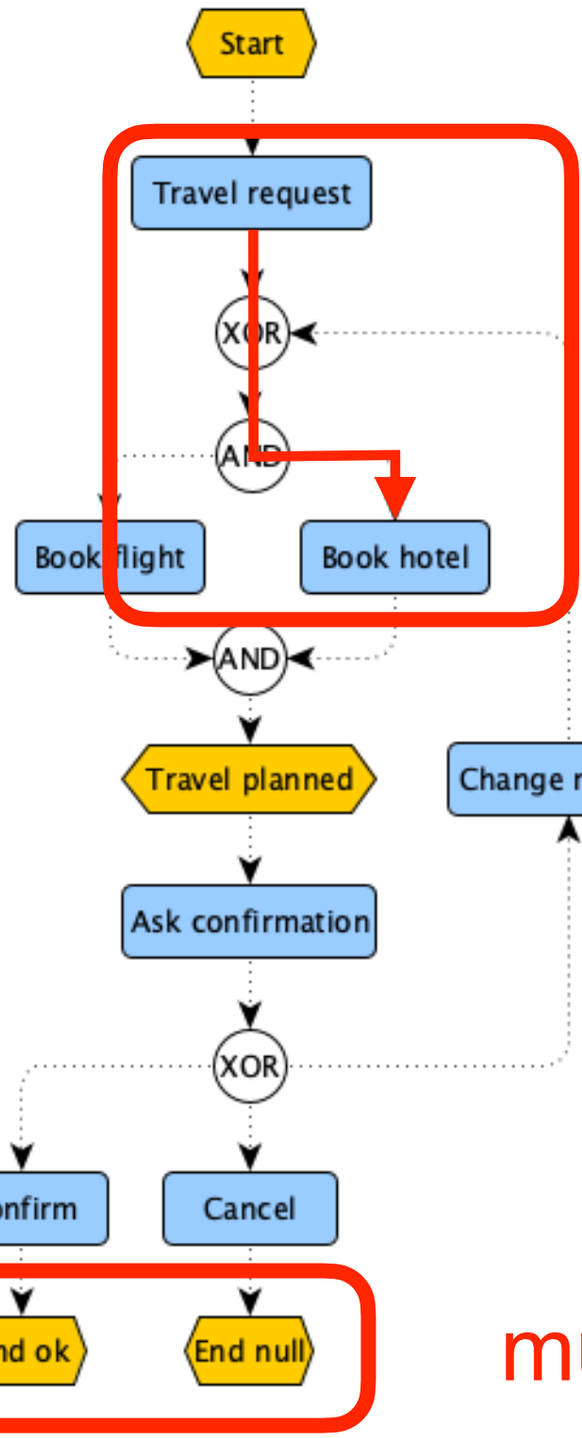
Unique start / end event

No direct flow between two events

No direct flow between two functions

No event is followed by a decision node
(i.e. (X)OR-split)

EPC guidelines: Example



direct flow between functions

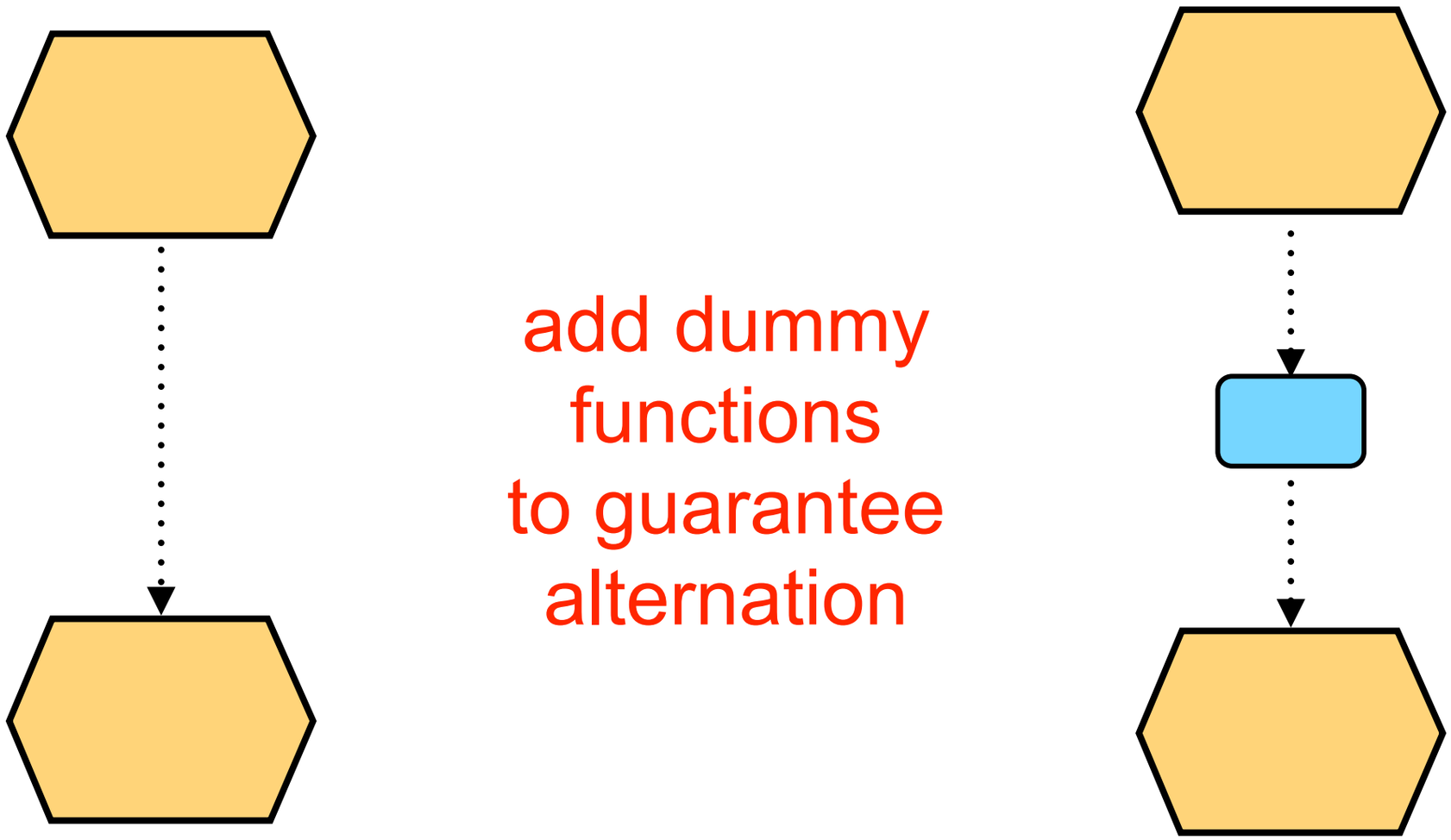
multiple end events

Problem with guidelines

From empirical studies:
guidelines are too restrictive and people ignore them
(otherwise diagrams would get unnecessarily complicated, more difficult to read and understand)

Solution:
It is safe to drop most constraints
(implicit dummy nodes might always be added later, if needed)

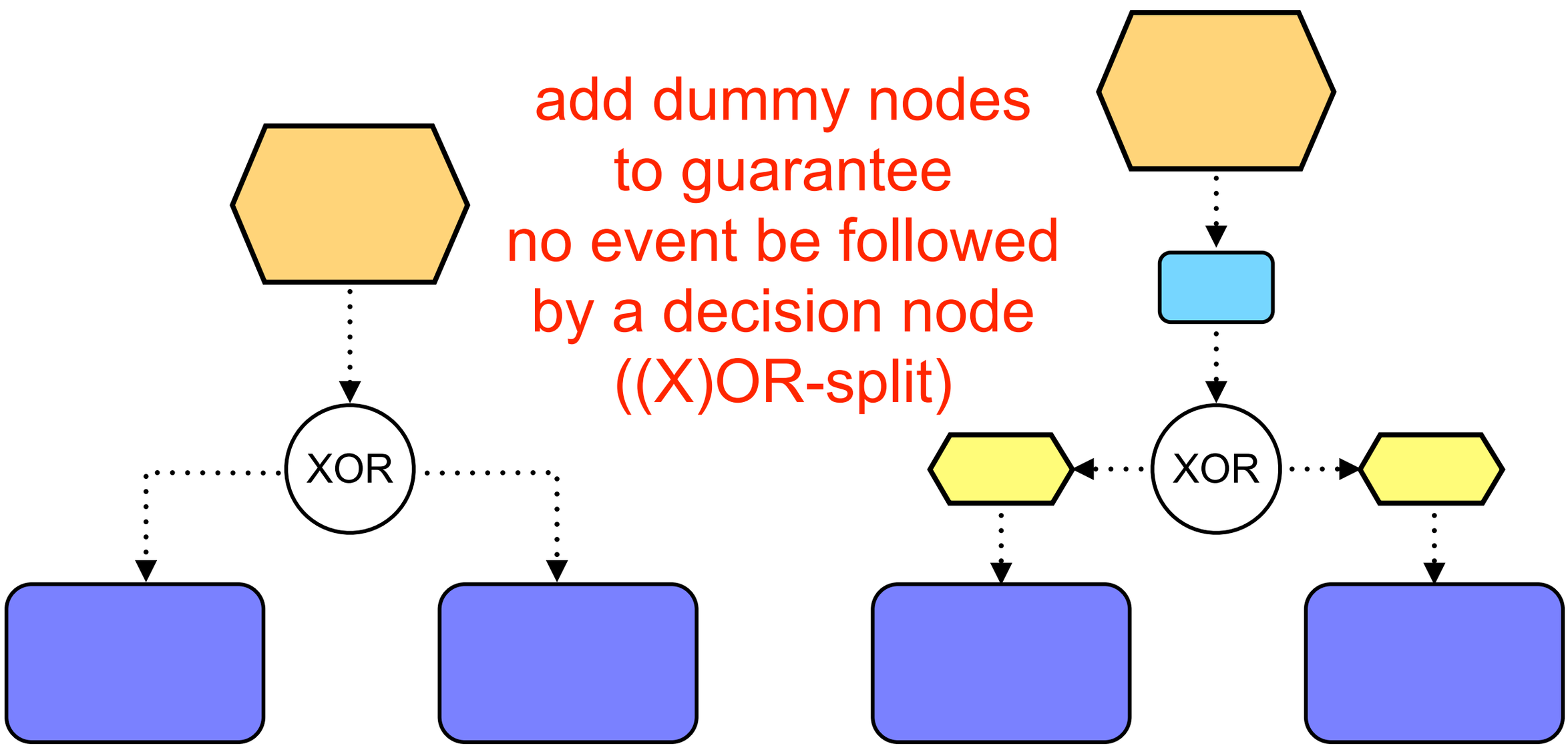
EPC: repairing alternation



EPC: repairing alternation

EPC: repairing decisions

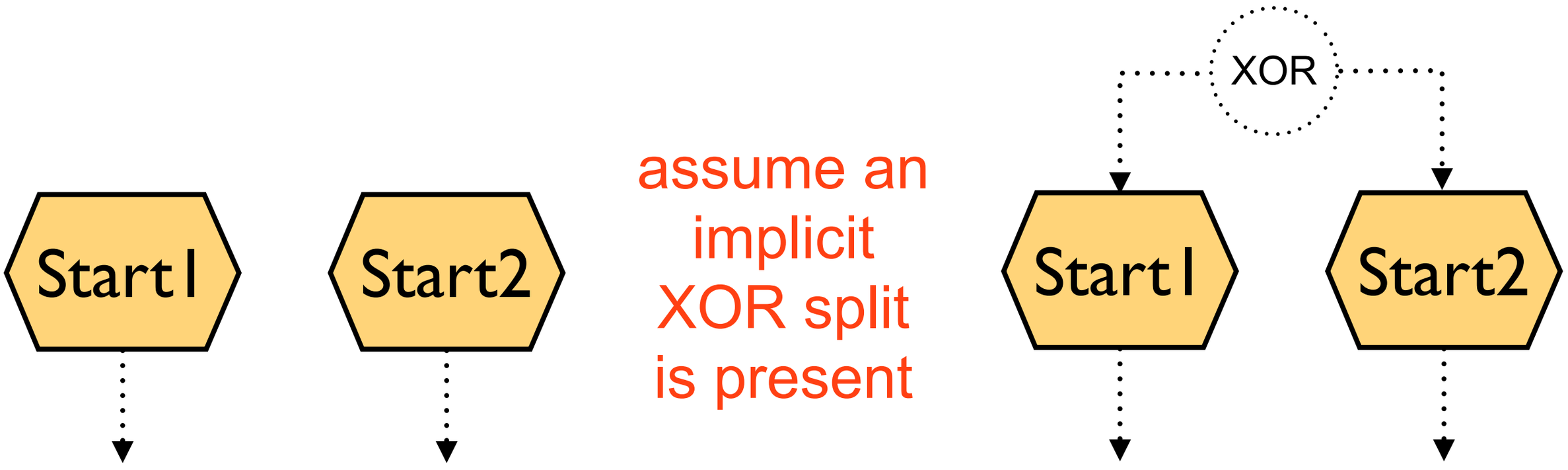
add dummy nodes
to guarantee
no event be followed
by a decision node
((X)OR-split)



EPC: repairing multiple start events

A start event is an event with no incoming arc
it invokes a new instance of the process template

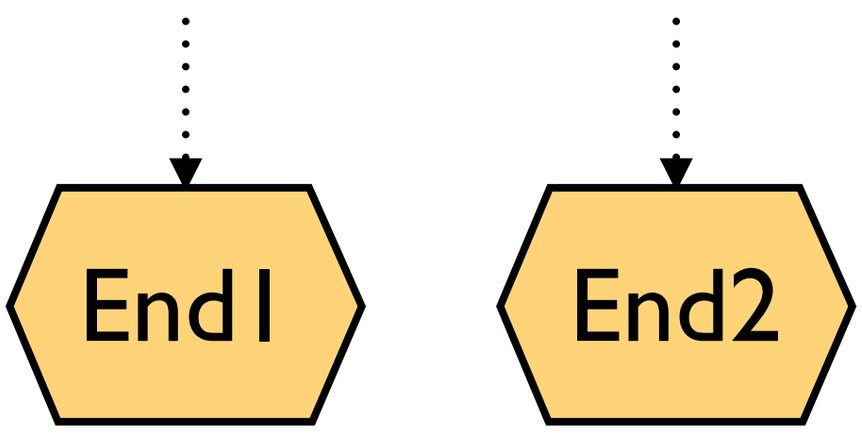
Start events are mutually exclusive



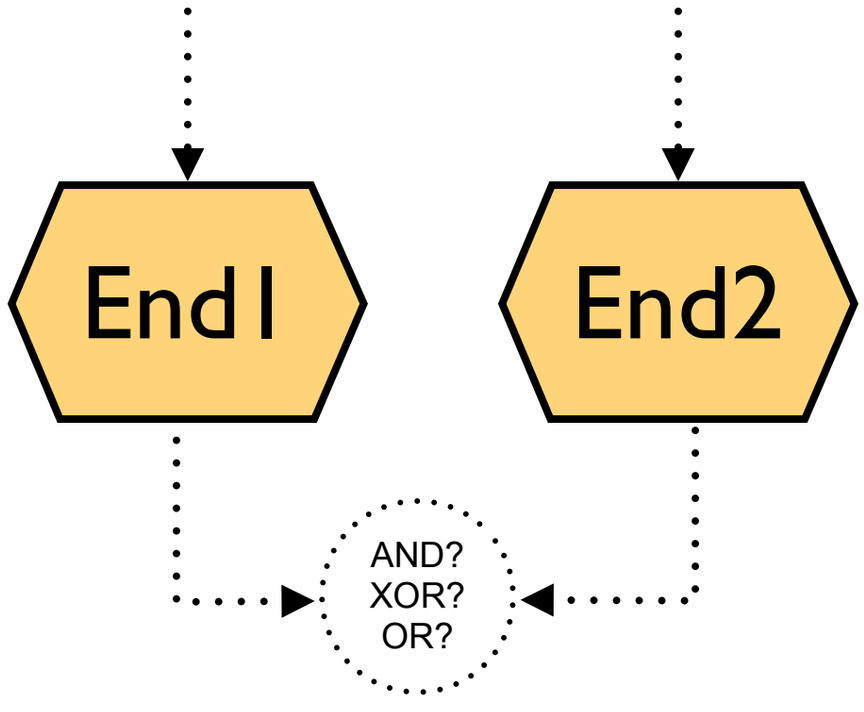
EPC: repairing multiple end events

An end event is an event with no outgoing arc
it indicates completion of some activities
What if multiple end events occur? No unanimity!

they are followed by an implicit join connector (typically a XOR… but not necessarily so)

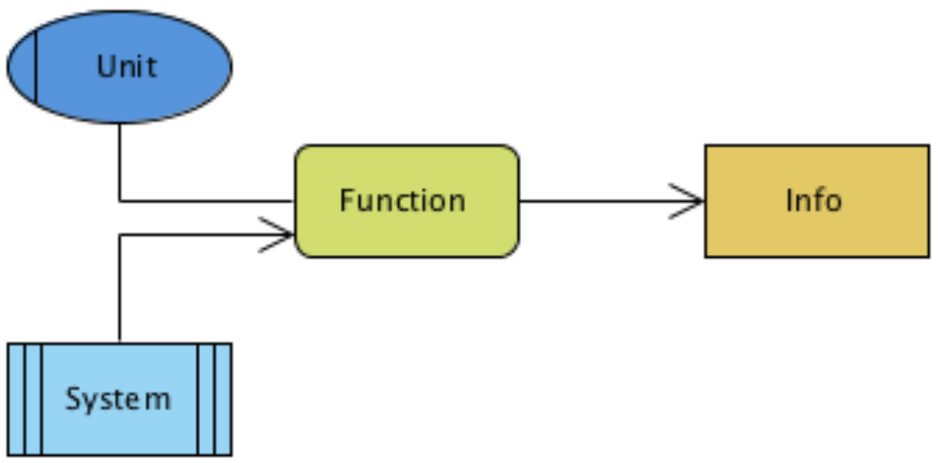


assume an implicit join is present



Other ingredients: function annotations

Organization unit:
determines the person or organization responsible for a specific function
(ellipses with a vertical line)



Information, material, resource object:
represents objects in the real world
e.g. input data or output data for a function
(rectangles linked to function boxes)
angles with vertical lines on its sides)

Supporting system: technical support
(rectangles with vertical lines on its sides)

A taste of EPML

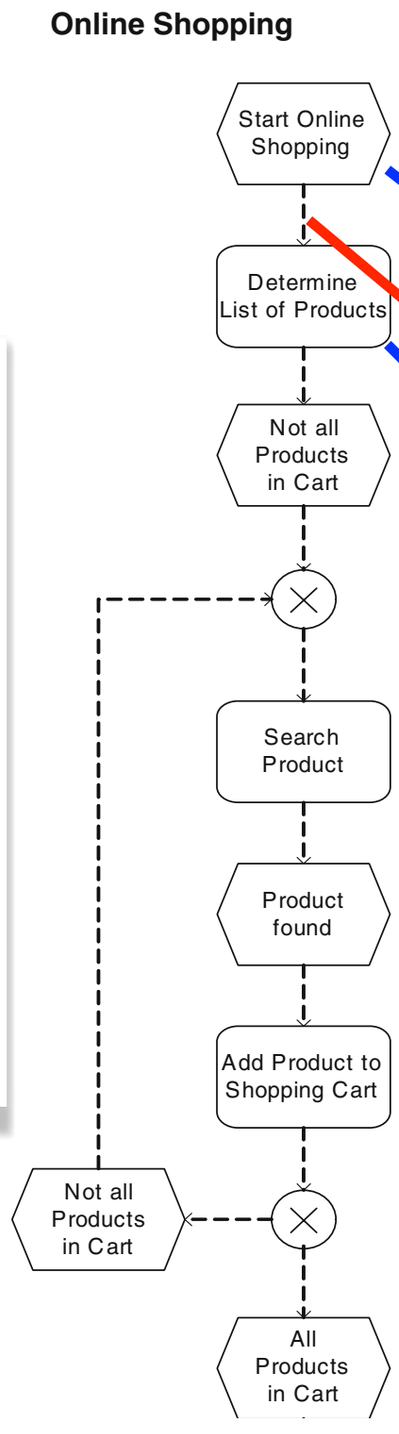
ISeB (2006) 4: 245–263
DOI 10.1007/s10257-005-0026-1

ORIGINAL PAPER

Jan Mendling · Markus Nüttgens

EPC markup language (EPML): an XML-based interchange format for event-driven process chains (EPC)

Published online: 22 October 2005

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  <coordinates
    xOrigin="leftToRight"
    yOrigin="topToBottom"/>

  <directory name="Root">

    <epc epcId="1"
        name="Online Shopping">

      <event id="1">
        <name>Start Online Shopping</name>
      </event>

      <arc id="10">
        <flow source="1" target="2"/>
      </arc>

      <function id="2">
        <name>Determine List of Products</name>
      </function>

      <arc id="11">
        <flow source="2" target="3"/>
      </arc>

      <event id="3">
        <name>Not all Products in Cart</name>
      </event>

      <arc id="12">
        <flow source="3" target="4"/>
      </arc>

      <xor id="4"/>

      <arc id="13">
        <flow source="4" target="5"/>
      </arc>

      ...

    </epc>

  </directory>

</epml:epml>
```

EPC Semantics

EPC intuitive semantics

A process starts when some initial event(s) occurs

The activities are executed according to the constraints in the diagram

When the process is finished, only final events have not been dealt with

If this is always the case, then the EPC is “correct”

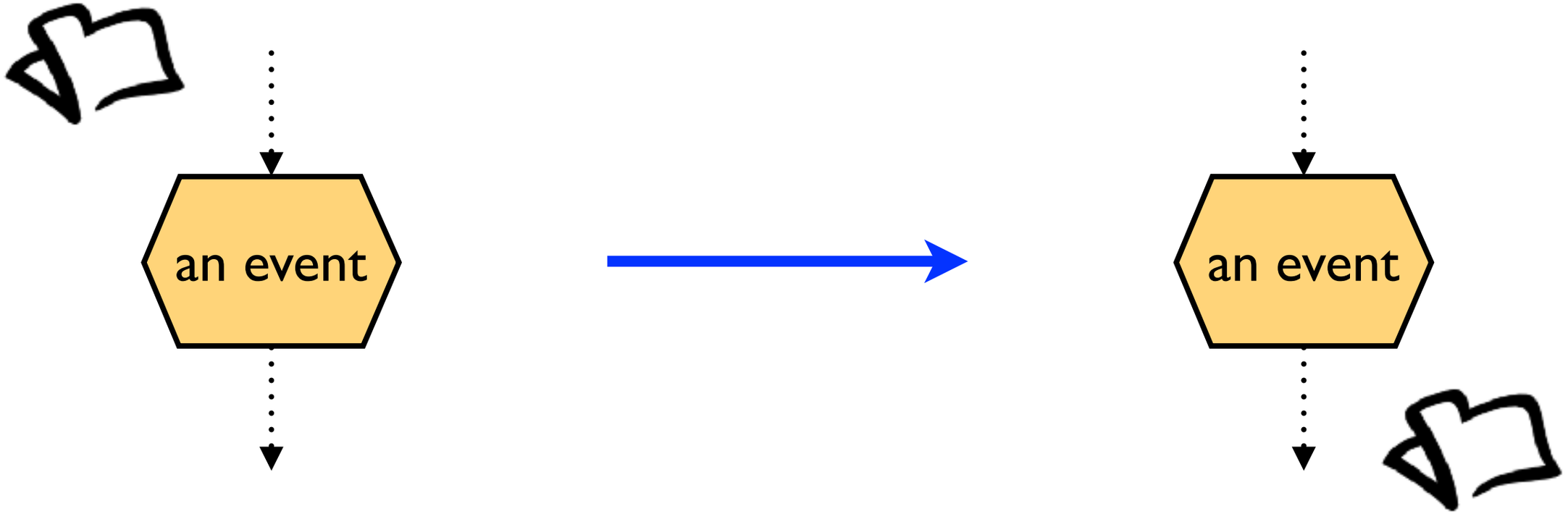
Folder-passing semantics

The current state of the process is determined by placing folders over the diagram

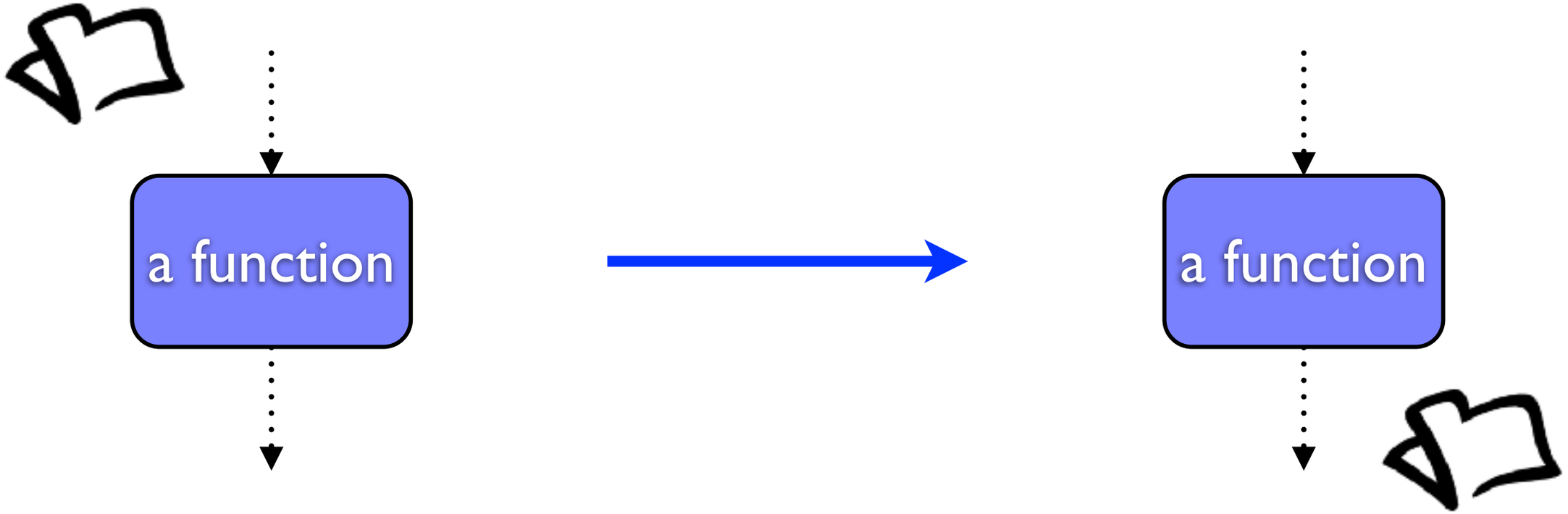
A transition relation explains how to move from one state to the next state

The transition relation is possibly nondeterministic

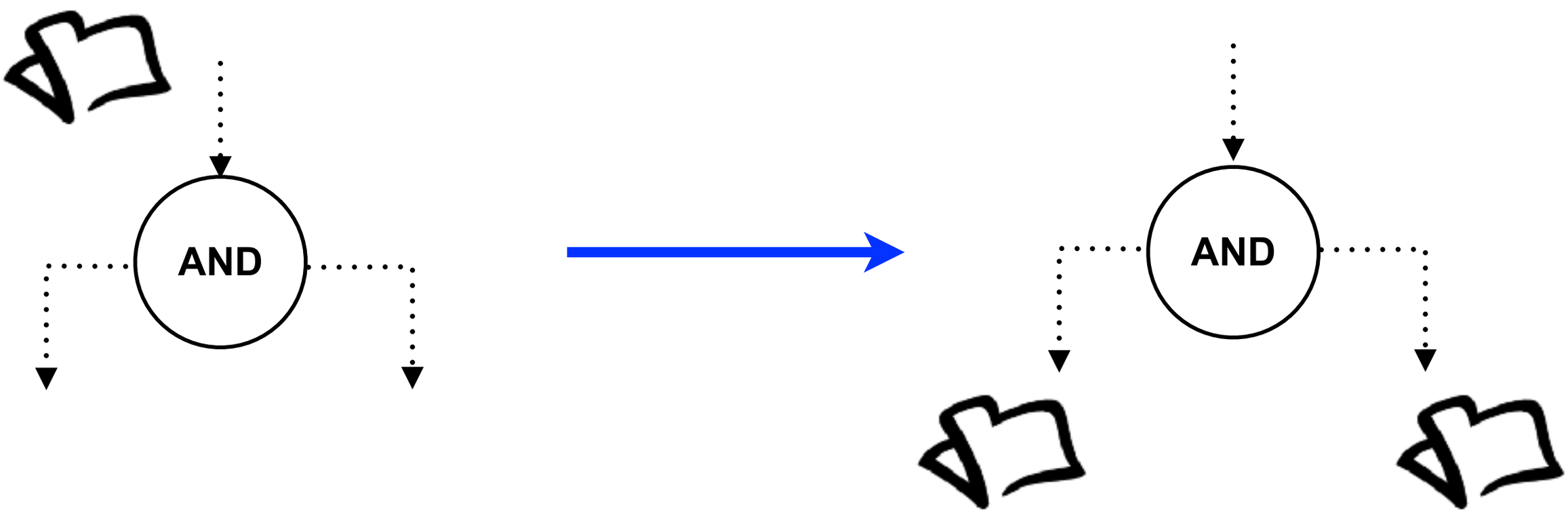
Folder-passing semantics: events



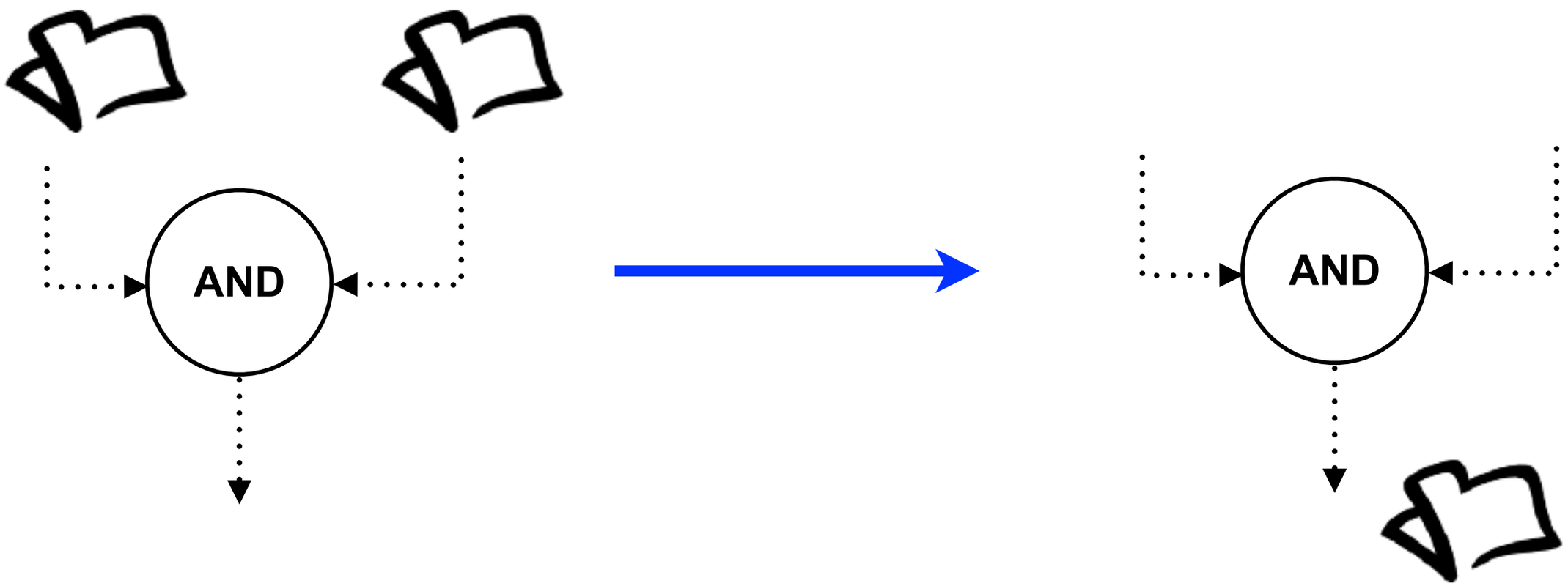
Folder-passing semantics: functions



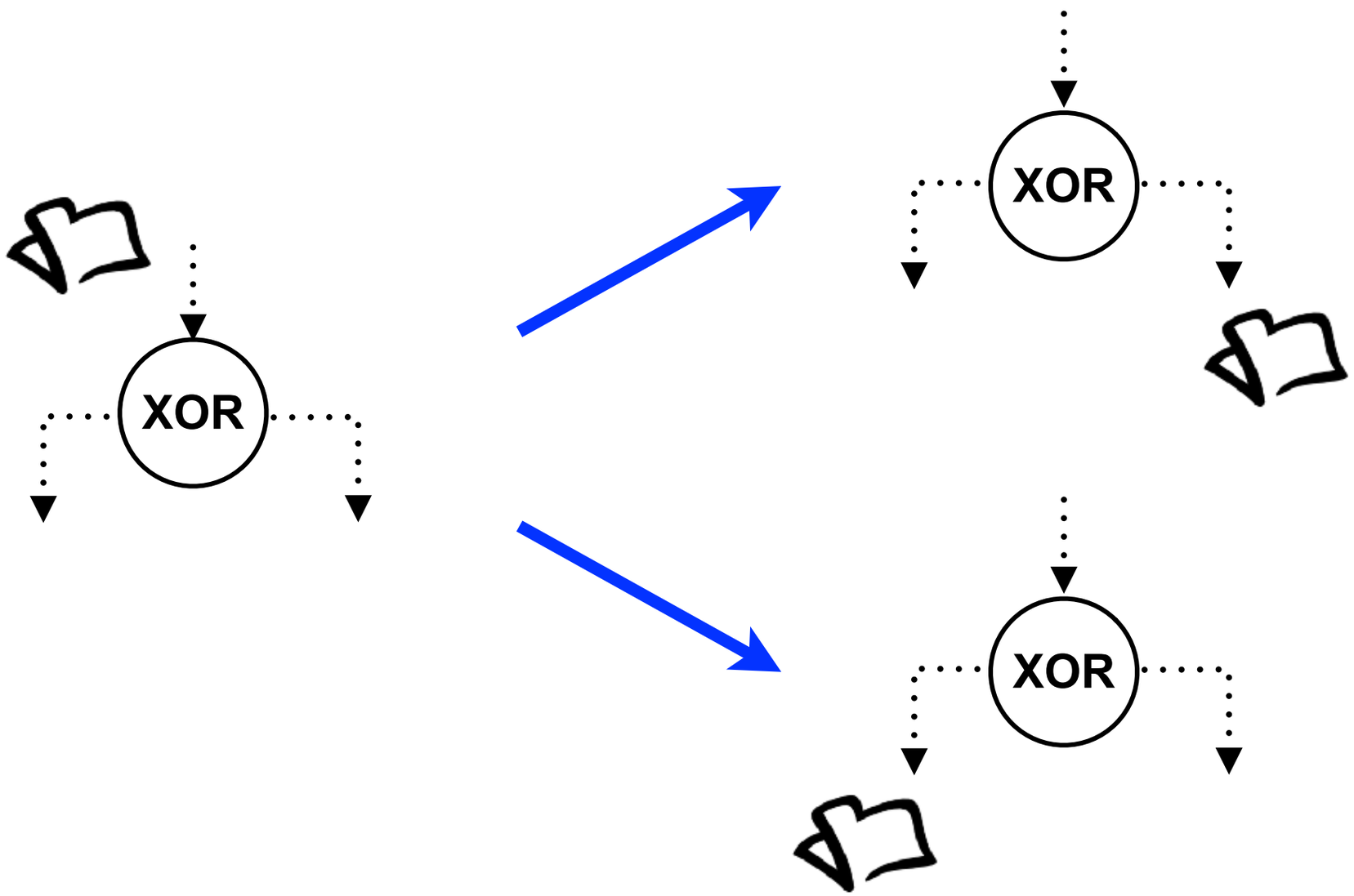
Folder-passing semantics: AND-split



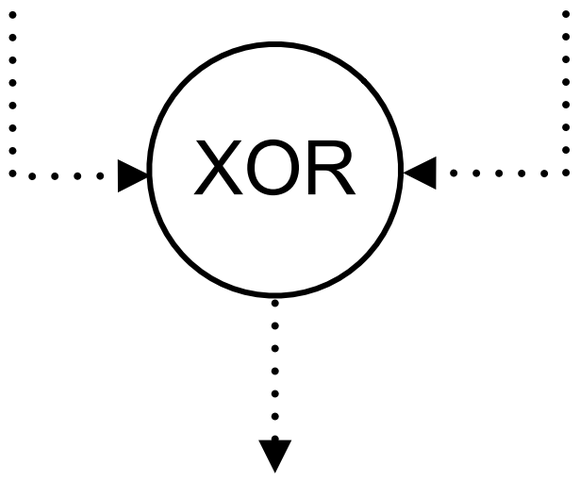
Folder-passing semantics: AND-join



Folder-passing semantics: XOR-split



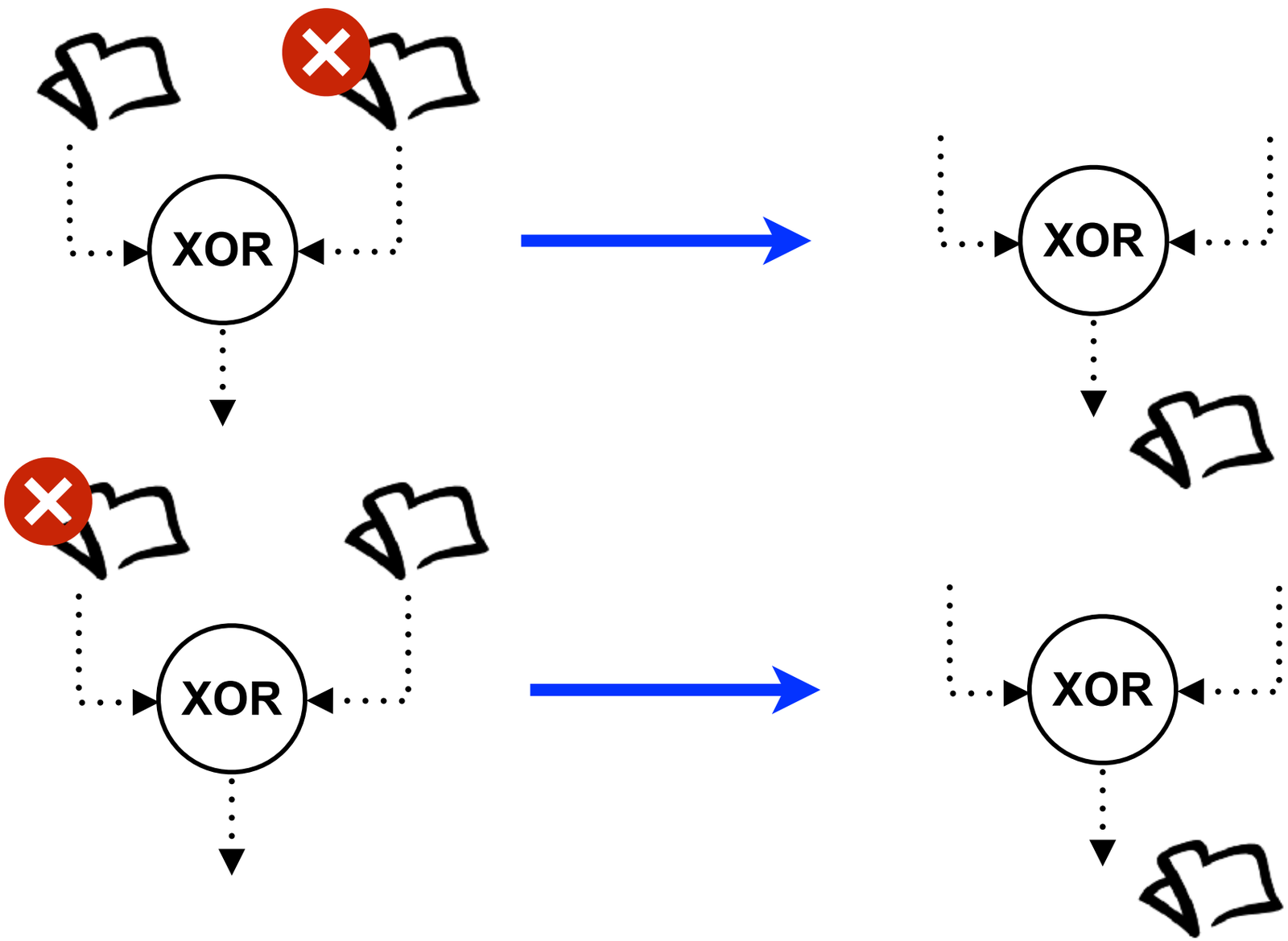
XOR join: intended meaning



if both inputs arrive,
it should block the flow

if one input arrives,
it cannot proceed unless
it is informed that
the other input will never arrive

Folder-passing semantics: XOR-join

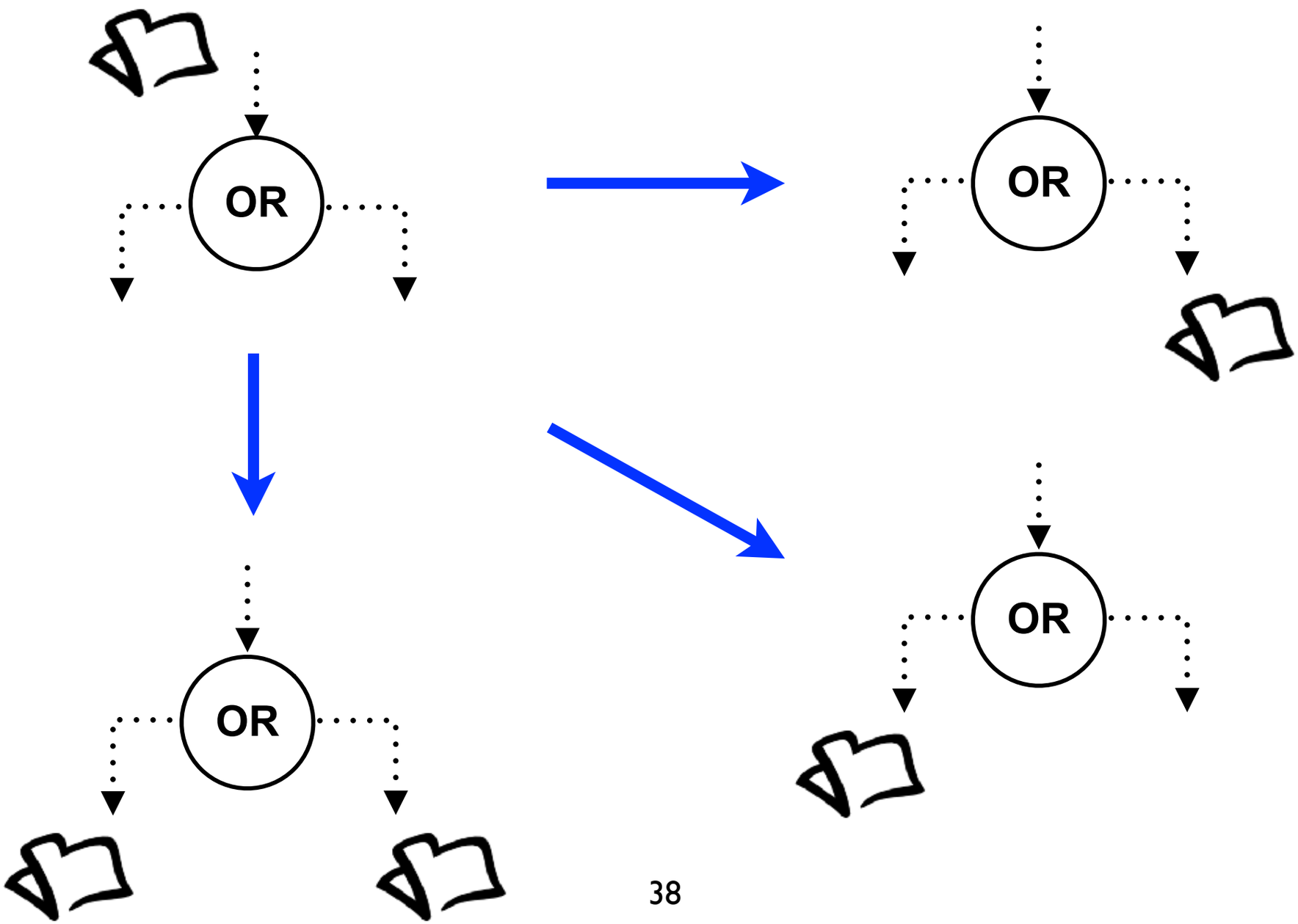


Folder-passing semantics?

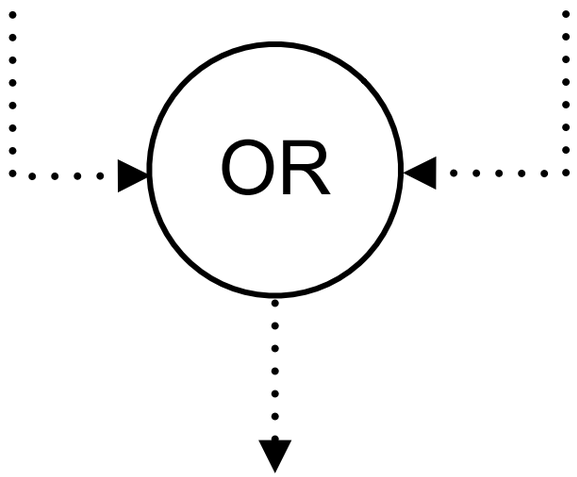
How can we infer the absence of folders?

When and how should such information be propagated?

Folder-passing semantics: OR-split



OR join: intended meaning

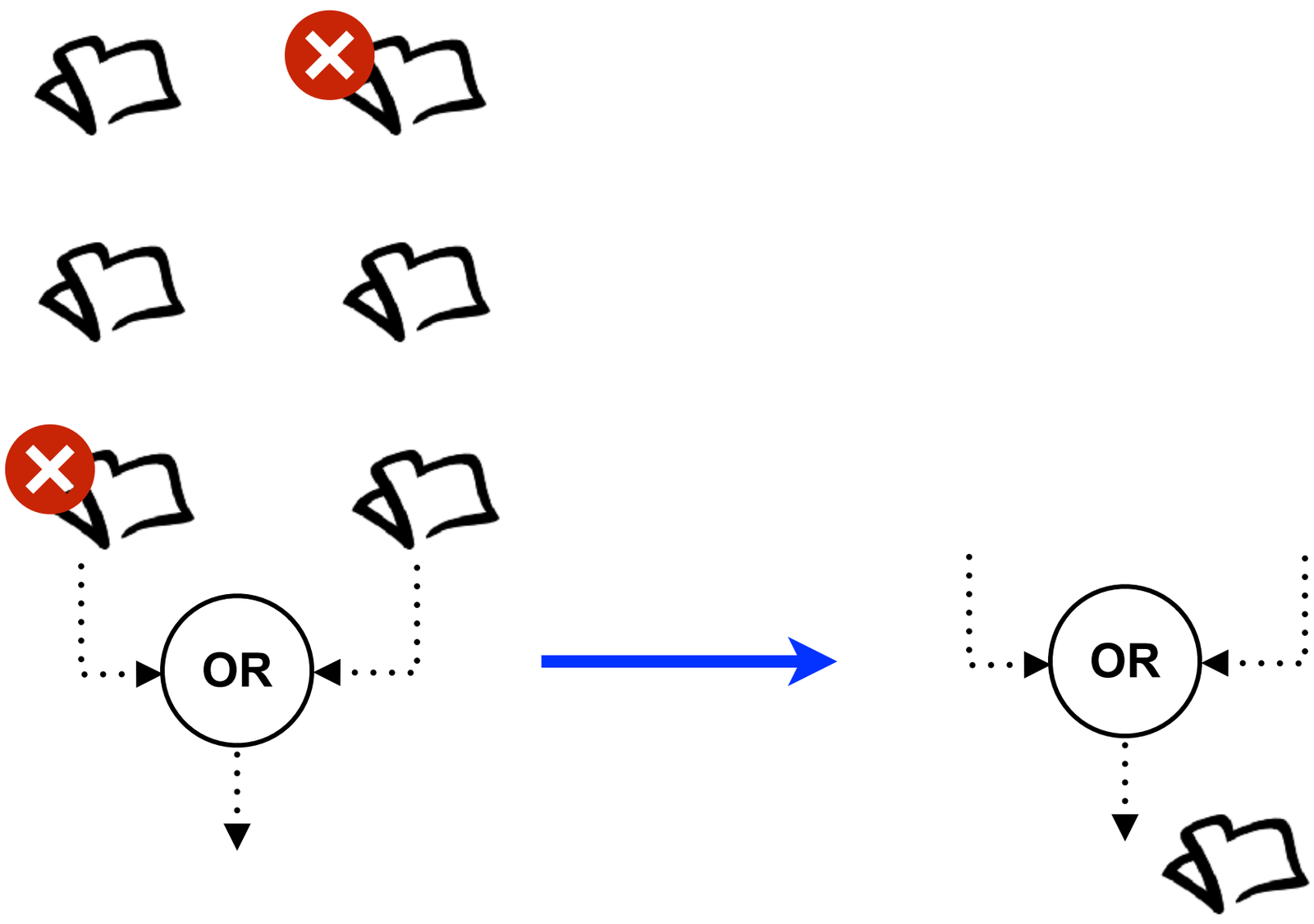


if only one input arrives,
it should release the flow

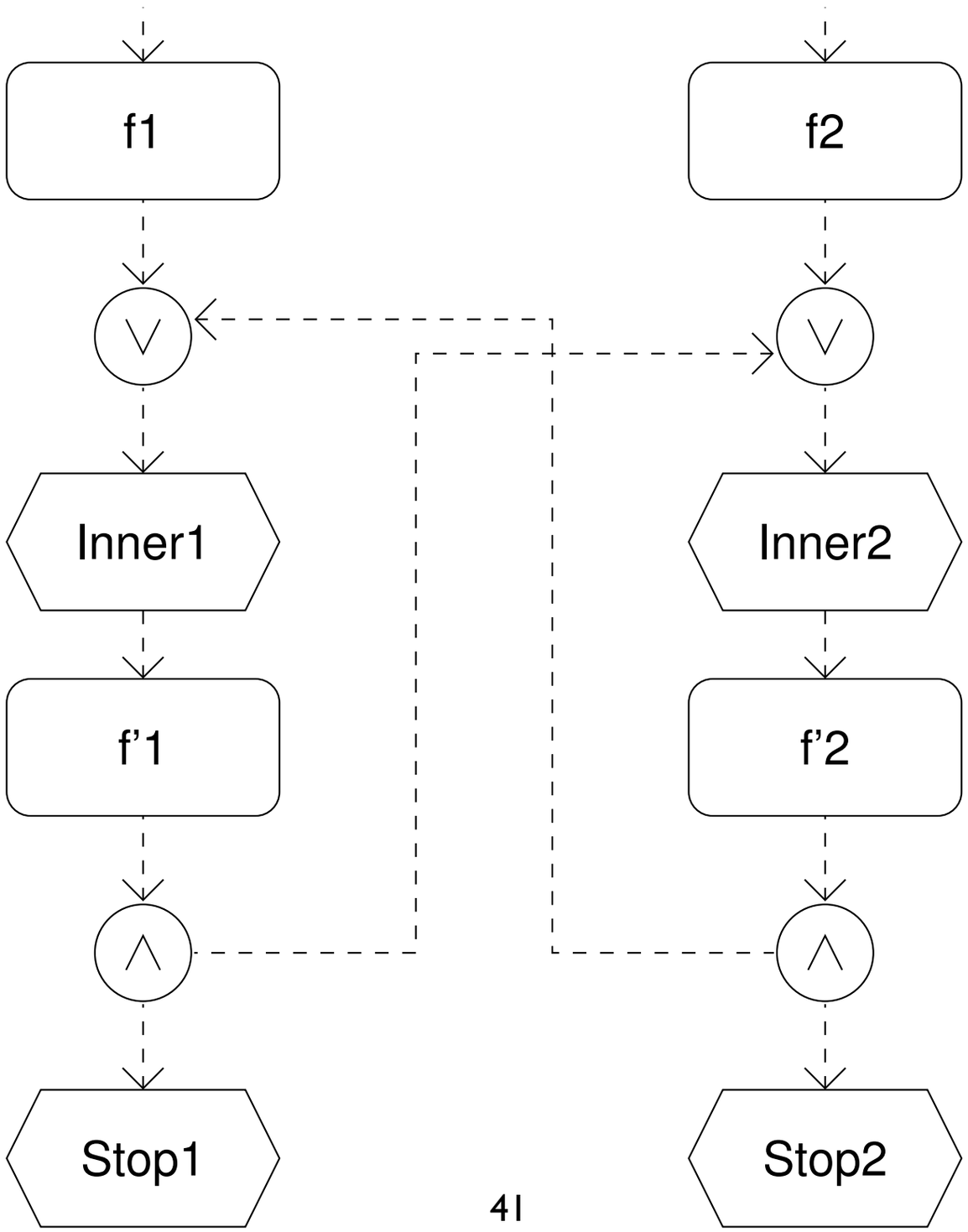
if both inputs arrive,
it should release only one output

if one input arrives,
it must wait until the other arrives or
it is guaranteed that the other will never arrive

Folder-passing semantics: OR-join?



A vicious circle?



Decorated EPC

To remove ambiguous behaviour for join connectors, designers can further annotate EPC diagrams

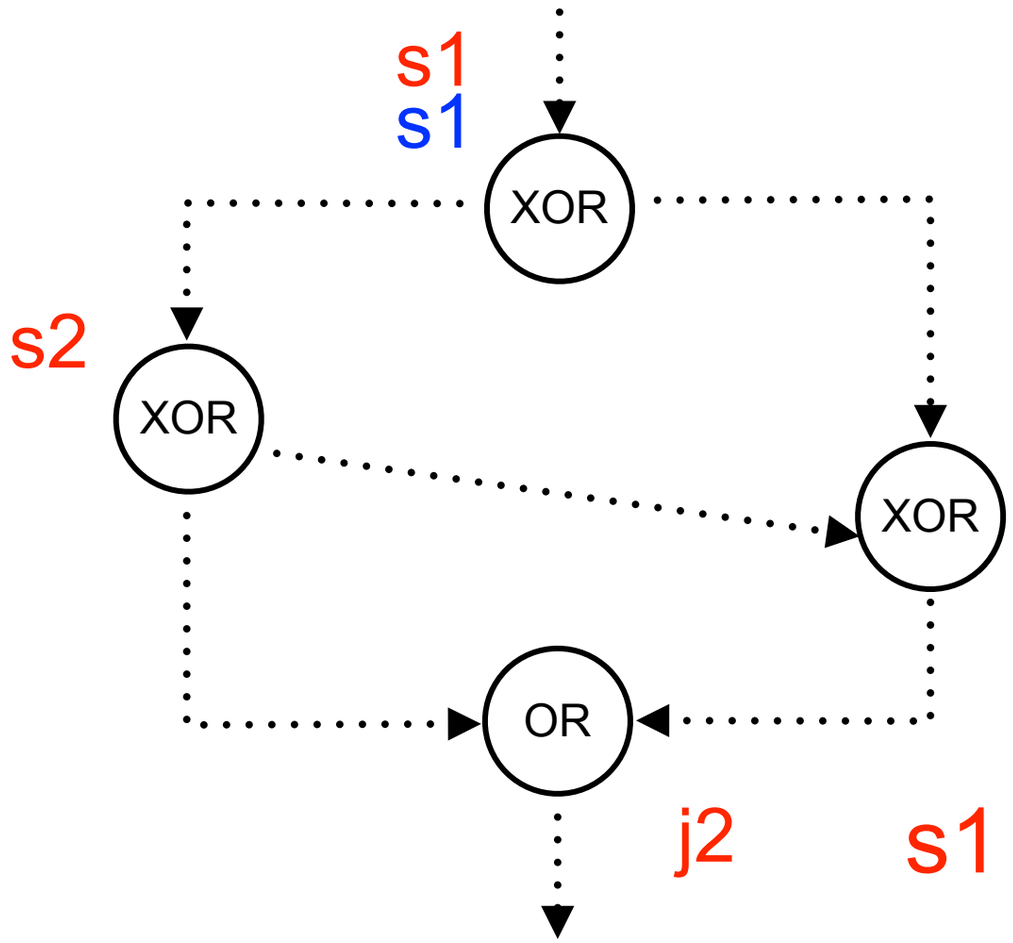
In particular we require to know:

corresponding split
which node separated the flows we are joining
(in the case of XOR/OR join)

applicable policy
how to trigger outgoing flow
(avoid OR join ambiguous behaviour)

Candidate split

A **candidate split** for a join node is any split node whose outputs are connected to the inputs of the join

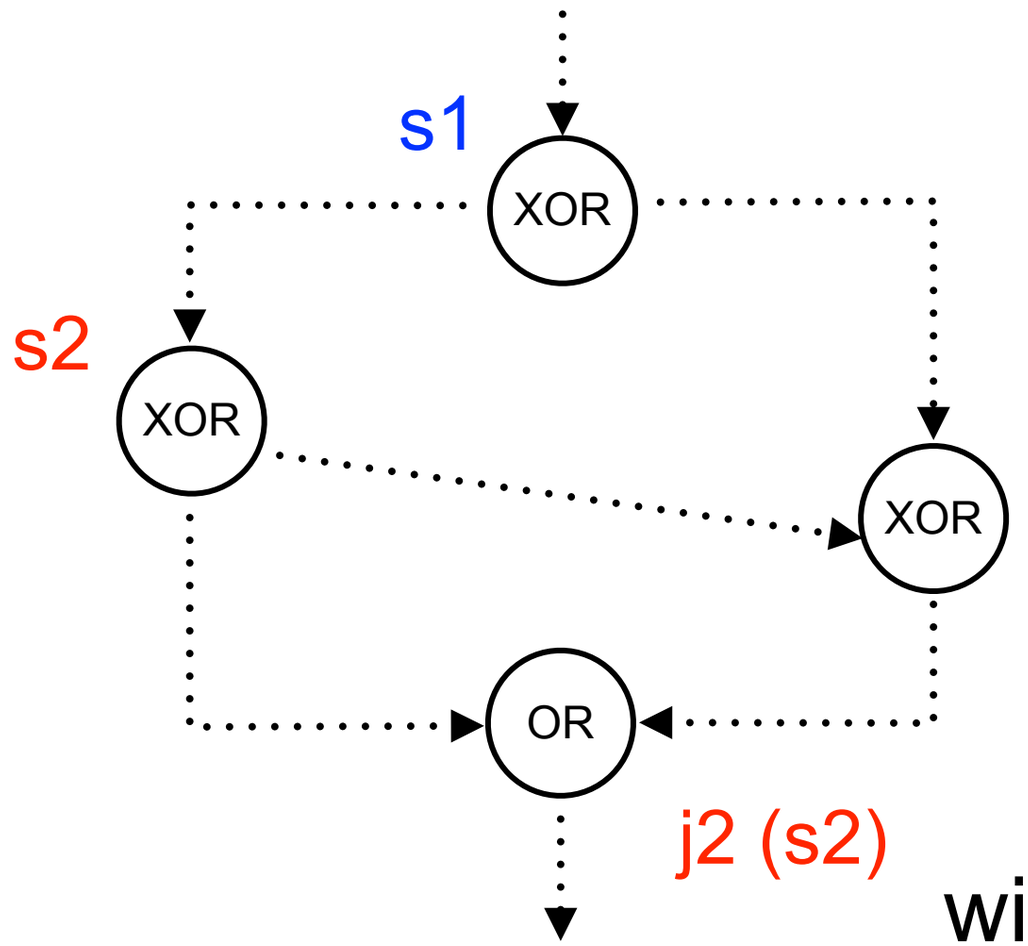


j1 s1 is a candidate split for j1

j2 s1 and s2 are candidate splits for j2

Corresponding split

A **corresponding split** for a join node
is a chosen candidate split



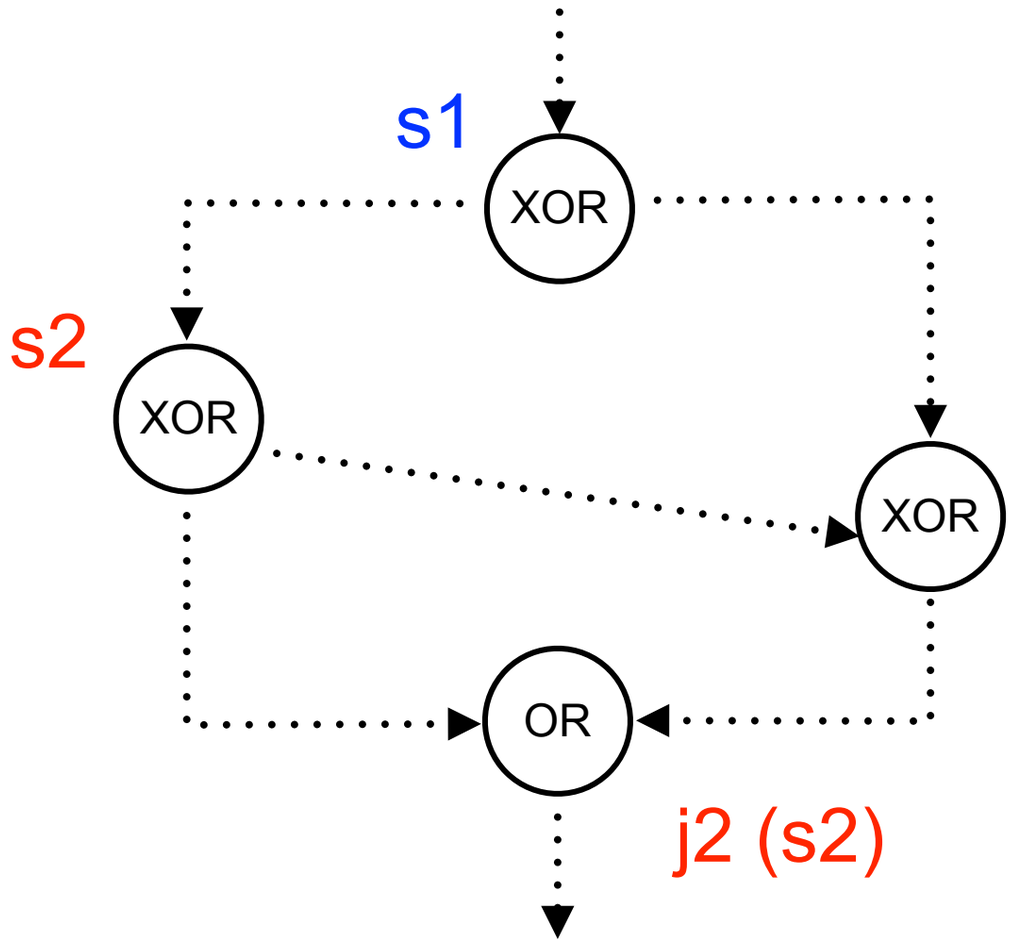
we choose s1 as a
corresponding split for j1

we choose s2 as a
corresponding split for j2

(we tag each join
with its corresponding split)

Matching split

A corresponding split for a join node is called **matching** if it has the same type as the join node



s1 is a matching split for j1

s2 is not a matching split for j2

OR join: policies

If an OR join has a **matching split**, its semantics is **wait-for-all**: wait for the completion of all *activated* paths

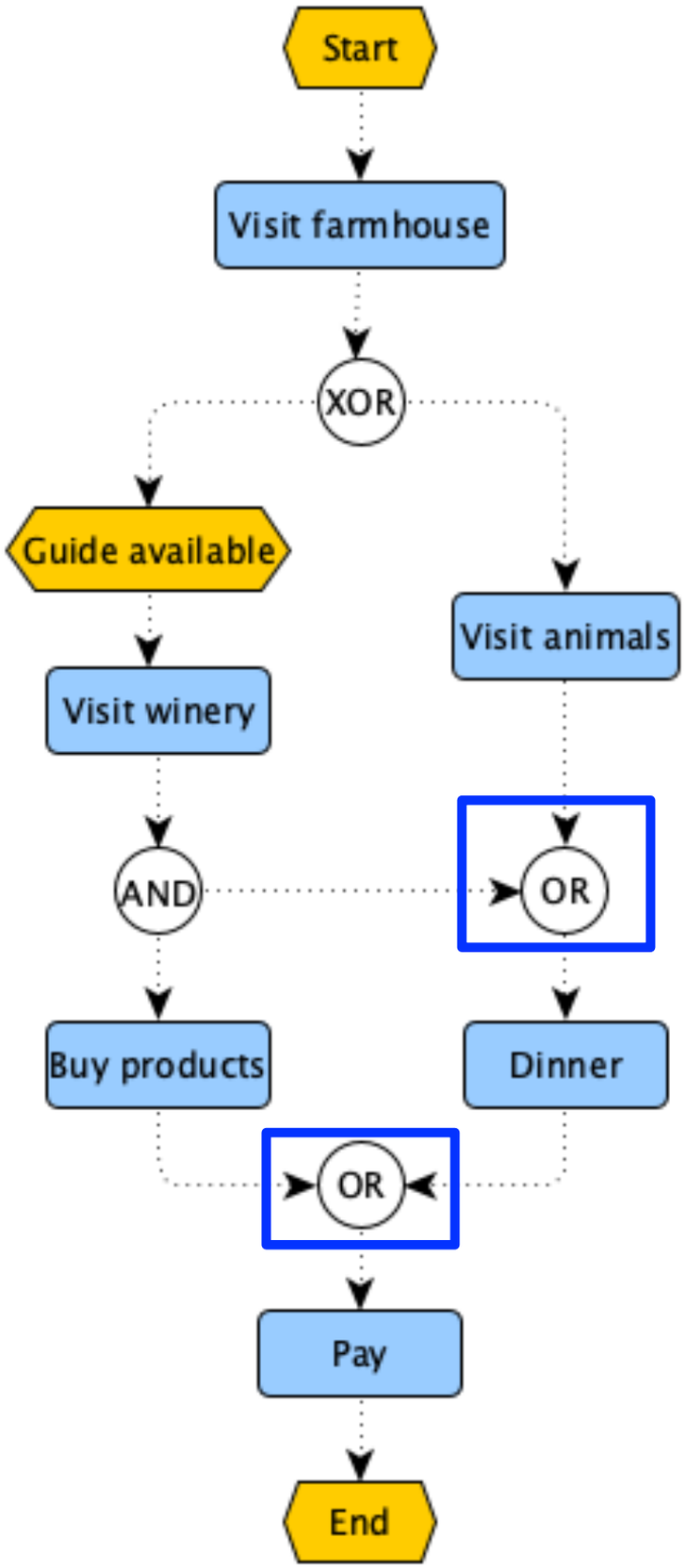
Otherwise, also other policies can be chosen:

every-time: trigger the outgoing path on each input

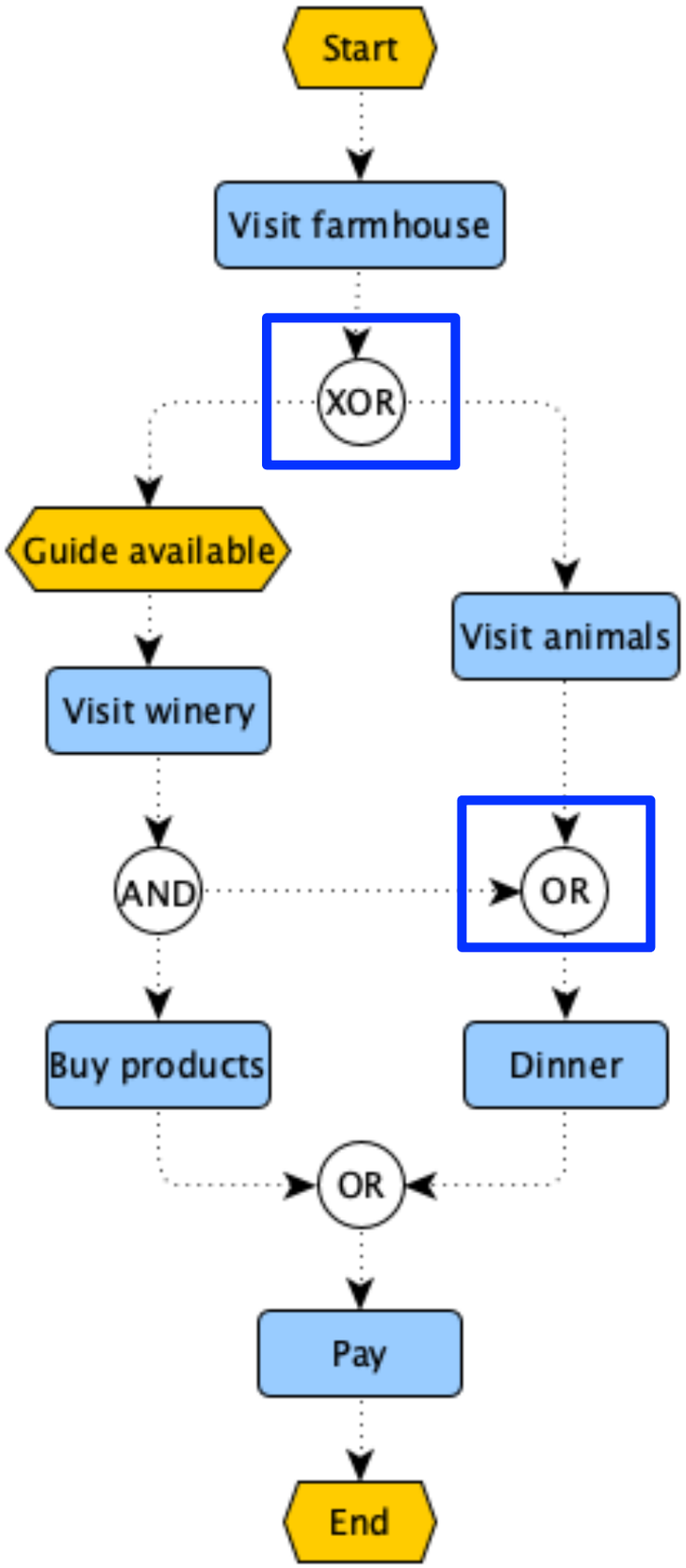
first-come: wait for the first input and ignore the second

Assumption: every OR join is tagged with a policy (some suggested to have different trapezoid symbols)

Example



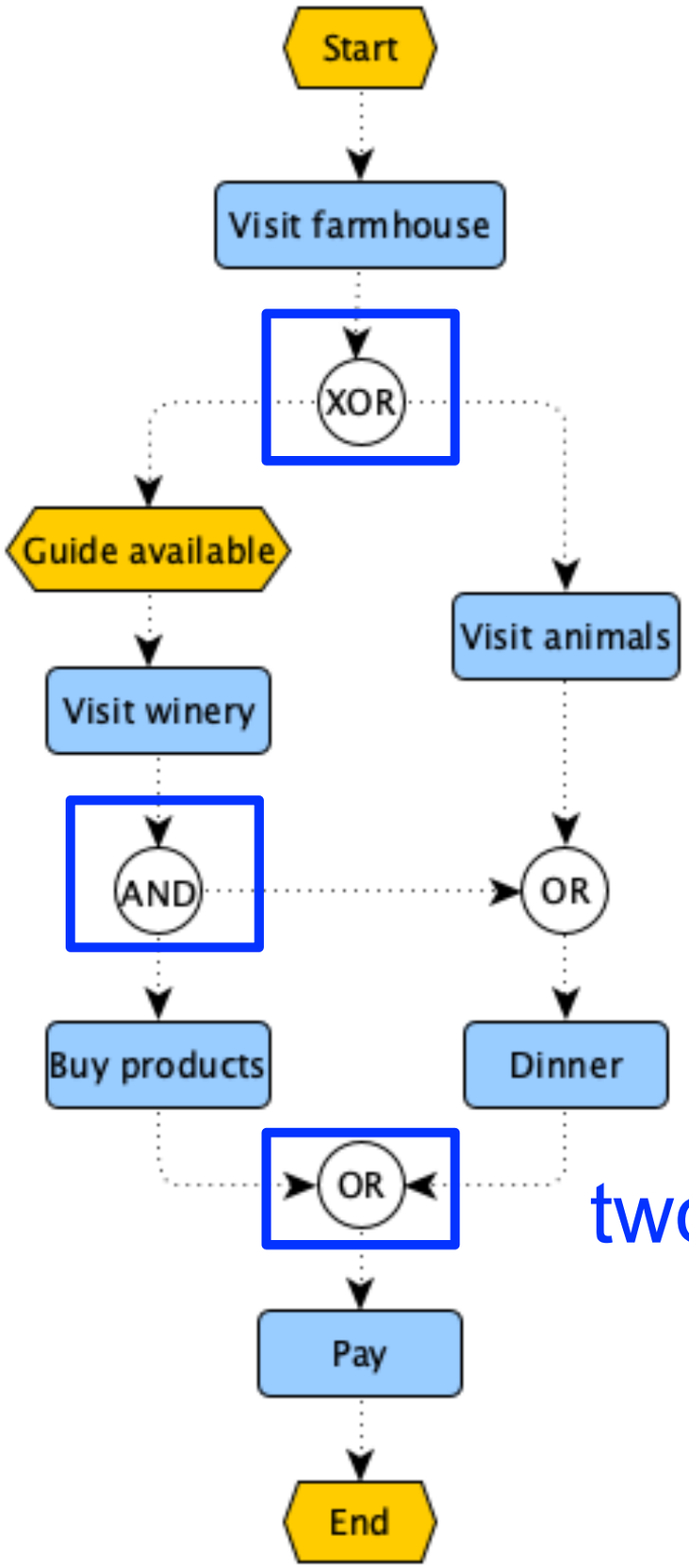
two OR joins
but no OR split



Example

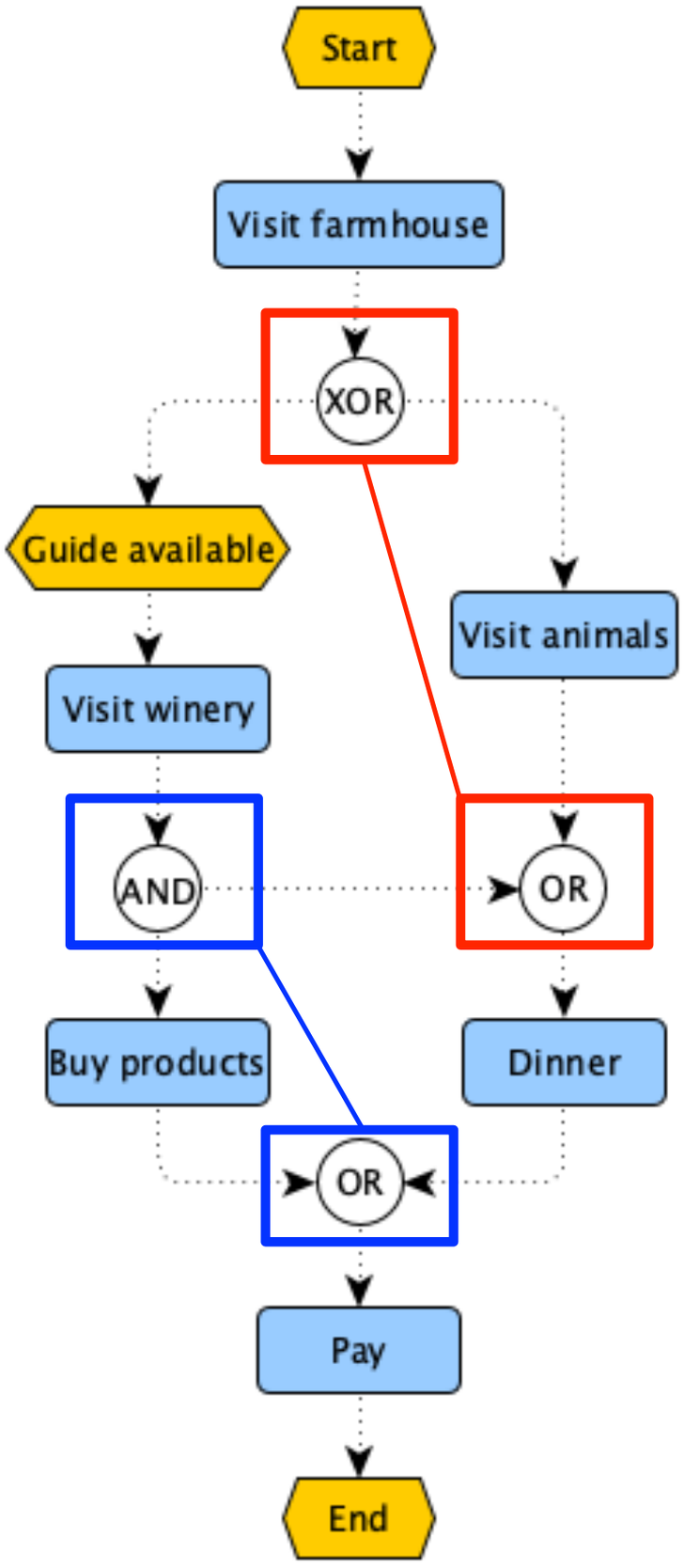
only one
candidate split

Example



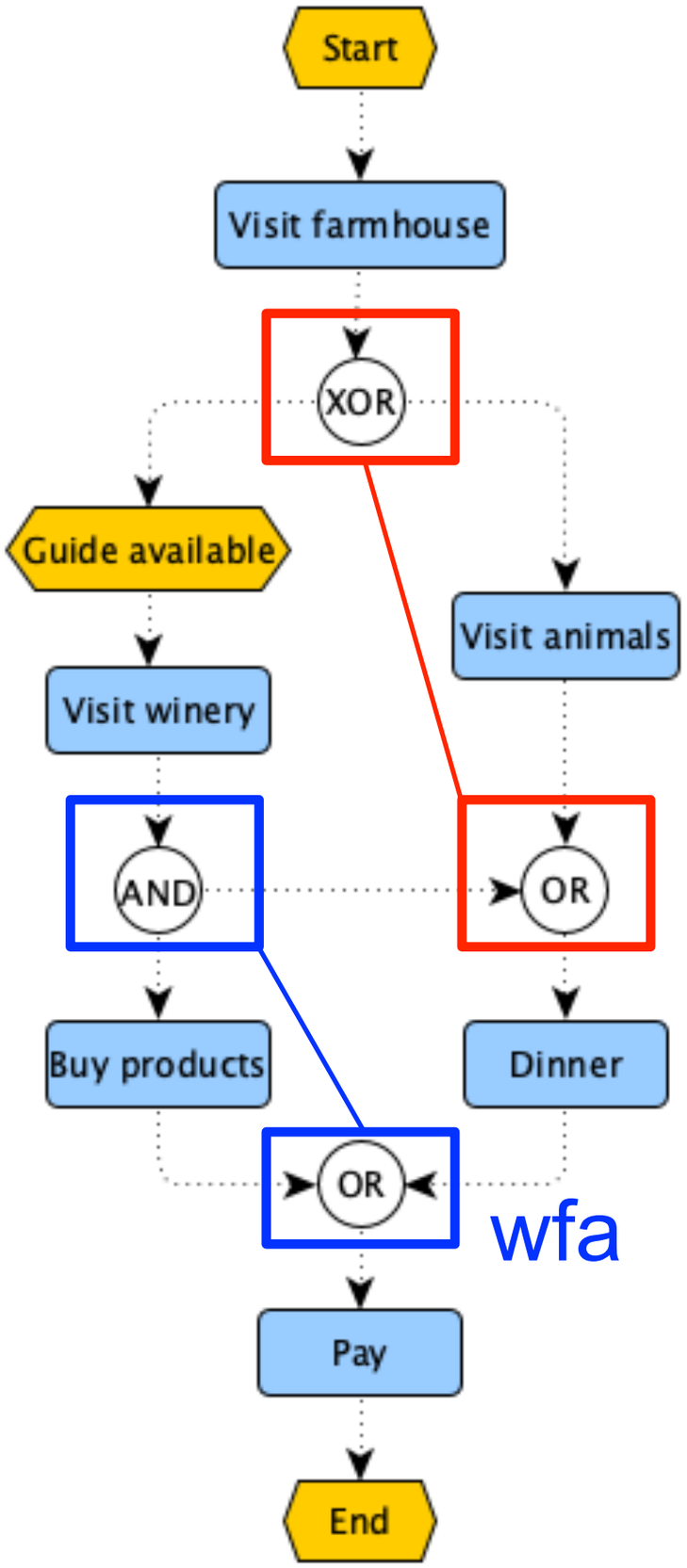
two candidate splits

Example



assign corresponding splits

Example



fc

wfa

assign policies

Assumption

An OR join with **matching split uses wfa**

If an OR join has non-matching corresponding split
it is decorated with a policy (wfa, fc, et)

wfa: wait-for-all
works well with any corresponding split

et: every-time
fc: first-come
work well with corresponding XOR split

XOR join: assumption

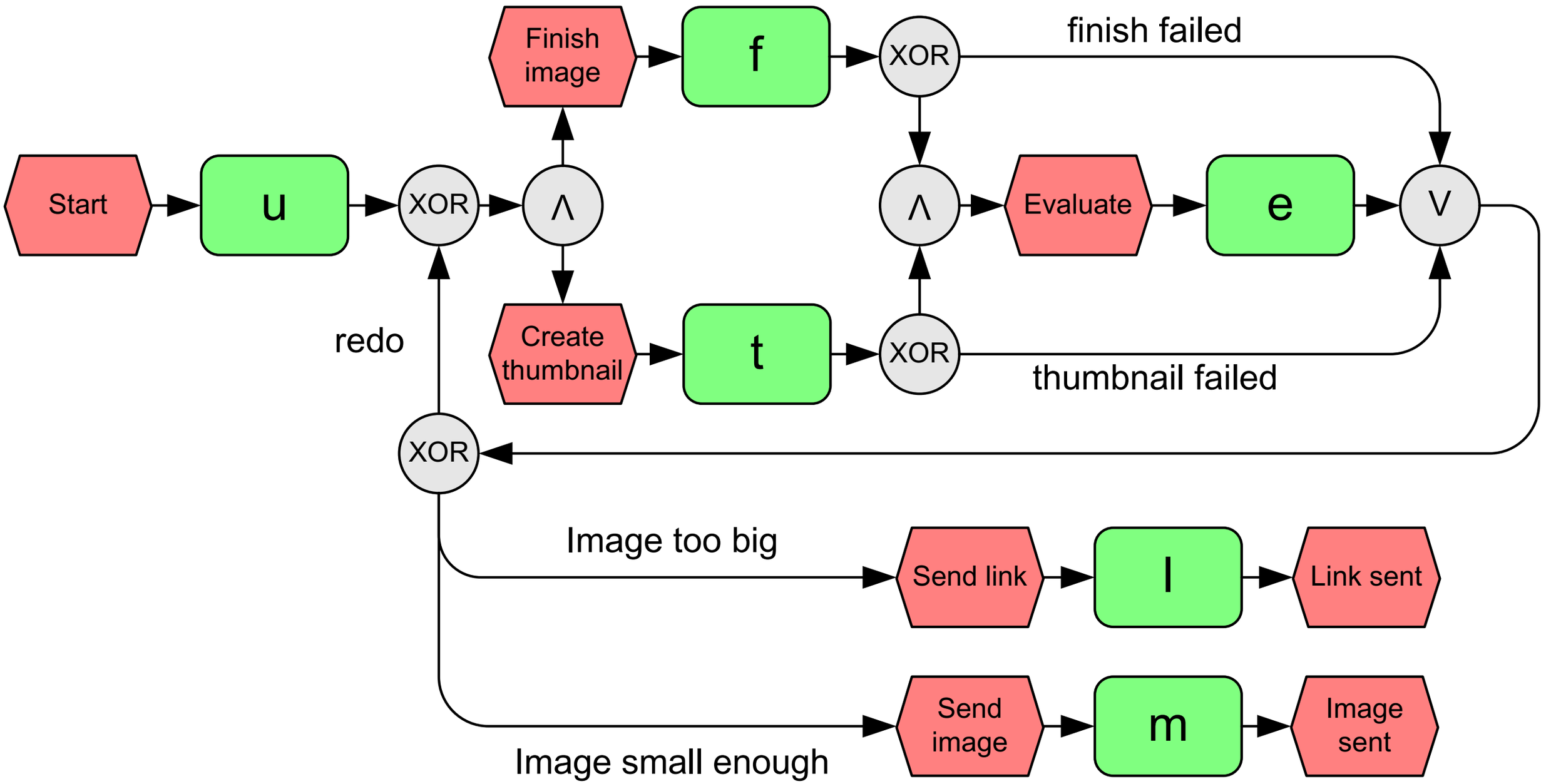
If a XOR join has a **matching split**, the semantics is:
"it blocks if both paths are activated and
it is triggered by a unique activated path"

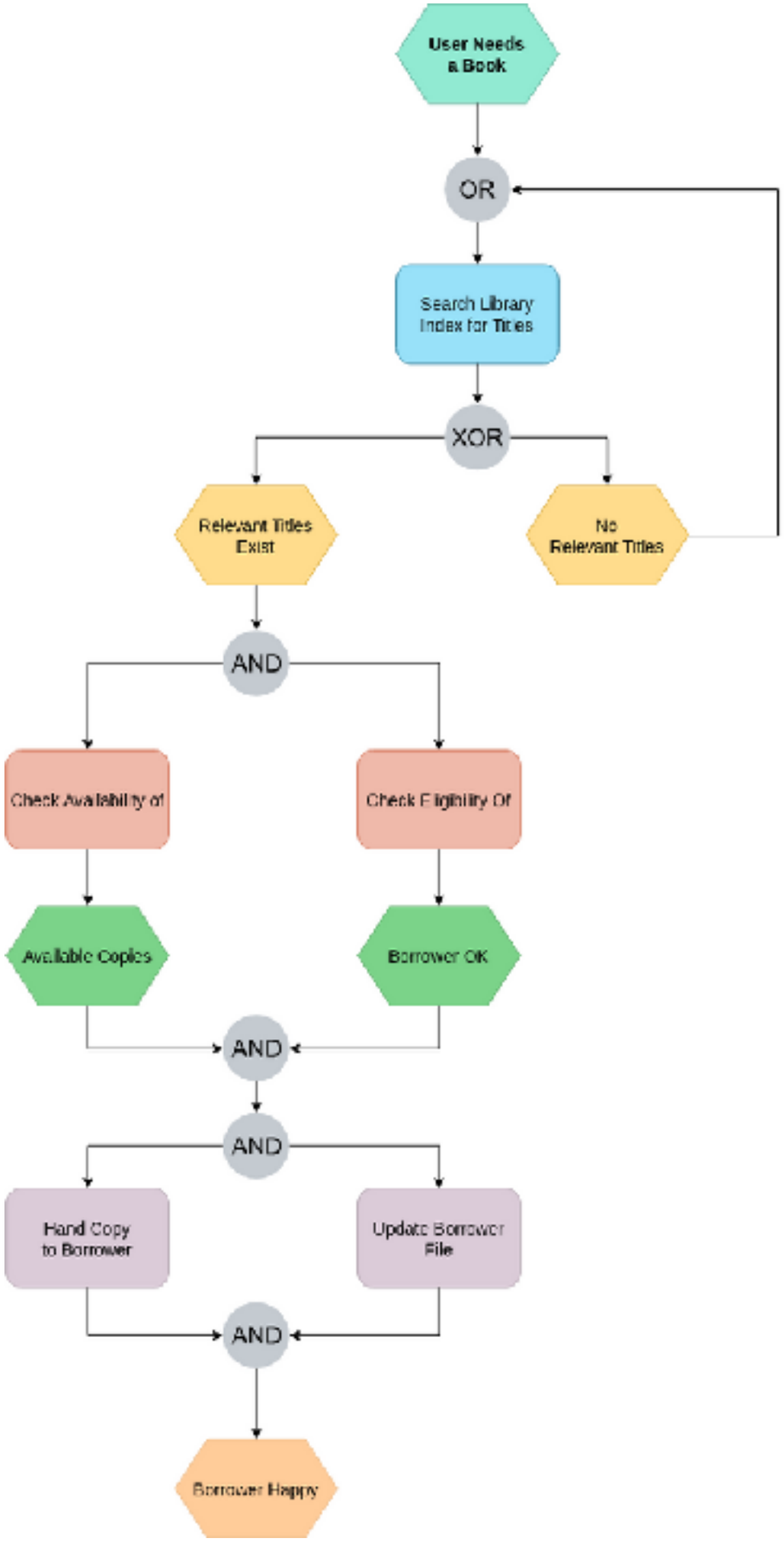
Any policy (wait-for-all, first-come, every-time)
contradicts the exclusivity of XOR
(a token from one path can be accepted only if we make sure that no second token will arrive via the other path)

Assumption: every XOR join has a matching split
(the implicit start split is allowed as a valid match)

EPC Sample Diagrams

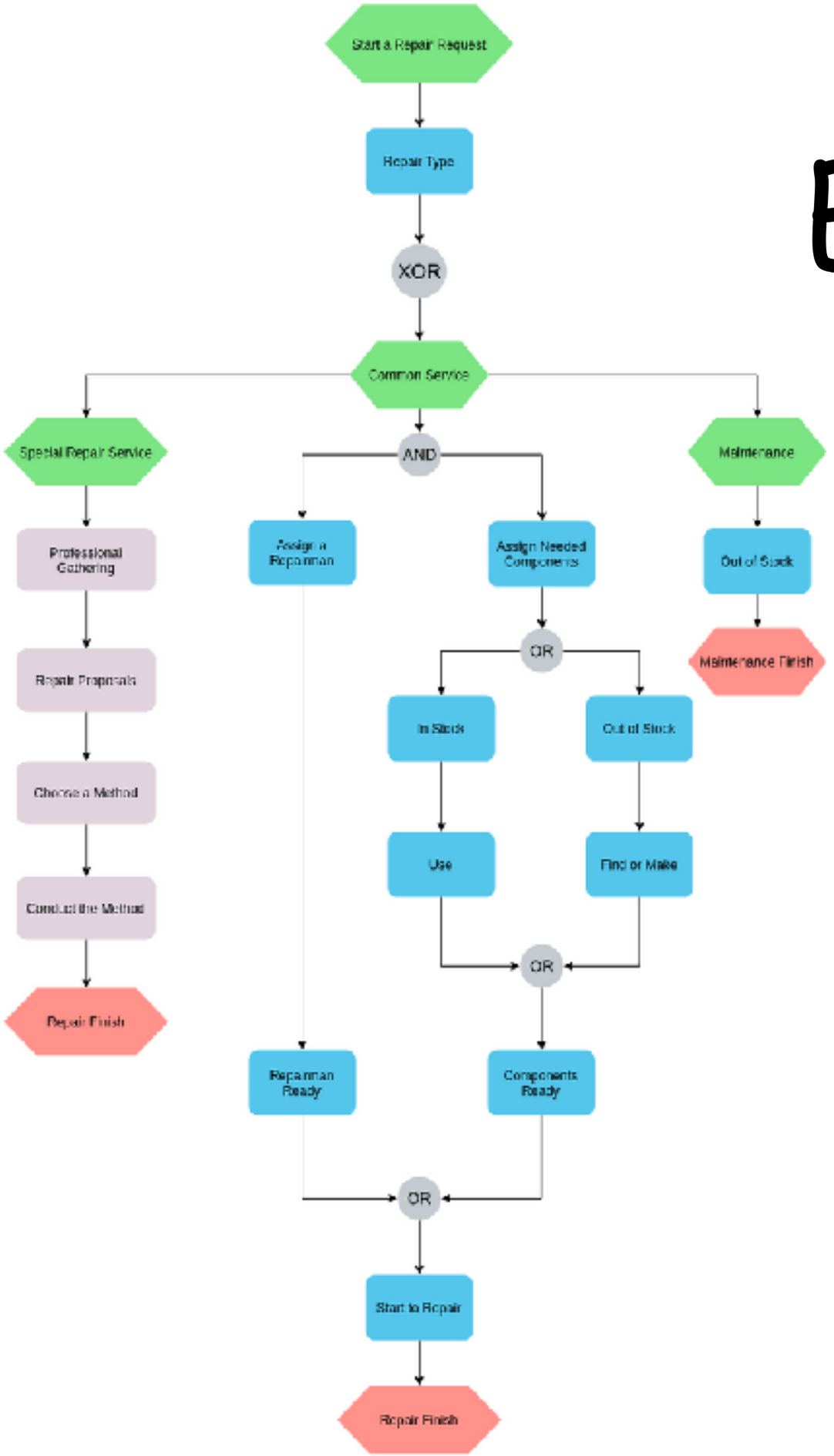
Example

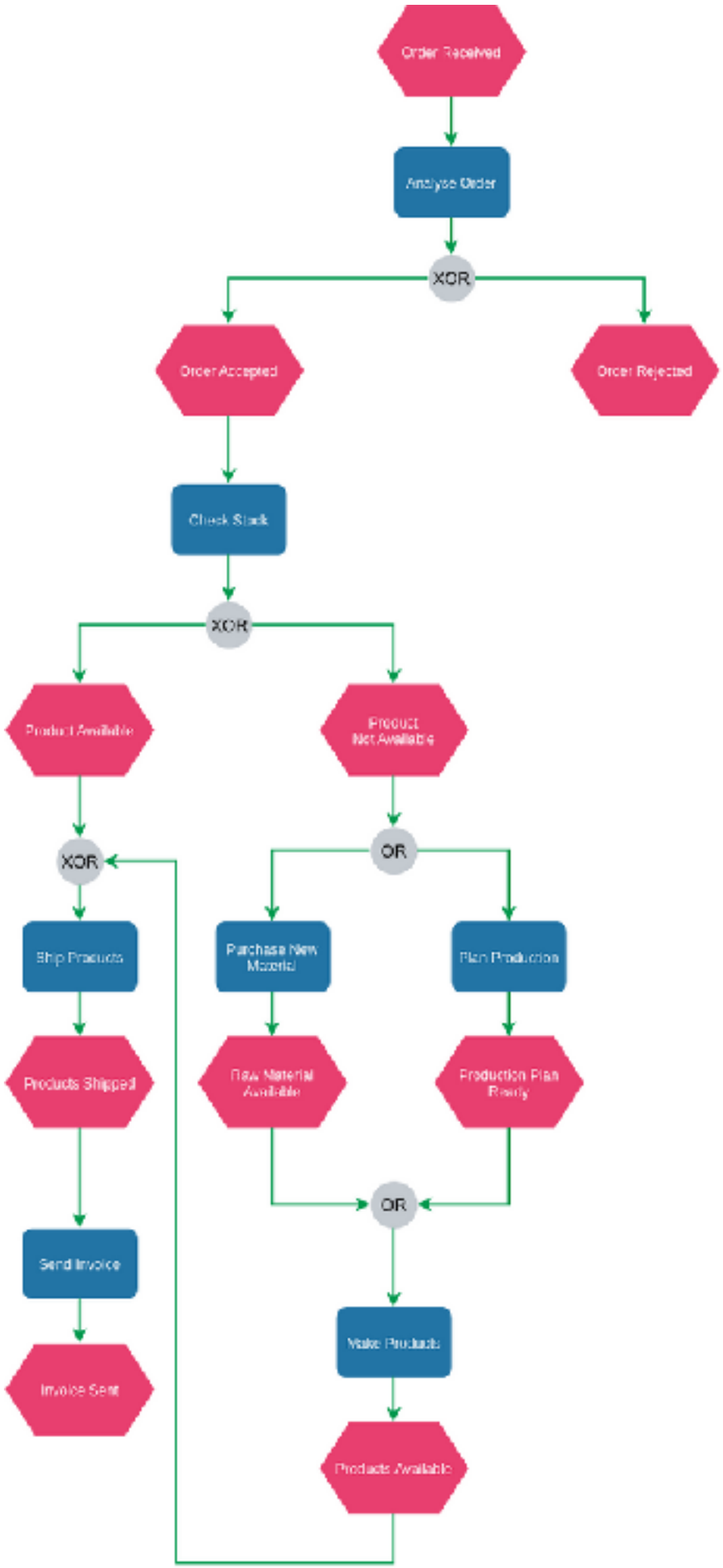

Start
u
XOR
Finish image
f
XOR
finish failed
Λ
Λ
Evaluate
e
V
redo
Create thumbnail
t
XOR
thumbnail failed
XOR
Image too big
Send link
l
Link sent
Send image
m
Image sent
Image small enough



Example

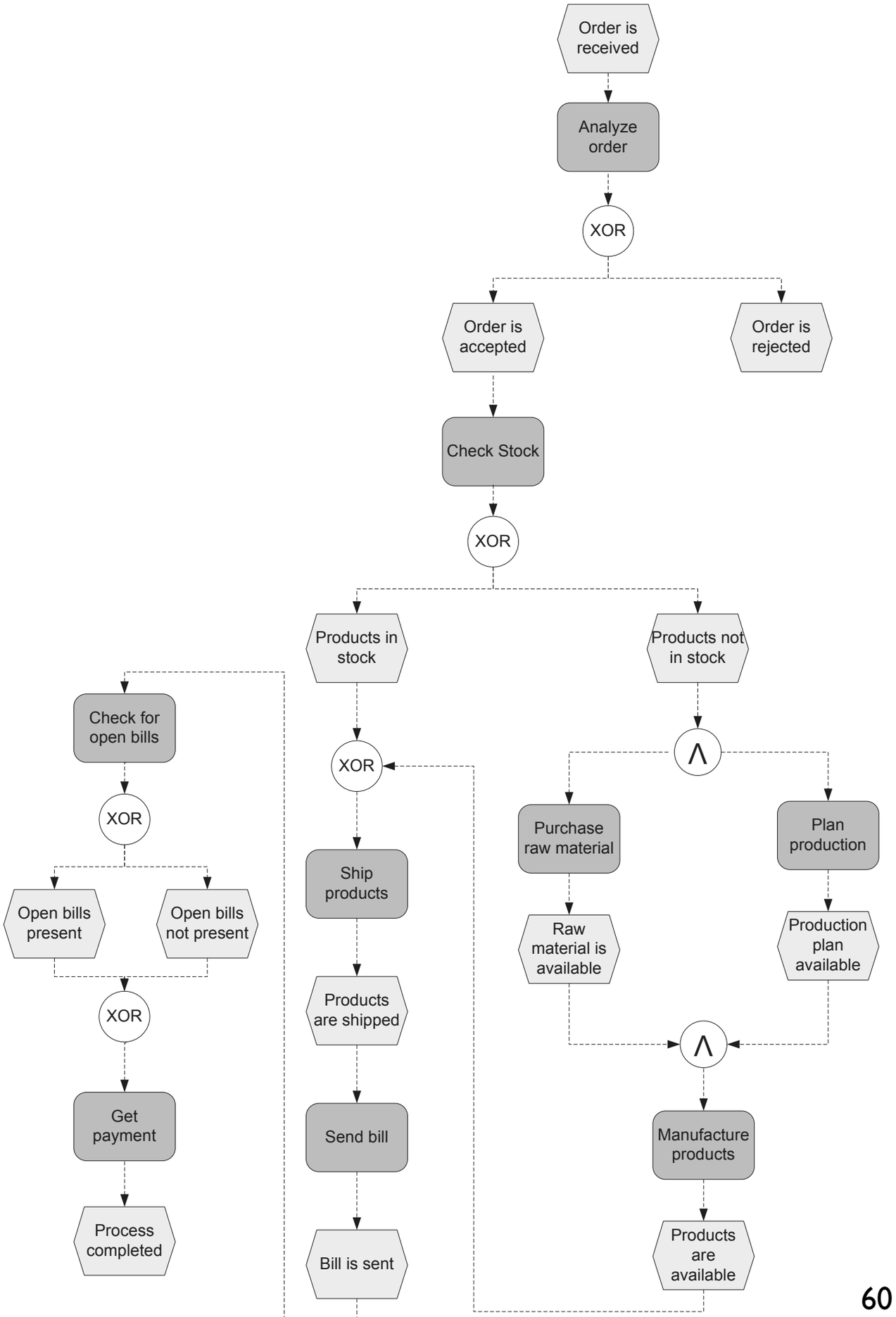
Example

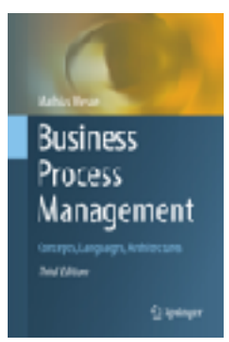




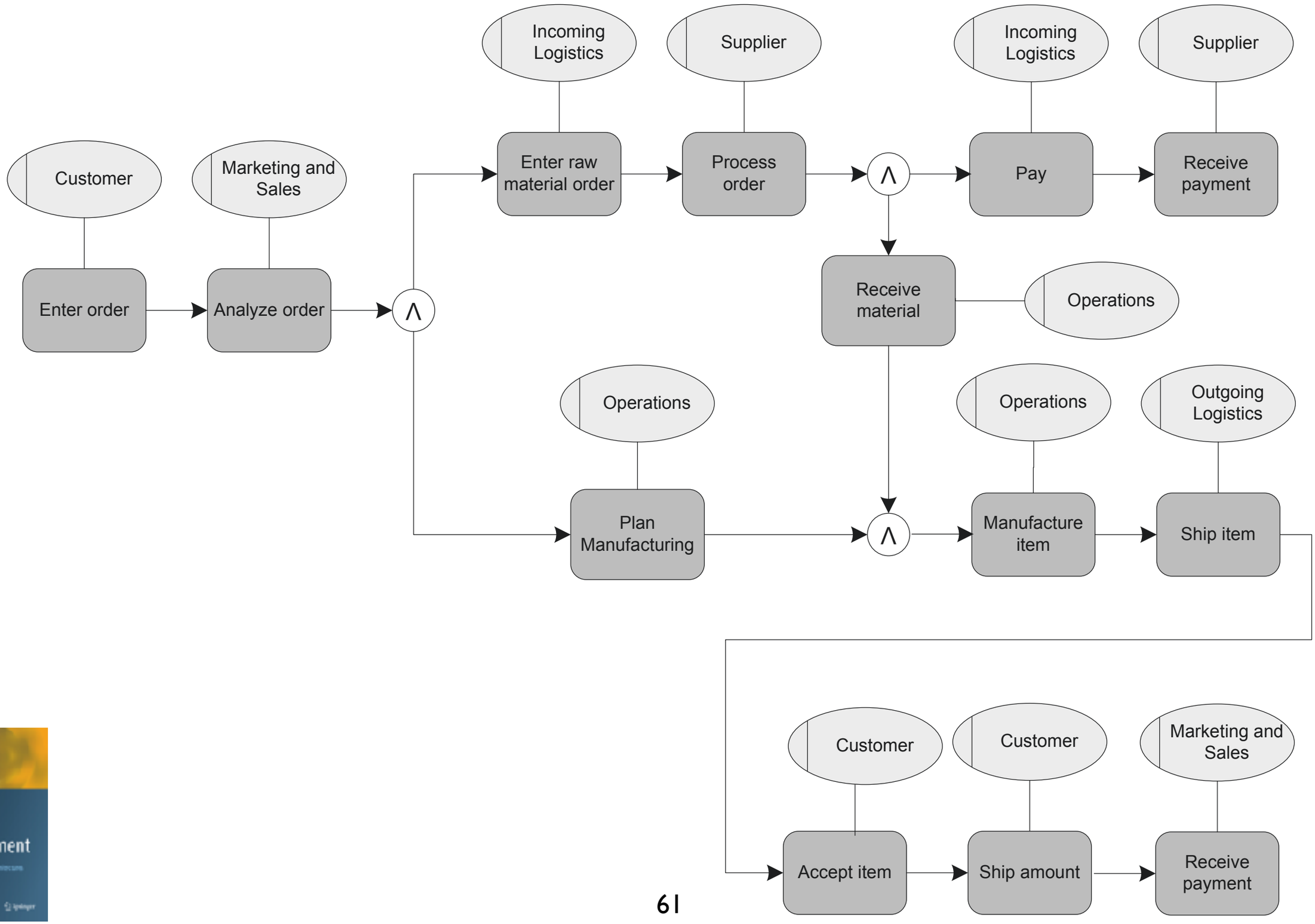
Example

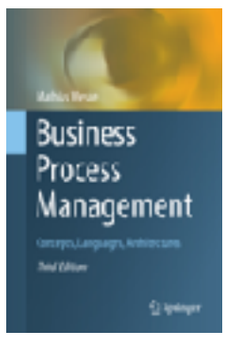
Example


Order is received
Analyze order
XOR
Order is accepted
Order is rejected
Check Stock
XOR
Products in stock
Products not in stock
Check for open bills
XOR
XOR
Ship products
Purchase raw material
Plan production
Open bills present
Open bills not present
Raw material is available
Production plan available
Products are shipped
Send bill
Manufacture products
Get payment
Process completed
Bill is sent
Products are available


Business Process Management

Example


Customer
Marketing and Sales
Enter order
Analyze order
Incoming Logistics
Supplier
Enter raw material order
Process order
Pay
Receive payment
Receive material
Operations
Operations
Plan Manufacturing
Operations
Outgoing Logistics
Manufacture item
Ship item
Customer
Customer
Marketing and Sales
Accept item
Ship amount
Receive payment


Business Process Management

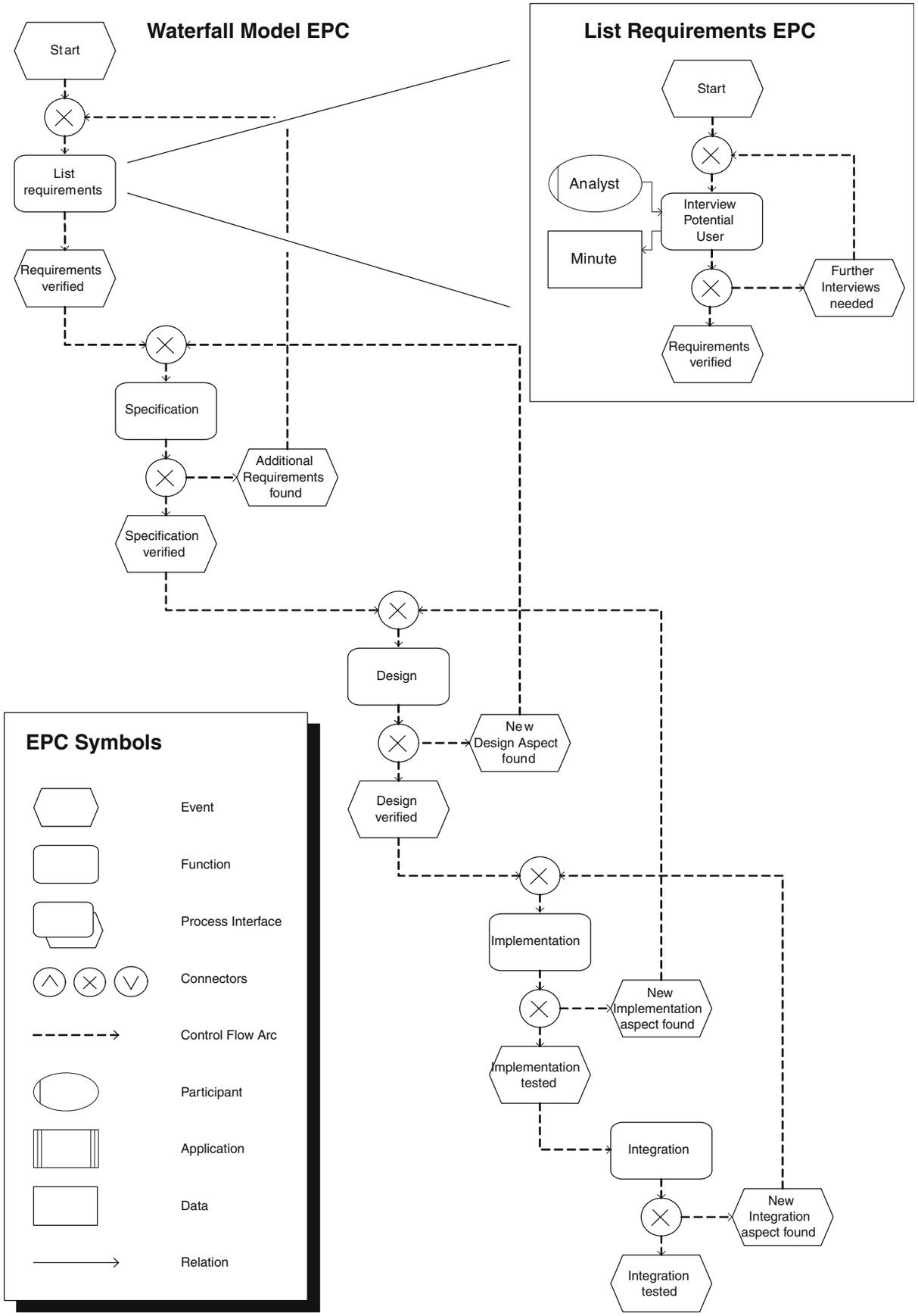
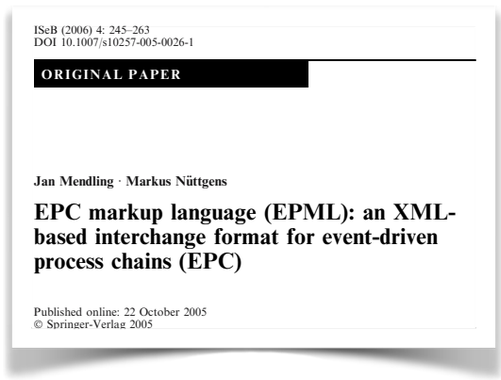


Fig. 1 Event-driven process chains representing the waterfall model for software engineering

Example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DOI 10.1007/s10257-005-0026-1

ORIGINAL PAPER

Jan Mendling · Markus Nüttgens

EPC markup language (EPML): an XML-based interchange format for event-driven process chains (EPC)

Published online: 22 October 2005

Exercises

Transfer the following verbal description into an EPC

a) When creating a cost centre (CC), the controlling department specifies the validity period of the cost centre, and then assigns it to a cost centre group.

b) Once the cost centres are assigned to the standard hierarchy, the basic data of the cost centre (CC name, person in charge, currency and category) is simultaneously determined.

c) Thereafter the controlling department assigns the organizational units (business area, profit centre or both) to the cost centres.

d) Once the organizational units are assigned, the controlling department determines the control indicators. Finally, the controlling department saves the captured data and, as a result, the cost centre is created.