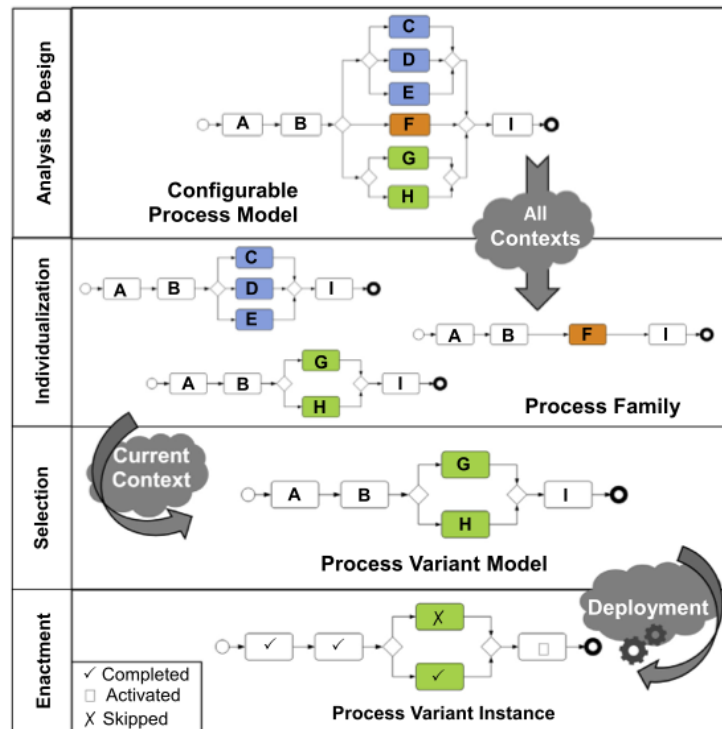# Modelling Variability of Business Processes using BPFM

Barbara Re

UNIVERSITA' DEGLI STUDI DI CAMERINO
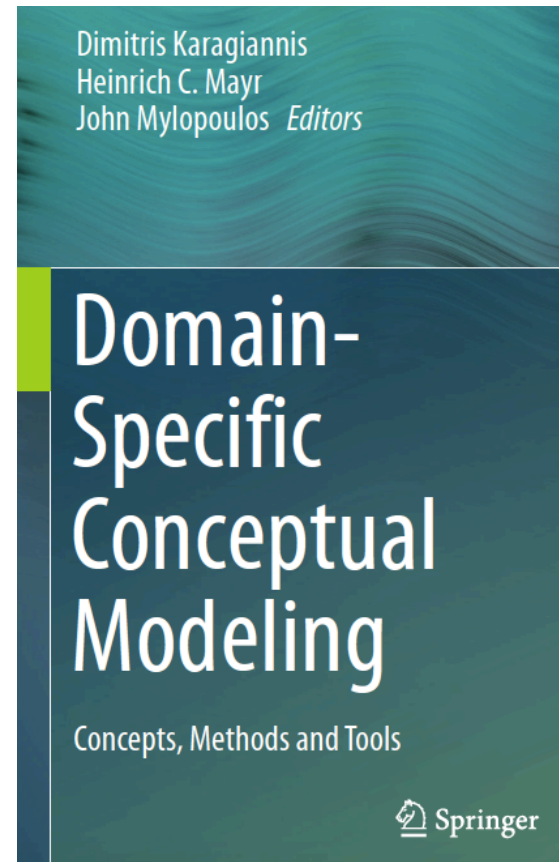
BP Variability Approaches

- **Variability** is the ability of deriving different BP variants from a **configurable BP model** at design-time

- BP variability approaches: following **C-iEPC**, **C-YAWL**, **vBPMN**, **PROVOP** and **PESOA**

C. Ayora et al., VIVACE: A framework for the systematic evaluation of variability support in process-aware information systems, Inform. Softw. Technol. (2014).

BP Variability Our Contribution

- We contribute with a **novel notation** and **modelling approach** to support flexibility when the control flow is not fully predetermined (i.e. it is not possible to include all the possible flow relations) **considering several perspectives of the Process Aware Information Systems**

- Using the **ADOxx development platform** we also implemented a **modelling environment** supporting the usage of the BPFM notation and the automatic derivation of BP variants

Dimitris Karagiannis
Heinrich C. Mayr
John Mylopoulos *Editors*

Domain-Specific Conceptual Modeling

Concepts, Methods and Tools

Springer

Business Process Feature Model: An Approach to Deal with Variability of Business Processes

Riccardo Cognini, Flavio Corradini, Andrea Polini and Barbara Re

Abstract In order to help organizations in providing similar services without the need to structure each of them separately, this chapter presents a modeling notation that supports variability for Business Process modeling. Variability is particularly relevant for Public Administration institutions where different offices organize the provisioning of services to citizens following similar rules, and adapting them to the characteristics of the different offices. The notation and the approach are inspired to feature modeling techniques, whereas in this case features are used to represent activities of a process family that can be differently implemented and connected. The proposed approach facilitates the development of a partially specified process model in terms of a set of fragments that in a subsequent step can be connected in order to fully specify the desired control flow. The notation and the approach were implemented on the the ADOxx platform.

Keywords Feature model · Variability · Business processes · Modeling environment

1 Introduction

In the context of BP modeling, variability refers to the ability of expressing and deriving different Business Process (BP) variants from a configurable BP model [14]. This is a generic model integrating all the possible BP variations eliminat-

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The Business Process Feature Model (BPFM) Approach

- The **BPFM** approach permits to deal with **large collections of Business Processes variants** thanks to the integration of Business Process and Feature Model notations

- The **BPFM** approach permits to reason on **functional, behavioural, information,** and **operational** perspective of **Process Aware Information Systems**
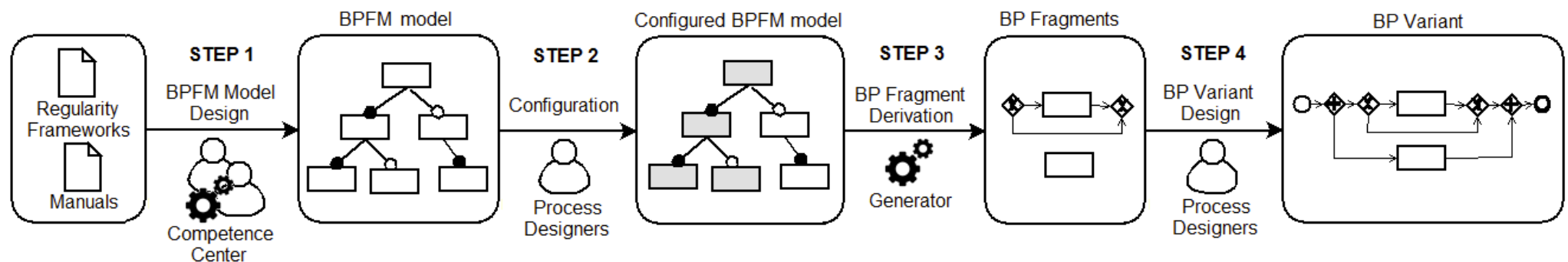
What is New?

- Functional perspective
  - Activity building blocks such as atomic task and complex sub-process from which BP models can be composed → **introducing detail via a progressive ne granularity**

- Behavioural perspective
  - The dynamic behaviour of an executable BP model partially → **differentiating between the static inclusion and the dynamic occurrence of an activity**

- Information perspective
  - Data objects involved in the BP → **supporting the part-of relation in data object modelling, while some data objects are primitives, other can be decomposed into more fine-grained object**

- Operational perspective
  - Details related to the implementation of the BP activities → **enabling the specification of different possible types of activities execution**
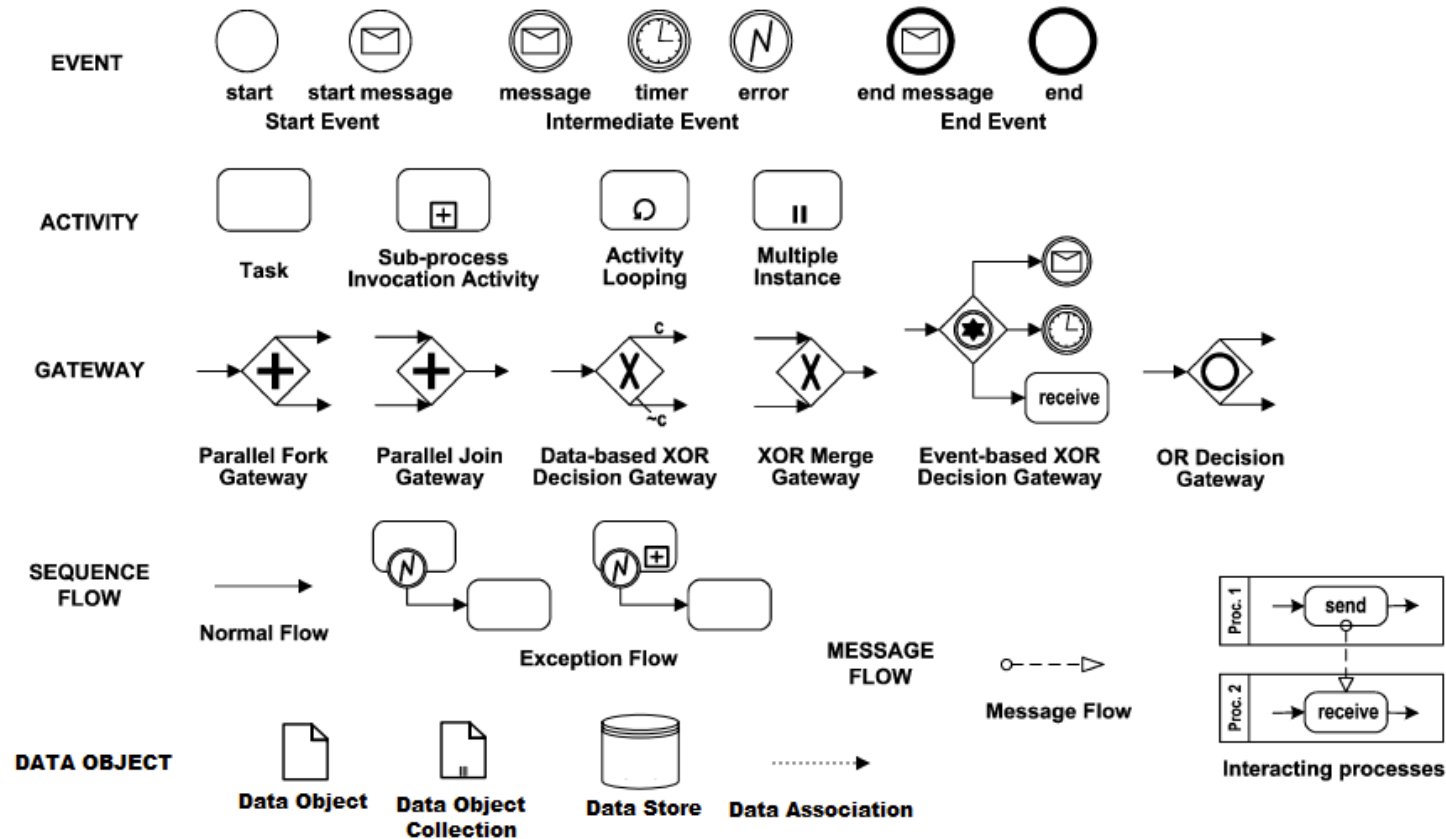
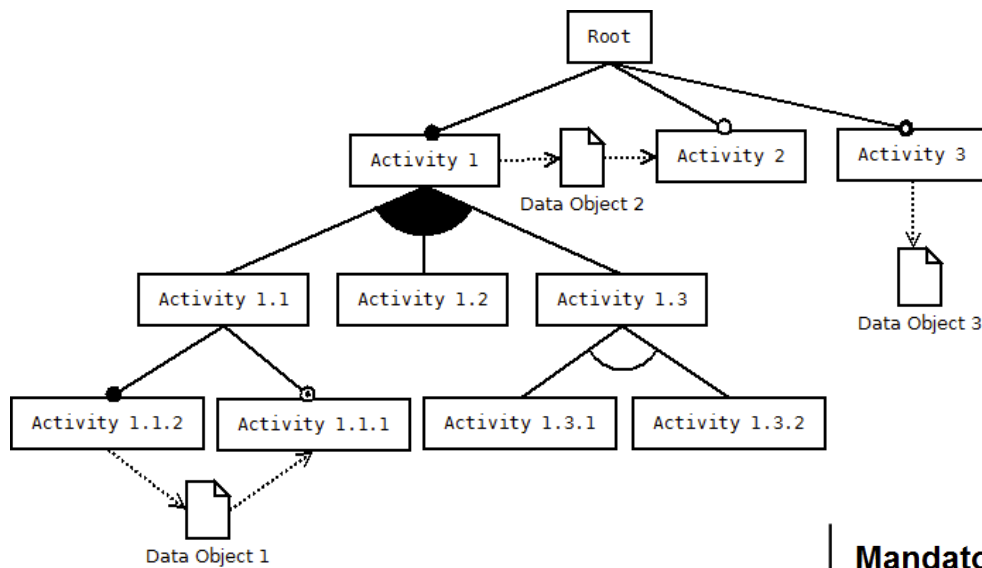# Background Knowledge: Feature Modelling
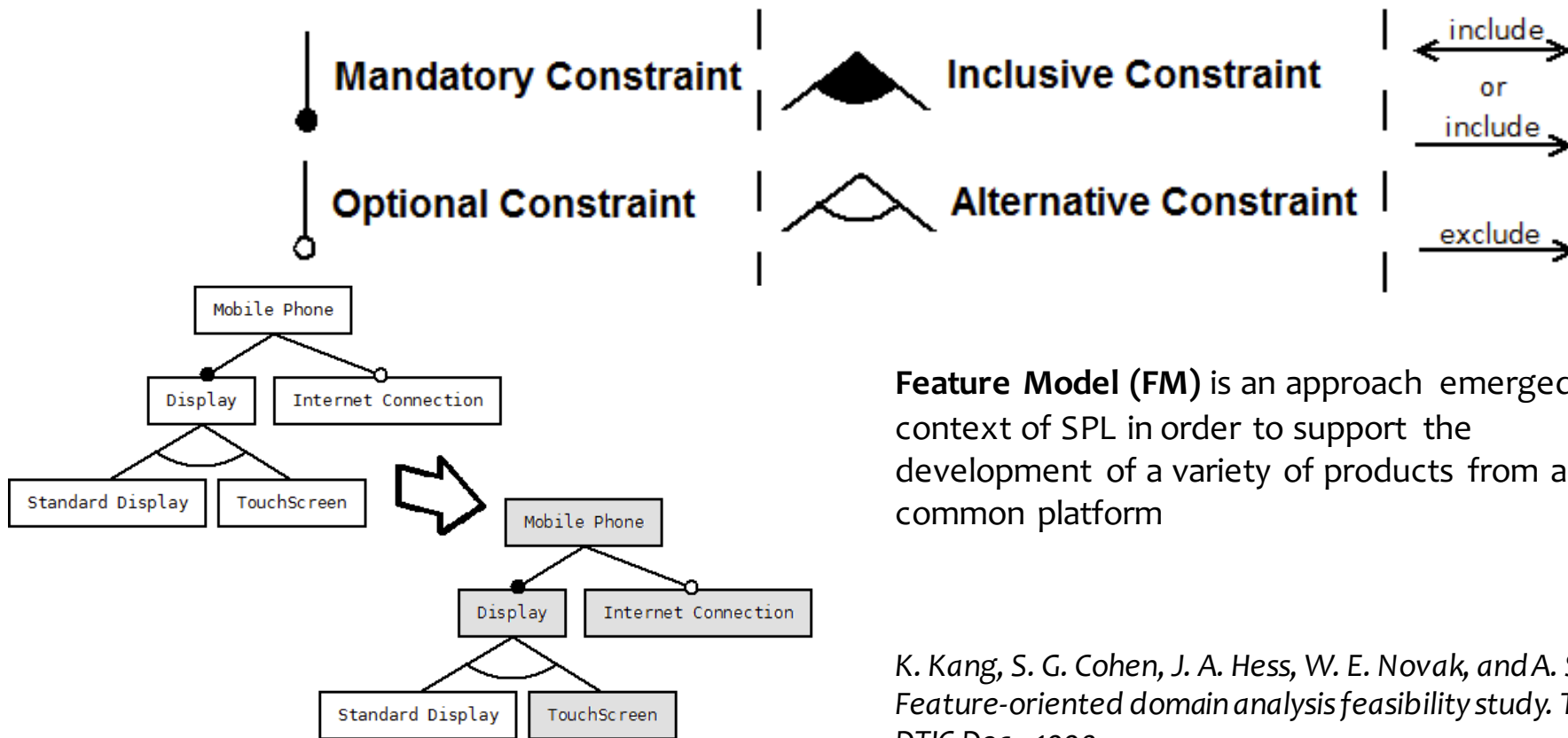
Feature Model (FM) is an approach emerged in the context of SPL in order to support the development of a variety of products from a common platform

K. Kang, S. G. Cohen, J. A. Hess, W. E. Novak, and A. S. Peterson. Feature-oriented domain analysis feasibility study. Technical report, DTIC Doc., 1990.
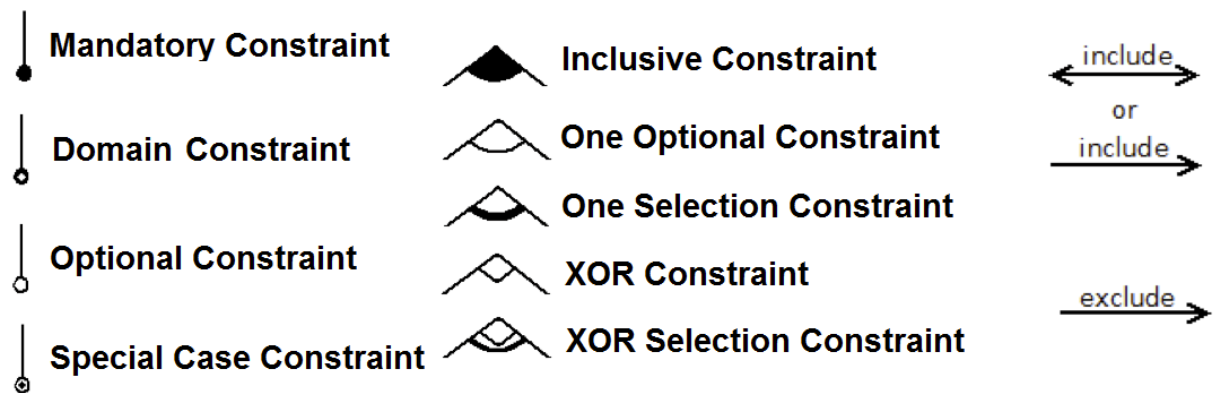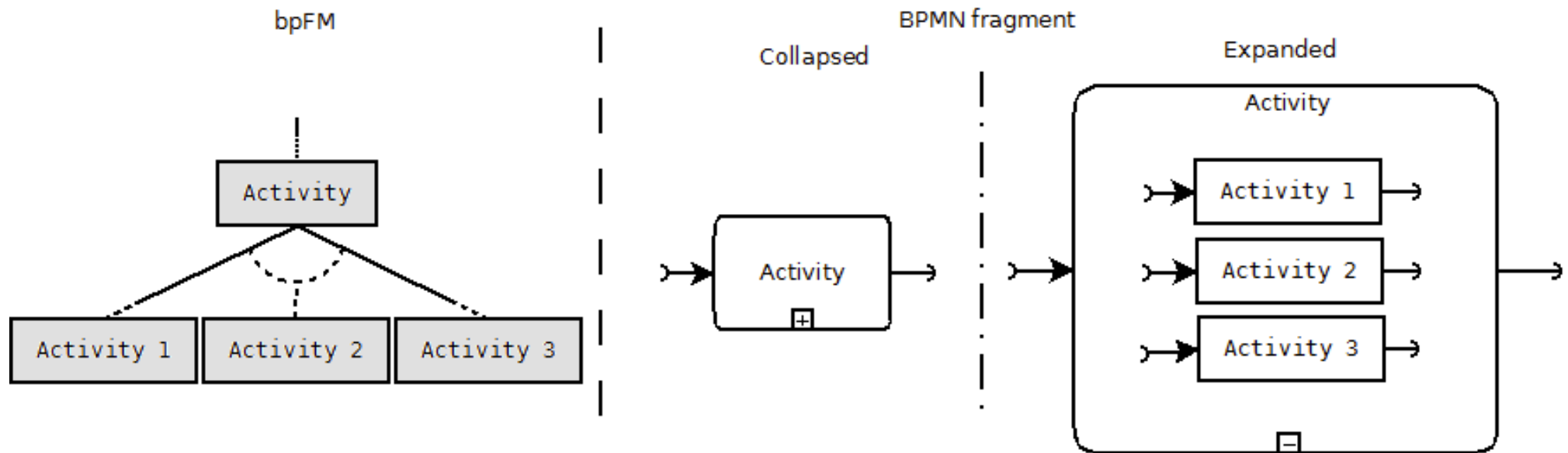
Background Knowledge: BPMN 2.0

BPFM Notation

In **BPFM** features represent the activities (sub-processes and task) characterizing a BP and constraints specify if activities have to be inserted in a BP variants and if activities have to or can be executed Information concerning the input and output data object are included, they are related to an activity

|		
Mandatory Constraint	Inclusive Constraint	include
Domain Constraint	One Optional Constraint	or include
Optional Constraint	One Selection Constraint	
	XOR Constraint	
Special Case Constraint	XOR Selection Constraint	exclude

Mapping BPFM Activities to BPMN

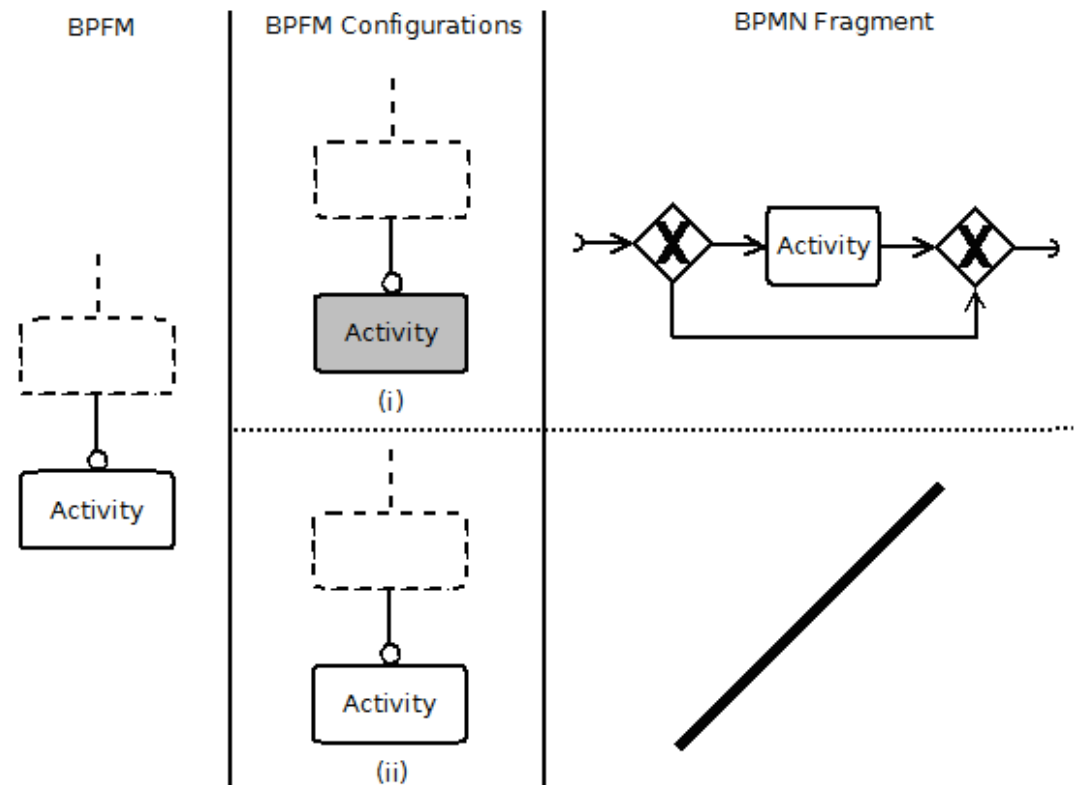# Mandatory Constraints Mapping to BPMN

It asks for including the child activity in each execution path since it has to be always selected
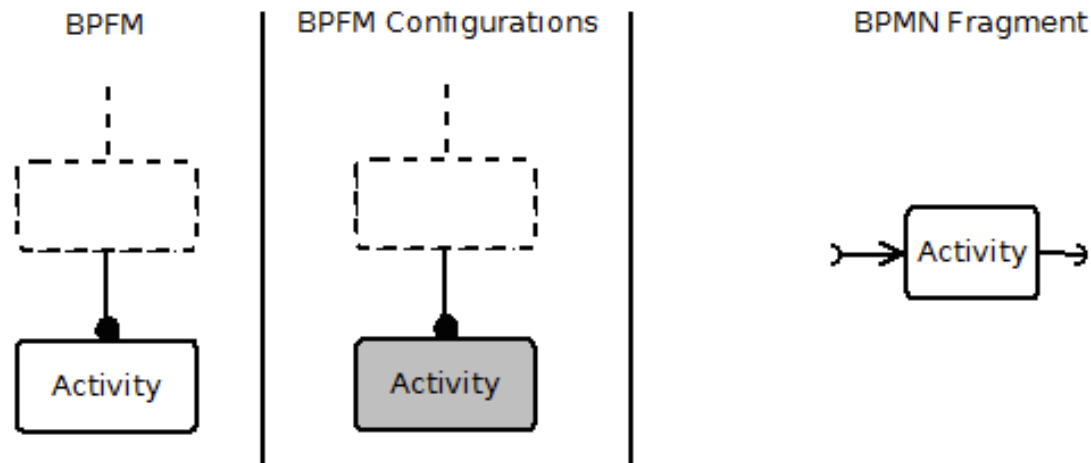
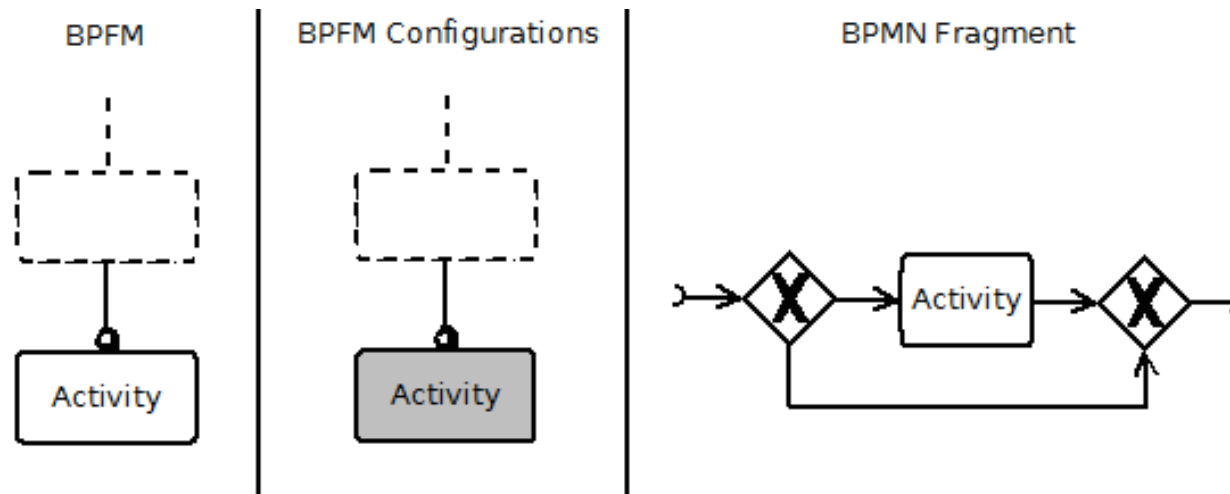# Optional Constraints Mapping to BPMN

It asks for a **combination of an activity and gateway** conditions when the child activity is selected (letter i), so that two execution paths of the fragment are possible, one including the activity and the other one not

When the activity is not selected it results with **no mapping** (letter ii)
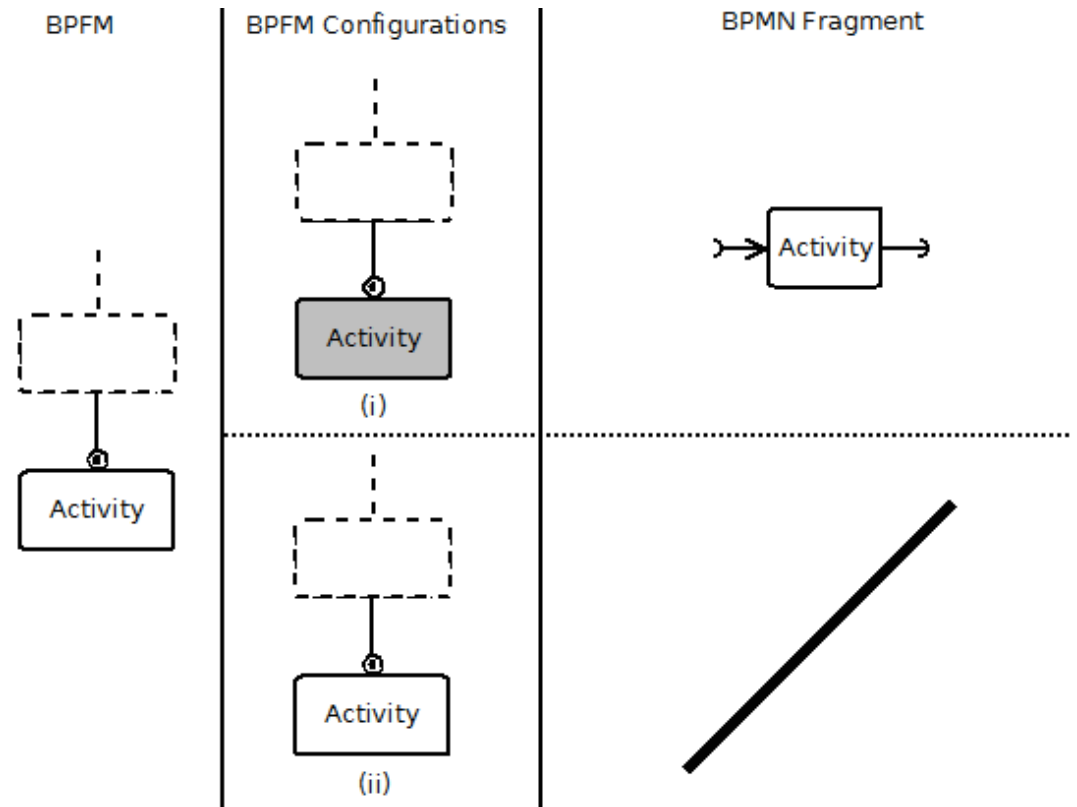
Domain Constraints Mapping to BPMN

- It asks for a **combination of the activity** since it has to be always selected and gateway conditions, so that two execution paths of the fragment are possible, one including the child activity and the other one not

Special Case Constraints Mapping to BPMN

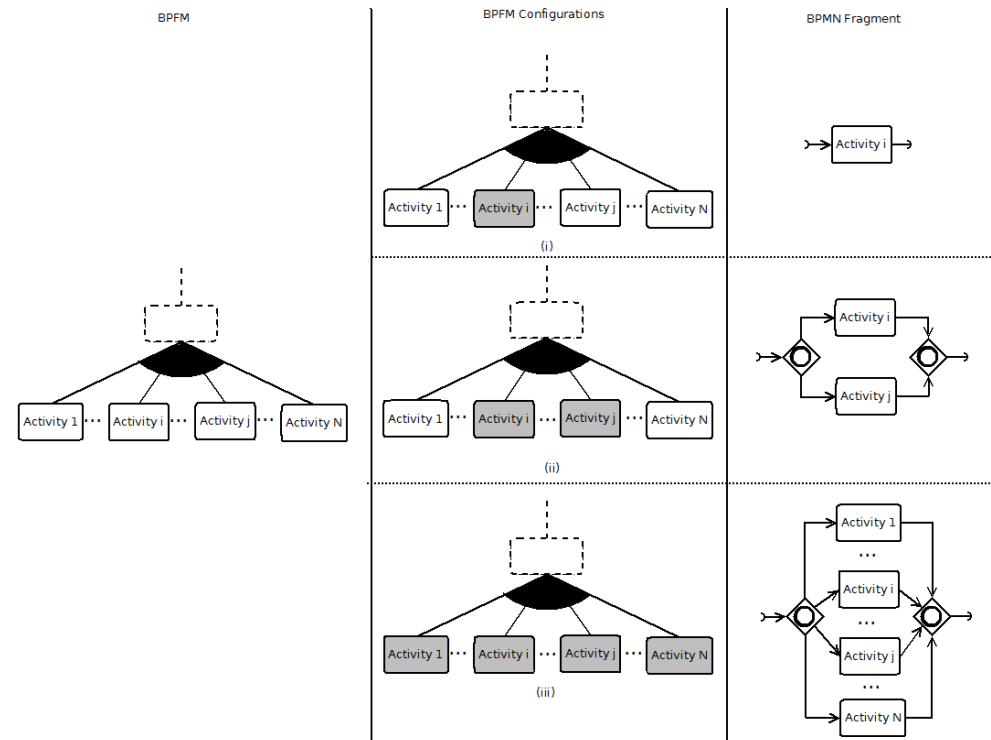It asks for including the child activity in the execution path of the fragment if selected (letter i)

When the activity is not selected it results with no mapping (letter ii)

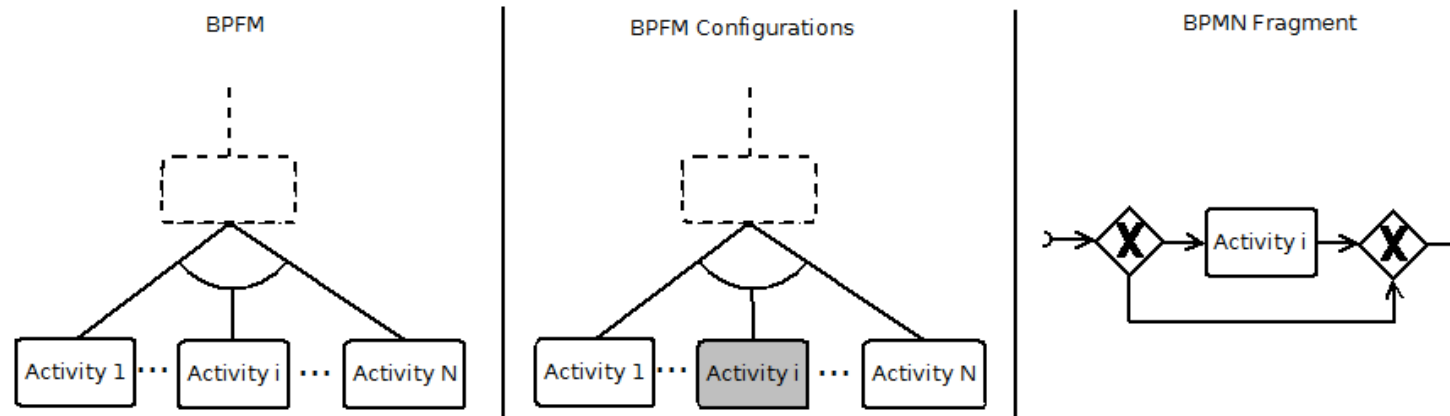# Inclusive Constraints Mapping to BPMN

It asks for a combination of the selected child activities and inclusive gateway conditions with a default path, so that multiple paths in the fragment are supported

- In case only one activity is selected it is mapped as an activity in the execution path of the fragment (letter i)

- Otherwise if two (letter ii) or more activities are selected all of them are included in the fragment

- Finally, it could be possible that all the activities in the BPFM are selected (letter iii), then all of them are included in the fragment
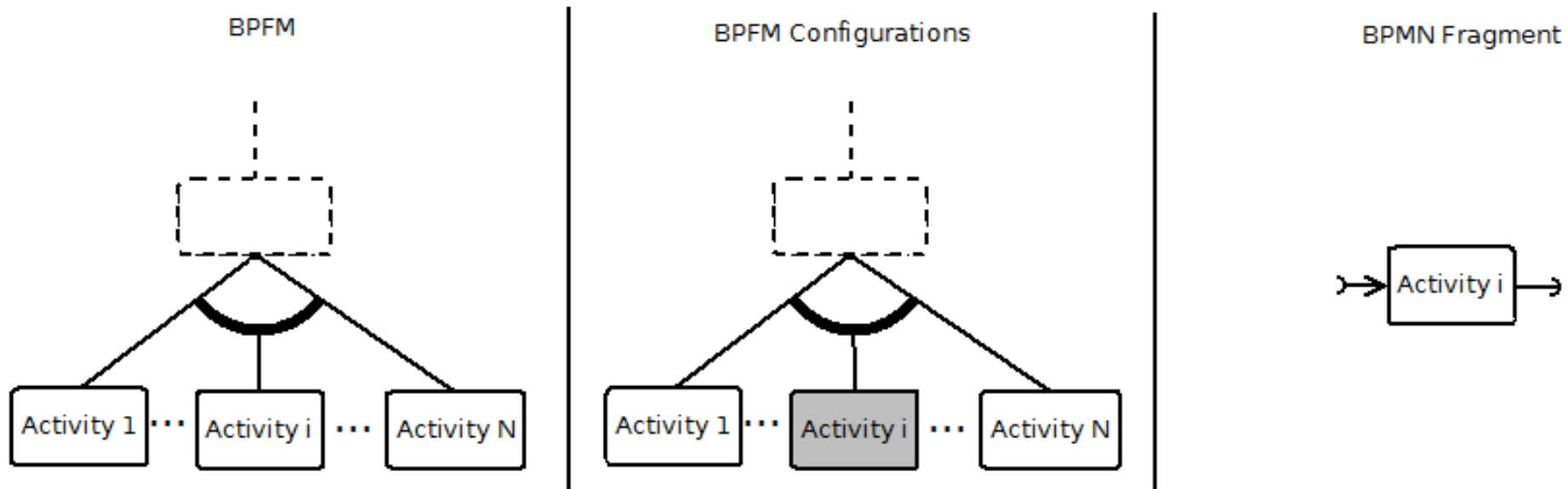
One Optional Constraints Mapping to BPMN

It asks for a combination of an activity and gateway condition, when the child activity is selected (assuming that exactly one activity has to be selected) than two execution paths of the fragment are possible one including the activity and the other one not

One Selection Constraints Mapping to BPMN

It asks for including the selected activity in the execution path of the fragment since at least one child activity has to be selected
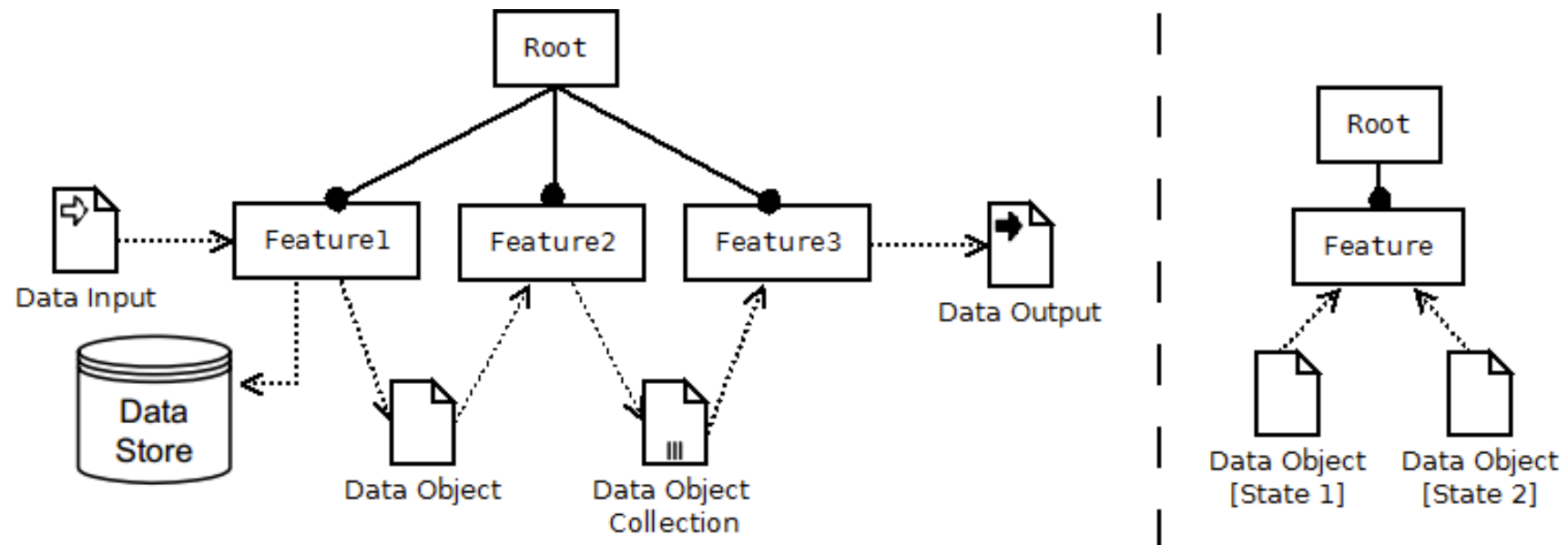
XOR Constraints Mapping to BPMN

It asks for a combination of the selected child activities and exclusive gateway conditions, so that alternative paths are supported in the execution path of the fragment
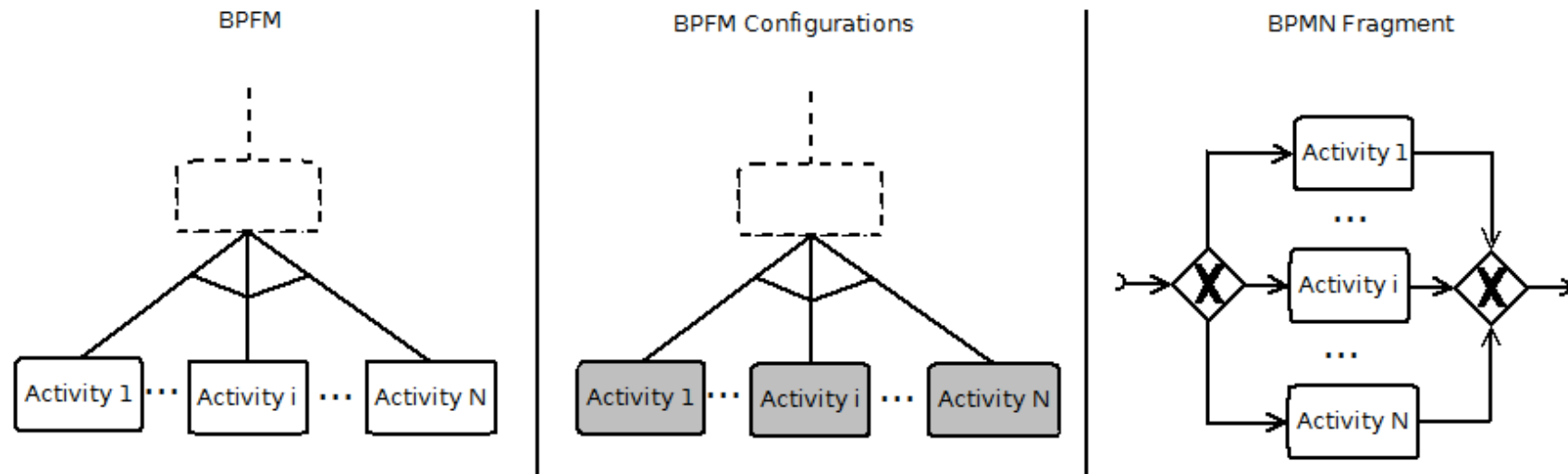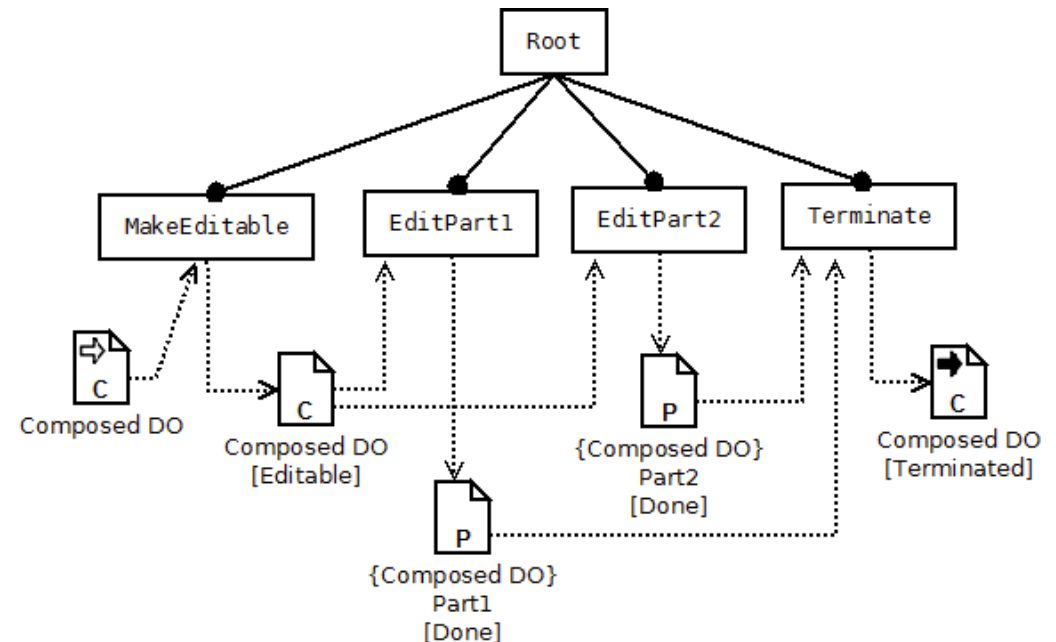
Data Objects in BPFM

BPFM manages all types of **BPMN 2.0 data objects**, including data object states, with the same modelling notation

Data Objects in BPFM

- BPFM introduces the notion of **composite** and **part of** data objects

- The state of a composed Data Object is not deduced by the states of the single parts
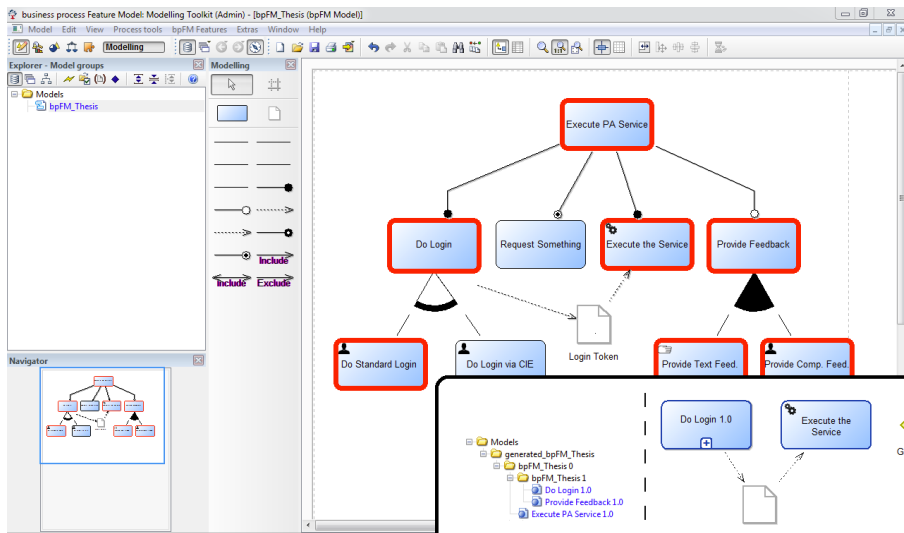
Cognini, R., Corradini, F., Polini, A., Re, B.: Using data object ow relations to derive control ow variants in congurable business processes. In: Business Process Management Workshop on Data Artifact-centric BPM 3th workshop, BPMW. Eindhoven (Netherland) 8 September, 2014.

Data Mapping to BPMN

BPFM Tool Based on ADOxx

http://book.omilab.org/psm/content/bpfm/info
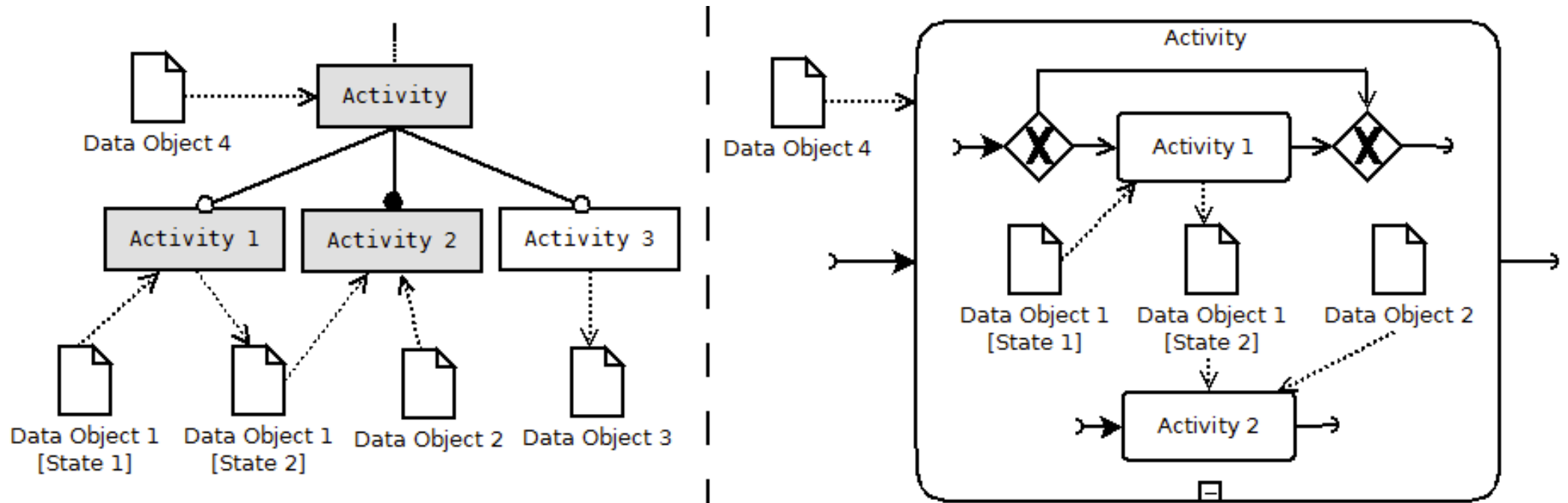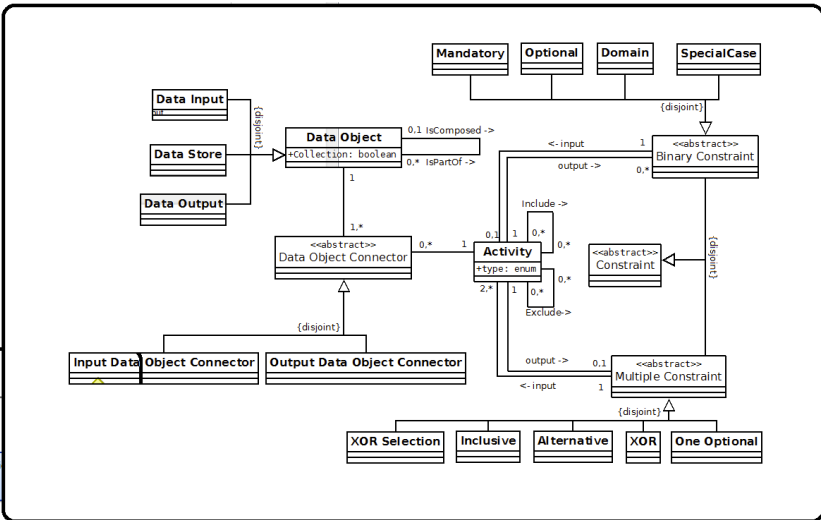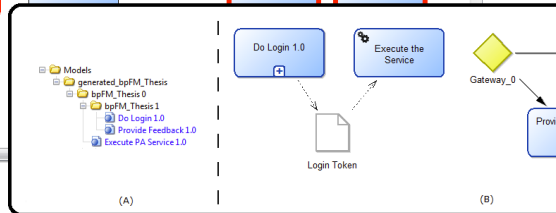
BPFM Validation in Public Sector (Smart Cities)

- **Public Administrations** engage in complex interactions in order to provide services to citizens and companies

- **Public Service** related activities can be modelled and analysed using notation and tools based on Business Process abstractions

Even if PAs share the same goal each of them can have different organizational structure depending on the PA self-organization capability

- In PA law partially denes the activities to be performed, their temporal order and the needed data-objects (global specification)

- Each PA autonomy reacts according to internally requirements (local implementation), BPs are differently implemented

Cases Studies

- Sportello Unico Attivita Produttive (SUAP)
  - It refers to the activities that the Italian PAs have to put in place in order to permit to entrepreneurs to set up a new company Since December 2009, companies and individuals must be able to complete online all necessary formalities accessing to a single contact point (one stop shop) constituted by the SUAP system (at national level - www.impresainungiorno.gov.it)

- European Project Budget Reporting (EPBR)
  - It refers to the activities that an Italian public research body (in reference to its administrative ofices) has to put in place in order to manage the administrative procedures related to the participation to a European research project

- From LearnPAd EU project http://www.learnpad.eu

EU Project Reporting

- The participation to a EU financed project obliges the beneficiaries in budget reporting activities as evidence of the work performed within the project

- A configuration refers to the UniCam internal organization referring to a specific type of project

- We refer to the reporting procedures for FP7

- The grant management BP has been selected as reference point and we consider the periodic budget reporting Business Process

- **European Union reference regulations**
  - REGULATION (EC) No 1906/2006 OF THE EUROPEAN December 2006 - laying down the rules for the participation of undertakings, research centers and universities in actions under the Seventh Framework Program and for the dissemination of research results (2007-2013).
- **National (Italian) Guideline reference regulations**
  - Law no. 240 of 30 December 2010 concerning the organization of Universities (the so-called Gelmini law), all Faculties have now been substituted by new organizational structures, i.e. Departments. These Departments are the principal center for scientific research, teaching and training.
  - Legislative Decree No 163 of 12 April 2006 - Code of public contracts of works, services and supplies in implementation of Directives 2004/17/EC and 2004/18/EC.
- **Local (UniCam university) reference regulations**
  - Statute of the University of Camerino (Rector Decree N. 194, July 30th 2012 and published in the Official Journal of the Italian Republic n. 200, August 28th 2012).
  - Some Internal rules and procedure (Mobility Regulation, Research Activity Regulation, Budget Management Regulation, etc)
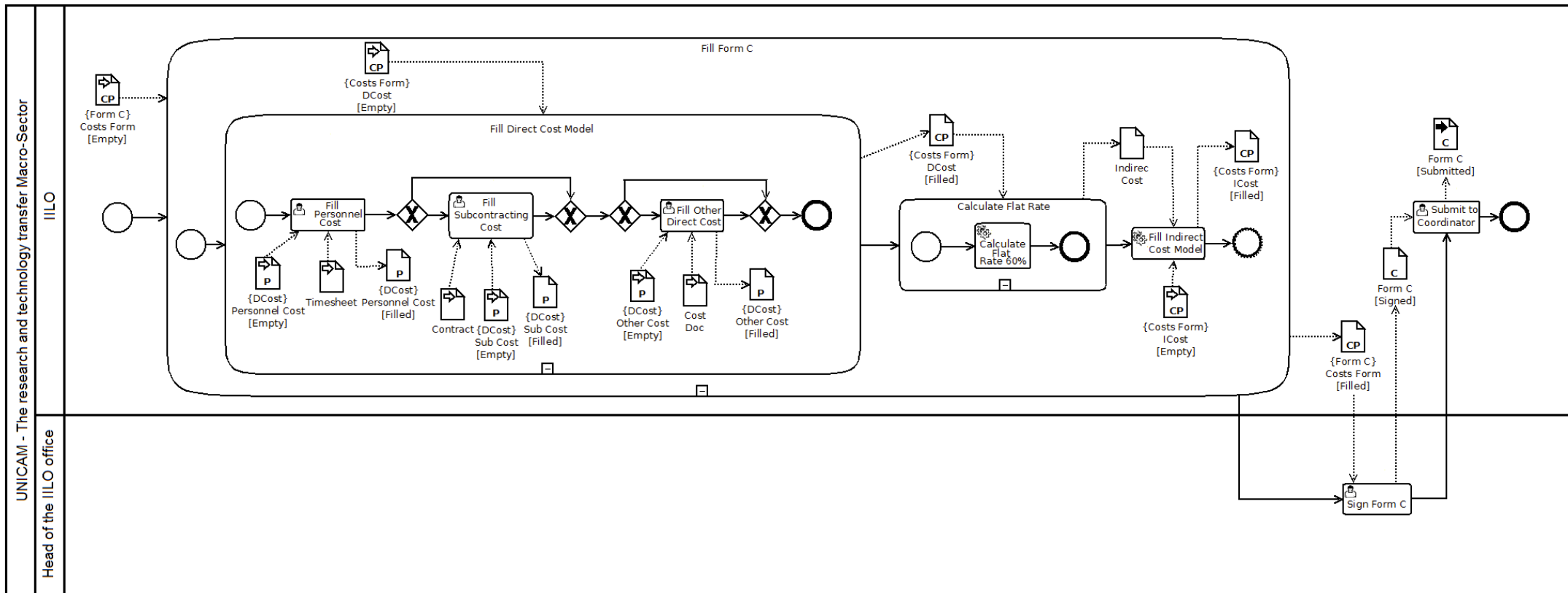
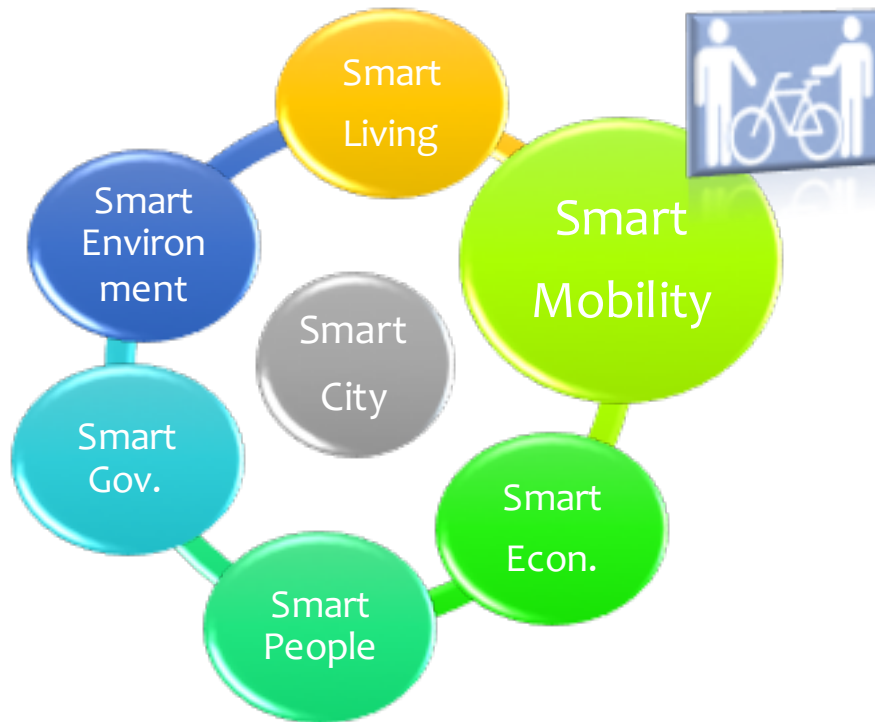# Participant Periodic Report: BPFM configuration
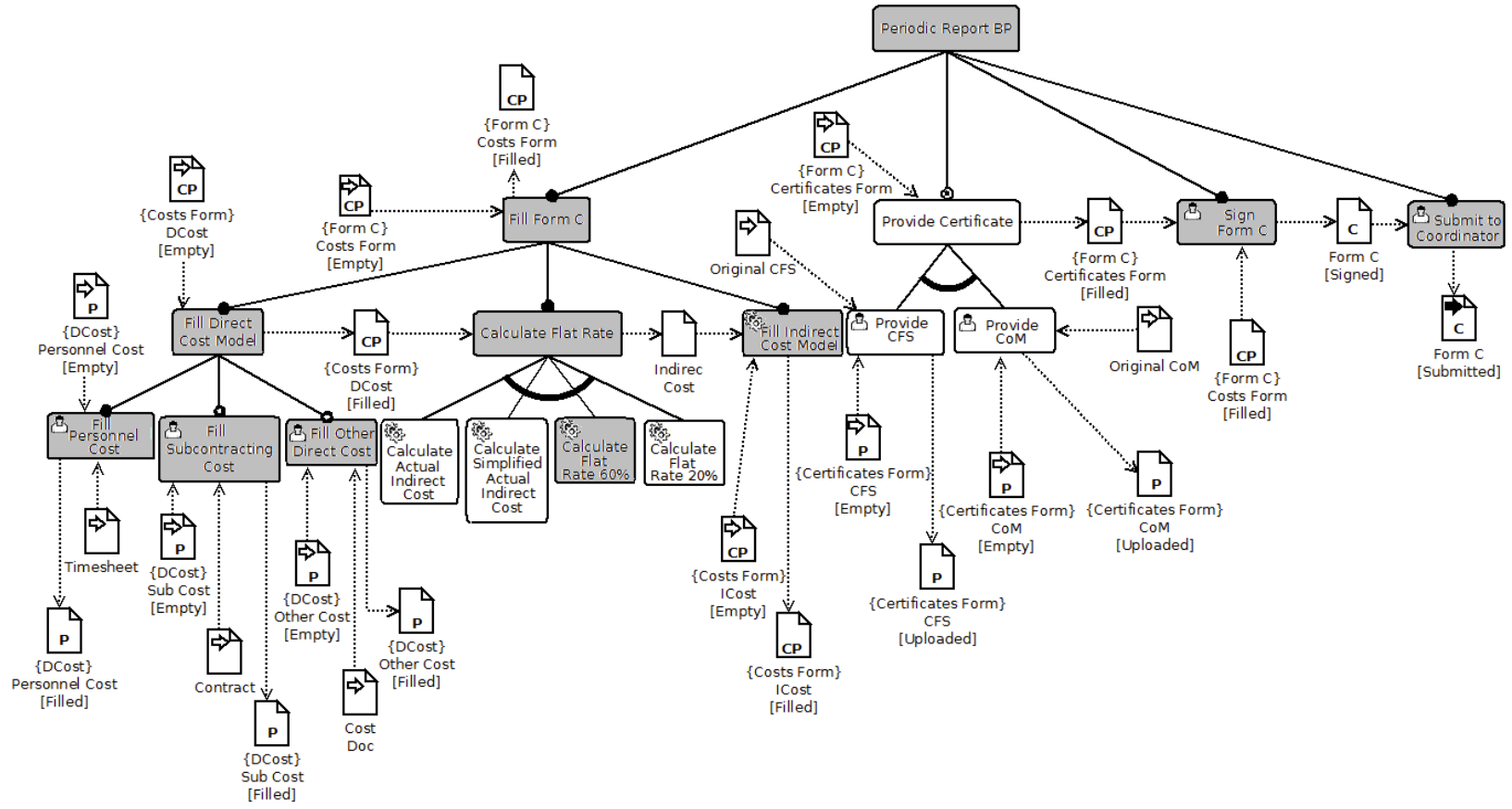
Participant Periodic Report: the Fragments Derivation
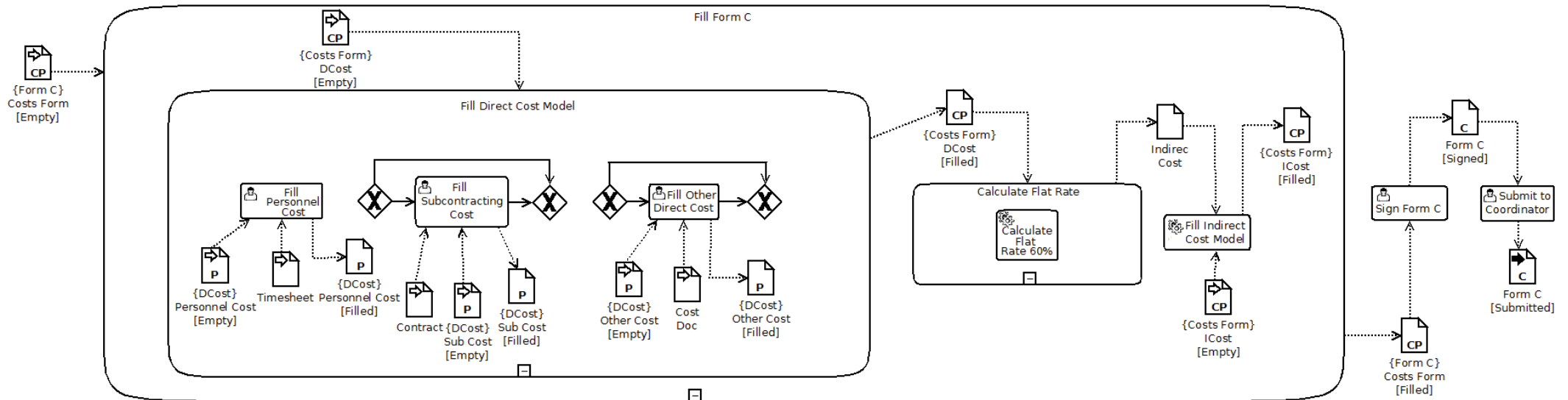
Participant Periodic Report: a BP Variant

Modeling Variability in Smart City Scenario

Bike Sharing System (BSS)

- Today more than 500 cities in 49 countries host BSS
- Wide spectrum for possible deployments
- Local laws, local habits, land's morphology, climate, among others

- Business Processes
  - User Registration
  - Bike Travel
  - Bike's Maintenance
  - Station Re-balancing
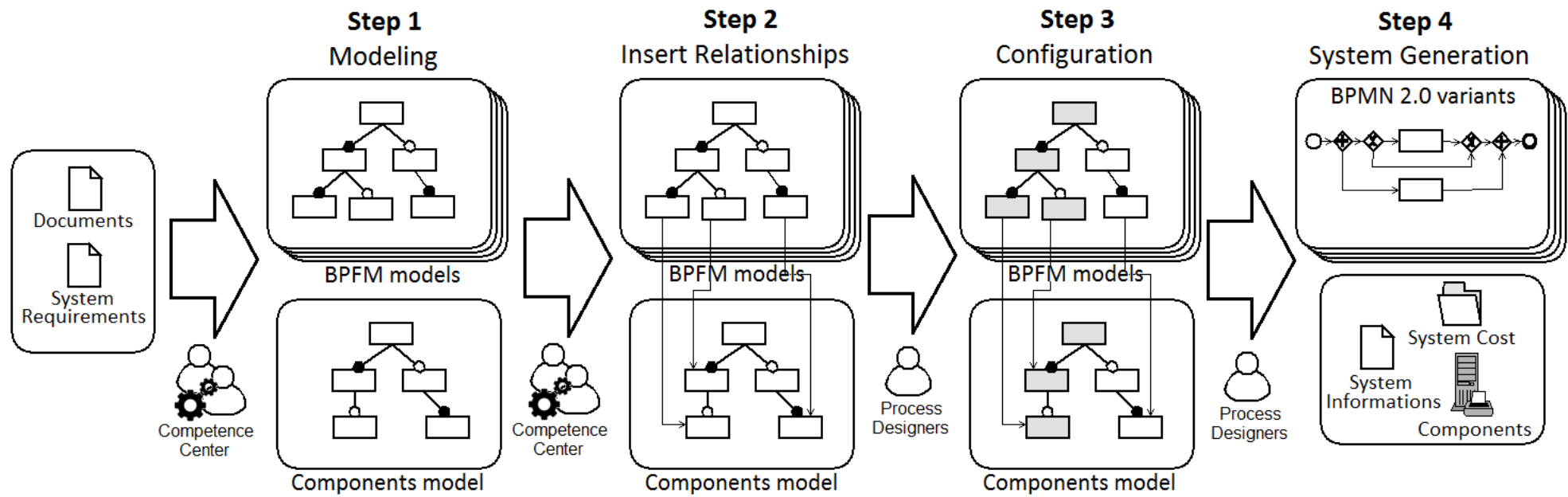
# Smart City scenario - Bike Sharing System

Bike Travel BP

Variation Points

- Check state of stations (Req1)
- Payment methods (Req2)
- Use of helmets (Req3)
- Bike's monitoring systems (Req5)
- Maintenance during trip (Req4)
- Citizens' Watch: Contributing with route problem (Req7)
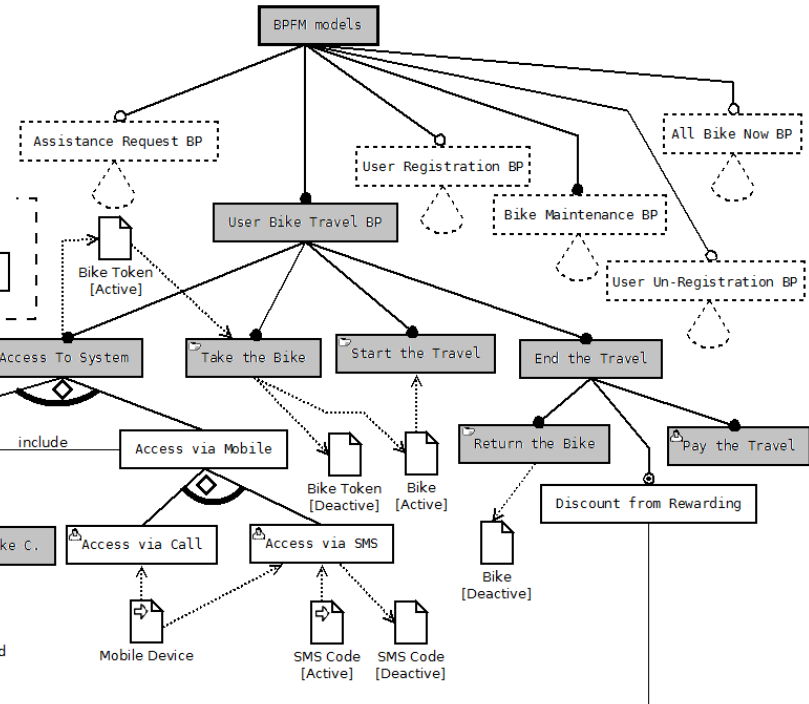- P2P Freights (Req8)
- Bike's return (Req6)

SWIPE OUT

RIDE!
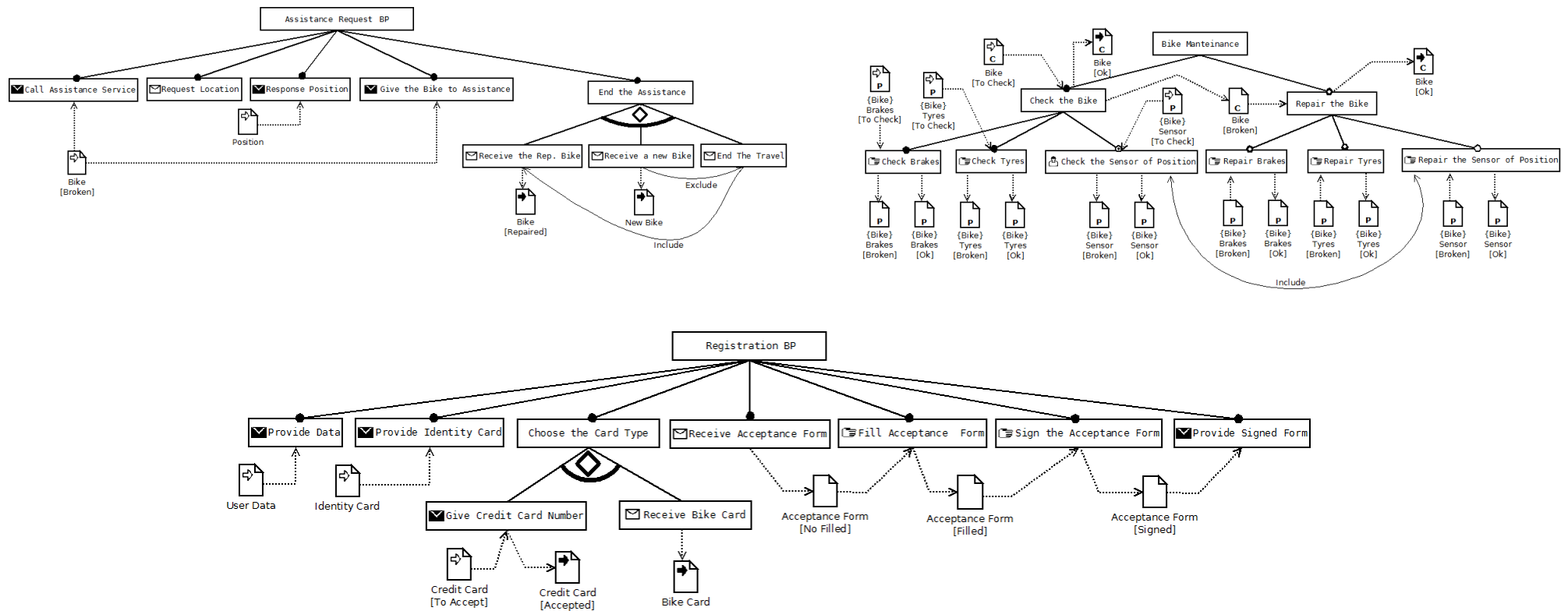
DOCK

Not only BP but also Components
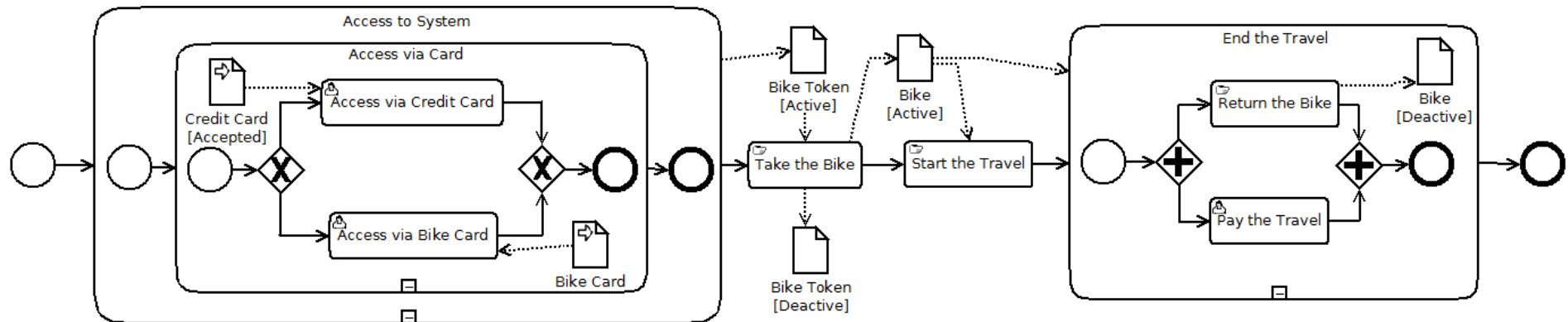
FM Configuration
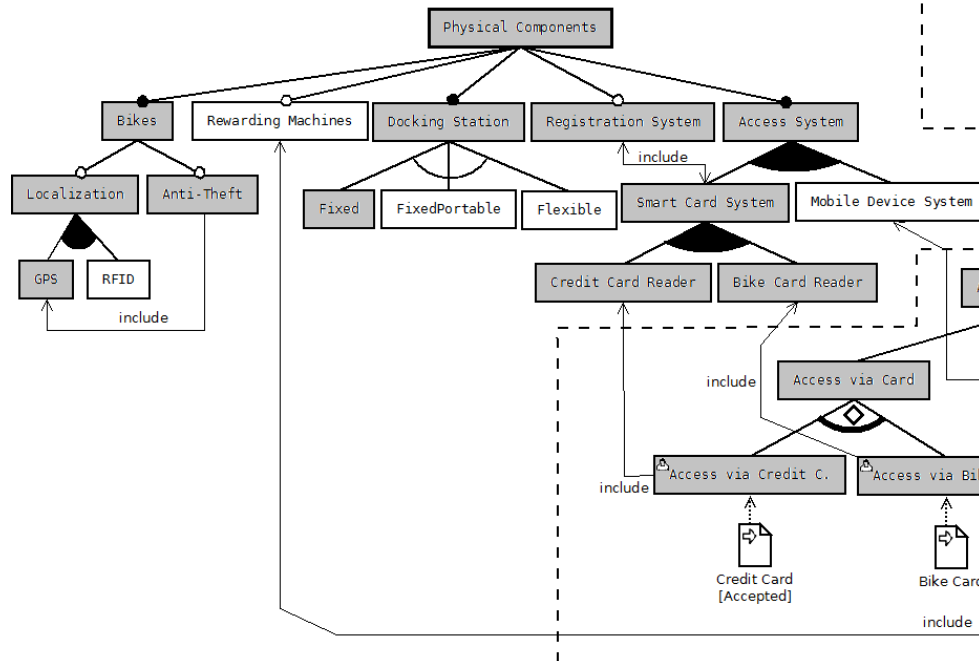
All the other Business Process Families

A supported Variant

Conclusions and Future works

- Variability needs to be more and more taken into account also in order to reduce costs; we presented an **approach to model variability of BP permitting to include in a single model many different variants of the same BP**

- We focused on **more than one perspective** during modelling activities

- There are many items in the future work list, among the others
  - Continue experiments and validation
  - The approach does not provide mechanisms to verify that derived BP variants are correct
  - Adopt the approach to drive run-time adaptation , in particular exploring the use of fragments

Reference Publications

BPFM Notation and Approach

- **R. Cognini, F. Corradini, A. Polini, B. Re. Business Process Feature Model: an approach to deal with variability of business processes. Domain-Specic Conceptual Modelling: Concepts, Methods and Tools. D. Karagiannis, H. C. Mayr, J. Mylopoulos (Editors), Springer, pp. 171- 194, 2016.**

- Cognini, R., Corradini, F., Polini, A., Re, B. Extending Feature Models to Express Variability in Business Process Models. In: Advanced Information Systems Engineering Workshops, CAiSE 2015, Stockholm, Sweden, June 8-9, (2015).

- Cognini, R., Hinkelmann, K., Martin, A. A Case Modelling Language for Process Variant Management in Case-based Reasoning. *AdaptiveCM 2015– 4th International Workshop on Adaptive Case Management and other non-workflow approaches to BPM* (2015).

- Cognini, R., Corradini, F., Fornari, F., Polini, A., Re, B. A Data Oriented Approach to Derive Public Administration Business Processes. In EGOV/ePart Ongoing Research (2015).

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