Business Process Flexibility

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Business Process Flexibility – an Overview

- **Flexibility** is always a multifaceted concept, and it can be defined in **different** ways depending on the considered **discipline**

- **Business Process flexibility** can be defined as the ability of an **organization** to deal with both **foreseen** and **unforeseen** changes, and in consideration of the **impact** they can have on the BPs regulating the activities of the **organization**

Flexibility Taxonomy

- **Variability** is the ability of deriving different variants from the same Business Process

- **Adaptation** is the ability to temporarily deviate the flow during the execution of a Business Process

- **Looseness** is the ability to execute a Business Process considering a specification in which aspects related to the decisions affecting the control flow are not fully defined or undefined

- **Evolution** is the ability to permanently modify a Business Process affecting all future Business Process enactments

Reichert, Manfred, and Barbara Weber. Enabling flexibility in process-aware information systems: challenges, methods, technologies. Springer, 2012.

Systematic Literature Review

- Since **much research** has been done on this topic a **better awareness** on the current state of knowledge is needed

- The **systematic literature review** helps to develop a **map** on **Business Process flexibility** with a special focus on *software systems related aspects*

  - It covers a spectrum of the state of the art from **academic point of view**
  - **It includes 164 research works from the main computer science digital libraries**

Methodology

- **A SLR aims to present a fair evaluation of a research topic by using a trust worthy, rigorous, and auditable methodology**

- We followed the **methodology** proposed by **Kitchenham**

- We highlighted some **research direction** that seem to deserve further attention by the community

Planning → Conducting → Reporting

Kitchenham, B. (2007). Guidelines for performing Systematic Literature Reviews in Software Engineering. Tech. rep., Keele University.

Planning the SRL

- Define research question

- Select digital library

- Automatic and manual search in digital library

- Specification of search criteria

Planning > Conducting > Reporting

Research Questions

- RQ1. What raises the **need** for BP flexibility?

- RQ2. Which **phases of the BP life-cycle** need to support flexibility?

- RQ3. Which are the **instruments** used to express and support BP flexibility?
  - RQ3.1 Which are the **languages** used and extended to express BP flexibility?
  - RQ3.2 Which are the **mechanisms** introduced to support BP flexibility?

- RQ4. Are there any **validation** of BP flexibility **instruments**?

Planning Conducting Reporting

Developing the SRL Protocol: Digital Library and Query

- We selected the main digital libraries in computer Science Area:
  IEEExplorer, ACM Digital Library, Citeseerx Library, ScienceDirect, SpringerLink, ISI Thompson Reuters Web of Science

((TITLE = (business process OR business processes OR business process management OR BPM OR Process Aware Information System OR PAIS OR BPMN) AND (TITLE = (flexibility OR flexible OR variability OR variant OR adapt OR adaptation OR adaptivity OR adaptive OR evolve OR evolution OR loosness) OR (ABSTRACT = (flexibility OR flexible OR variability OR variant OR adapt OR adaptation OR adaptivity OR adaptive OR evolve OR evolution OR loosness OR dynamic OR self-adaptation OR context-awareness OR context-aware))

Planning Conducting Reporting

Developing the SRL Protocol: Inclusion and Exclusion Criteria

ID	Inclusion Criteria
I.1	The paper is a primary study
I.2	The paper must be published after 2000 (included)

ID	Exclusion Criteria
E.1	The paper does not relate to software systems aspects in the context of BPM
E.2	The paper is not written in English Language

Planning Conducting Reporting

Conducting the SRL

- Identify the Papers

- Selection of Papers

- Data Extraction and Synthesis

Planning Conducting Reporting

Identification and Selection of Paper
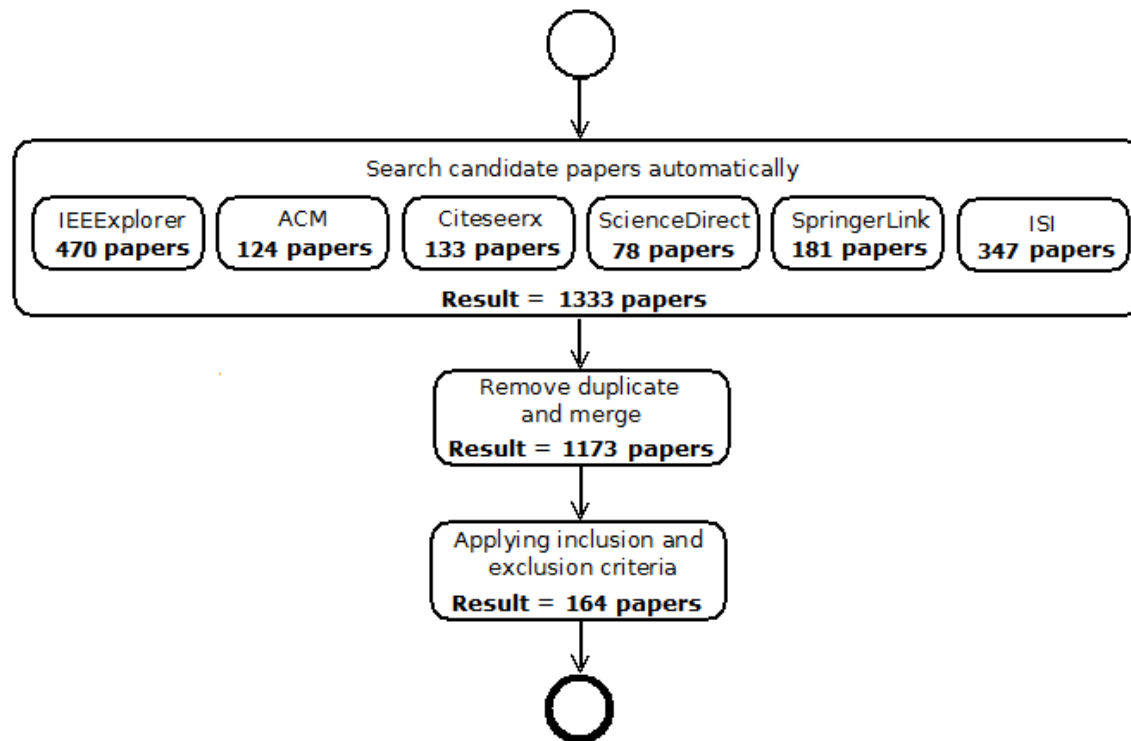
Data Extraction and Synthesis

Research Questions	Attributes
All	Title, publication year, publication venue and publication type
RQ1	Exceptions, Technology Evolution, New Working Methods, Changes in Low, Changes in the Target Goal, Saving
RQ2	Design/Modelling, Analysis, Enactment/Execution, Monitoring/Improvement
RQ3.1	Language Independence, BPMN, BPEL, UML, Petri-Net, Process Algebra, Declarative Model
RQ3.2	Process Family, Business Rule, Event Management, Case Based, Edit BP, Algorithm, Pattern, Modularity
Flexibility Taxonomy	Variability, Adaptation, Looseness, Evolution

Planning > Conducting > Reporting

Reporting

- Overview of the results

- Answer the question
    i.   Emerging needs for BP flexibility
    ii. The flexibility impact on BP life-cycle
    iii. Instruments (language and mechanisms) used to express and to support BP flexibility
    iv. Available case studies on the real usage of flexible BP languages and mechanism

Planning   Conducting   Reporting

Summary of Papers by Publication Type and by Publication Year

	2000	2001	2002	2003	2004	2005	2006	2007	
Conference	0	0	1	2	3	7	8	7	
Journal	1	1	0	0	1	2	1	0	
Workshop	1	0	1	0	0	0	4	1	
Other	0	0	0	0	0	0	0	0	
Total	*2*	*1*	*2*	*2*	*4*	*9*	*15*	*8*	
	2008	2009	2010	2011	2012	2013	2014	2015	Total
Conference	14	7	12	19	11	7	3	1	*104*
Journal	3	3	5	4	3	7	6	0	*39*
Workshop	0	1	0	4	3	2	2	0	*18*
Other	1	1	0	0	0	0	1	0	*2*
Total	*18*	*12*	*17*	*27*	*17*	*16*	*12*	1	**164**

Papers Distribution by Publication Year
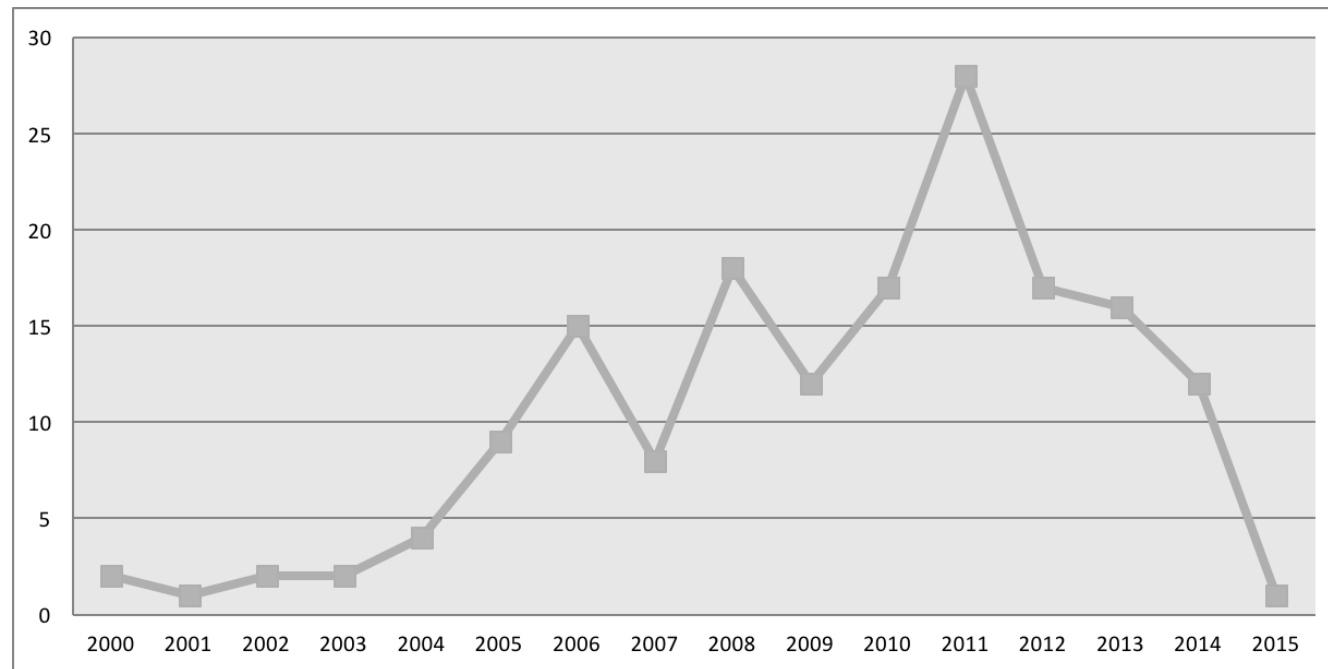
Papers Distribution by Main Events or Journals
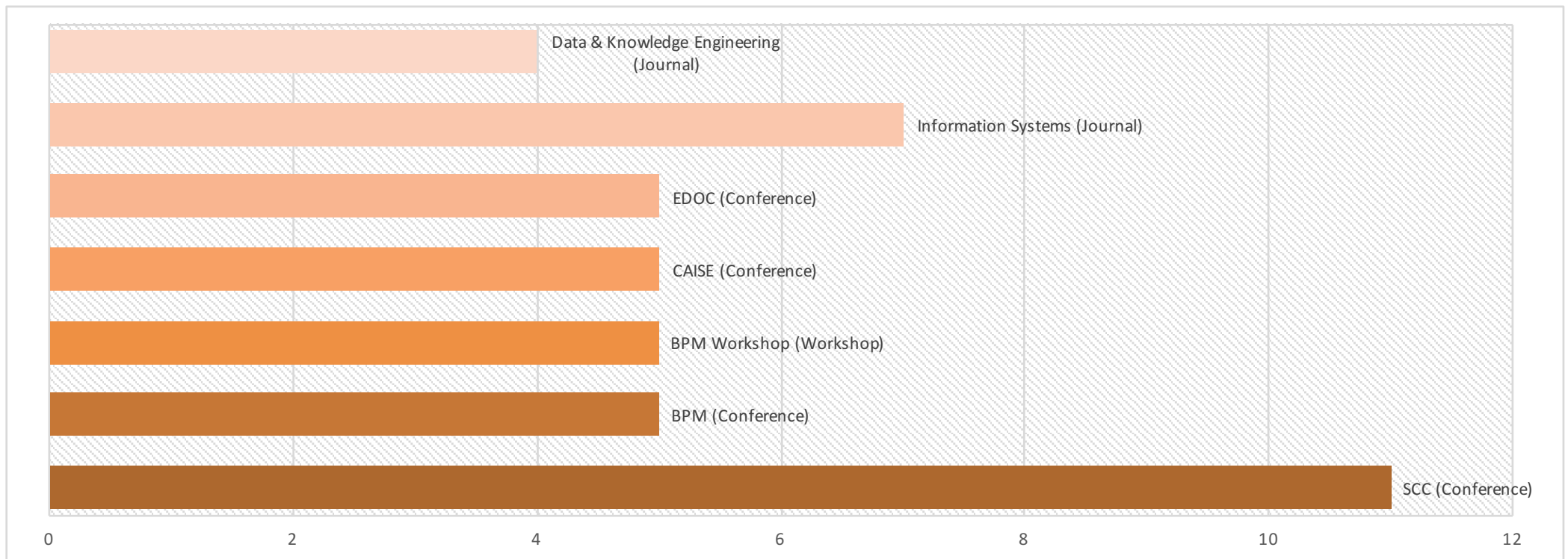
Papers Distribution by the Needs for BP Flexibility (RQ1)
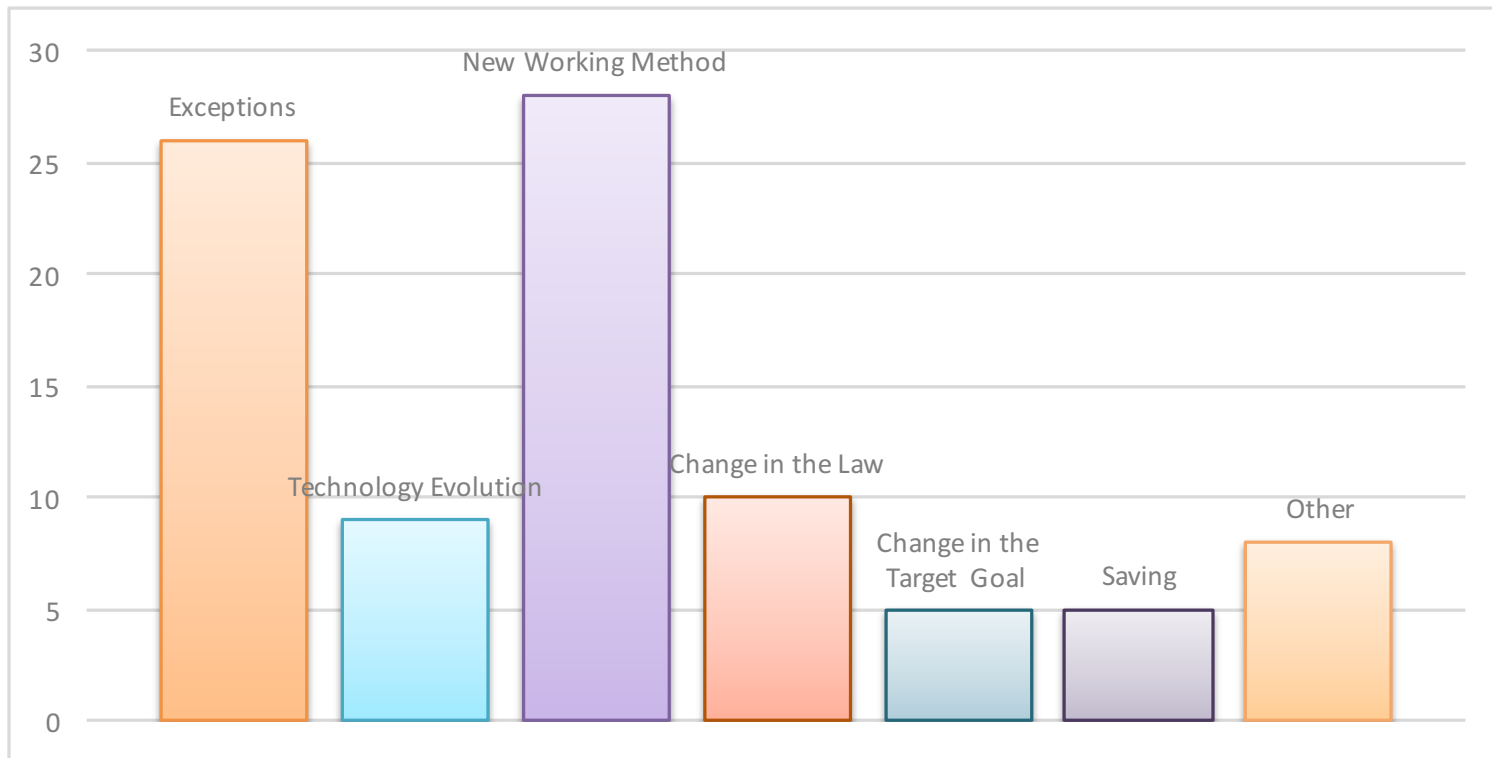
Category	Number of Paper	%
Exceptions	26	37%
Technology Evolution	9	13%
New Working Method	28	40%
Change in the Law	10	14%
Change in the Target Goal	5	7%
Saving	5	7%
Other	8	11%

Number of Papers presenting a specific need	70	43%

Papers Distribution by BPM Life Cycle (RQ2)
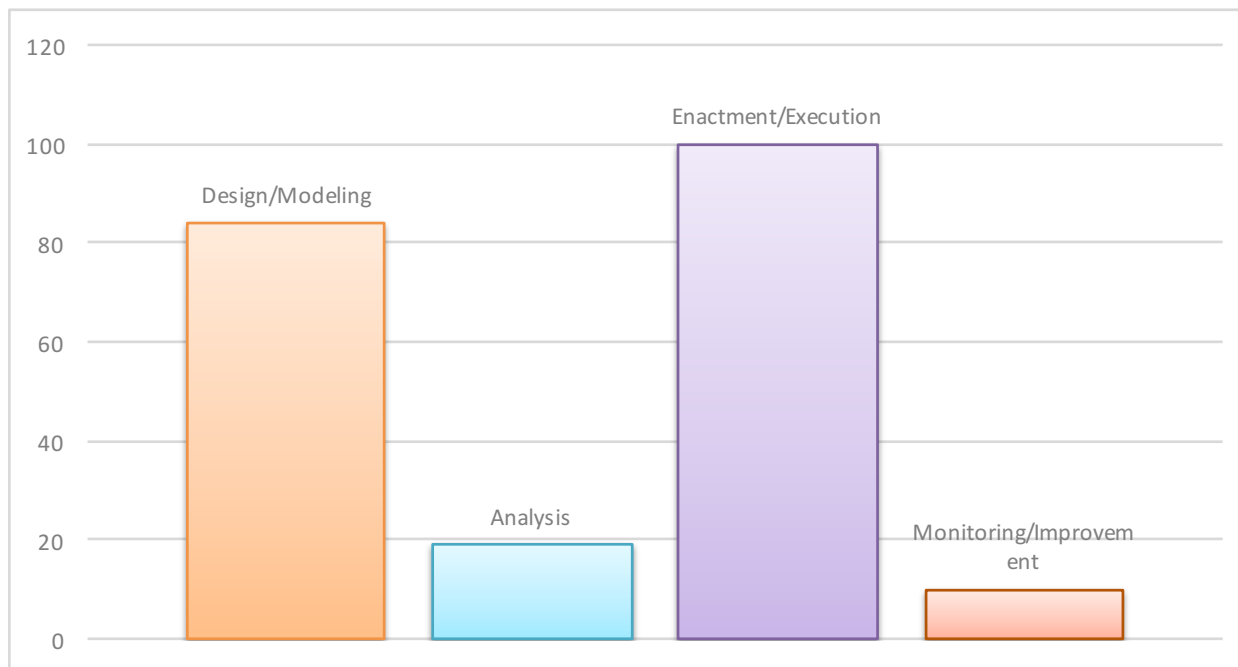
Category	Number of Paper	%
Design/Modeling	84	52%
Analysis	19	12%
Enactment/Execution	100	61%
Monitoring/Improvement	10	6%

	Number of Paper	%
Number of Papers referring a spcific phase of the BP life cycle	163	99%

Papers Distribution by Modelling Languages (RQ3.1)
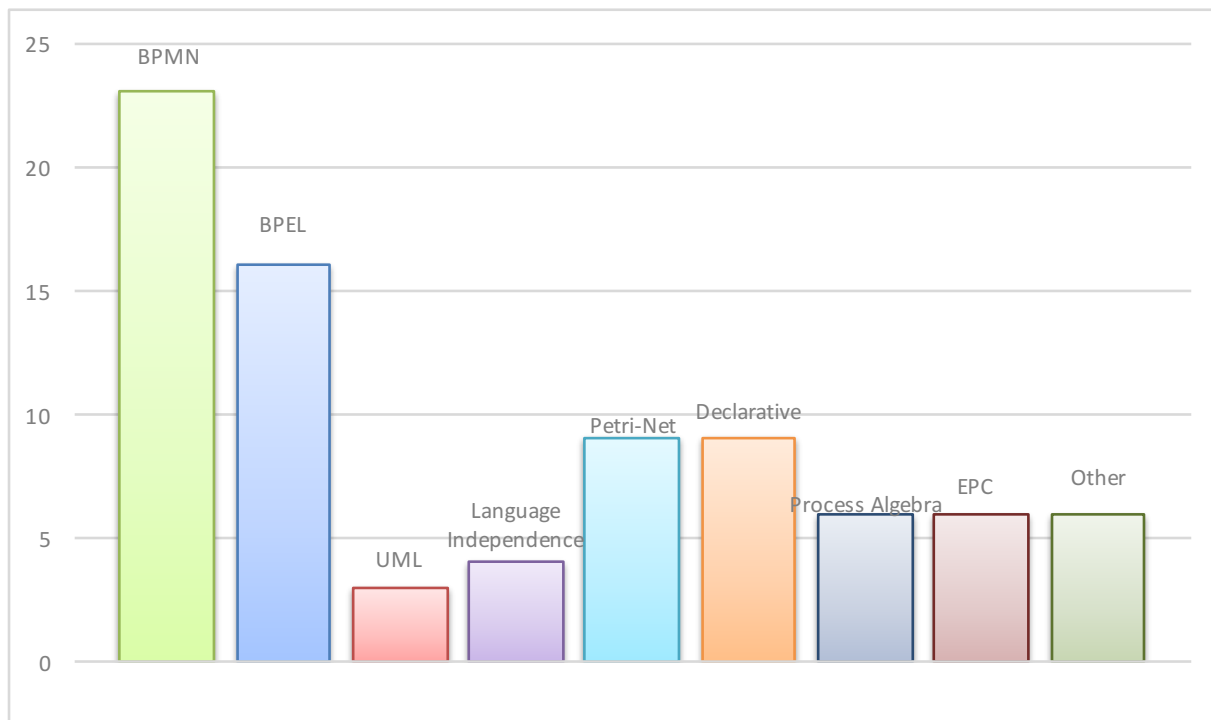
Categories	N.Paper	%
BPMN	23	28%
BPEL	16	20%
UML	3	4%
Language Independence	4	5%
Petri-Net	9	11%
Declarative	9	11%
Process Algebra	6	7%
EPC	6	7%
Other	6	7%

Number of Paper Refferring a specific language		
	81	49%

Papers Distribution by Mechanisms (RQ3.2)
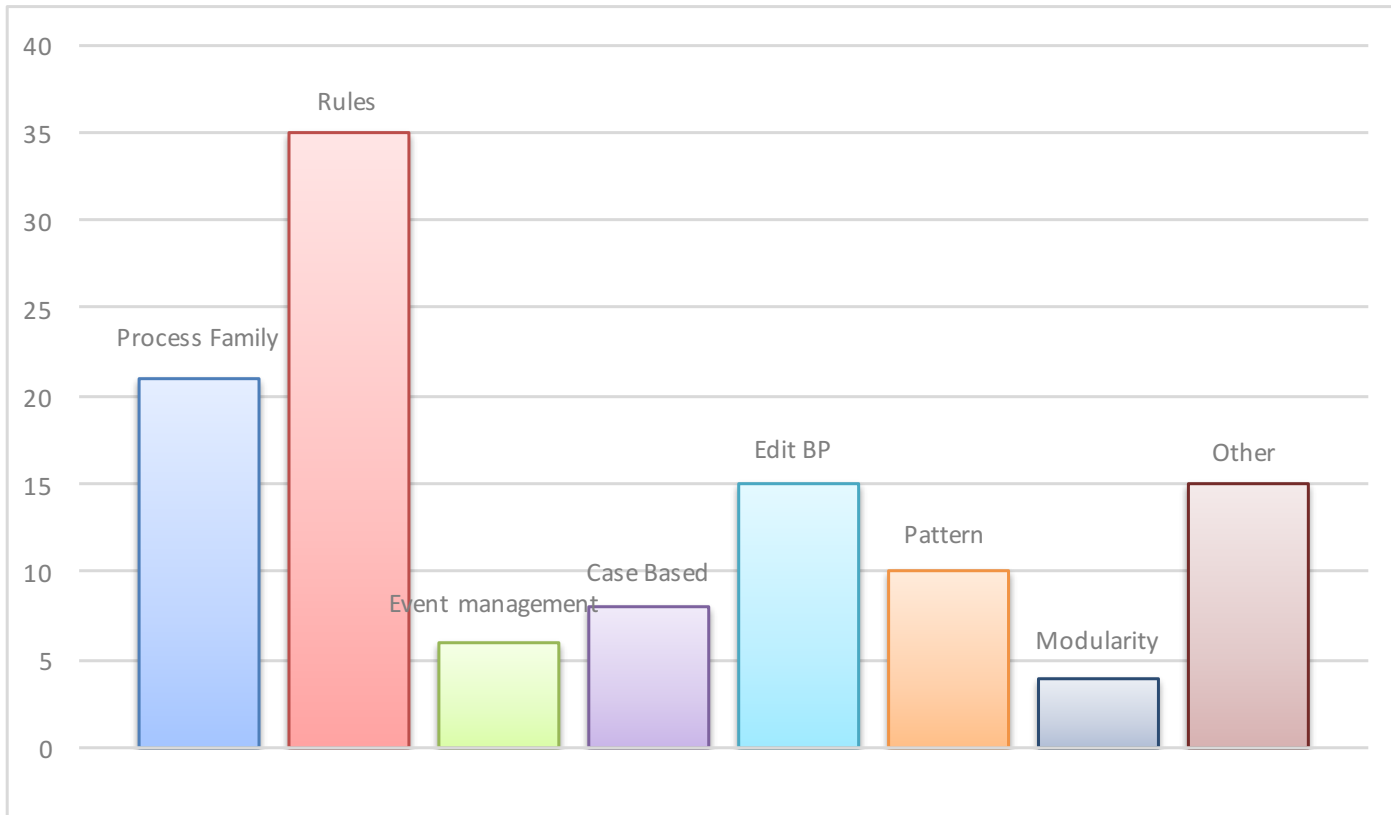
Category	Number of Paper	%
Process Family	21	19%
Rules	35	32%
Event management	6	5%
Case Based	8	7%
Edit BP	15	14%
Pattern	10	9%
Modularity	4	4%
Other	15	14%

Number of Paper Refferring a specific mechanism	110	67%

Languages Used in the Different BPM Life-Cycle Phases
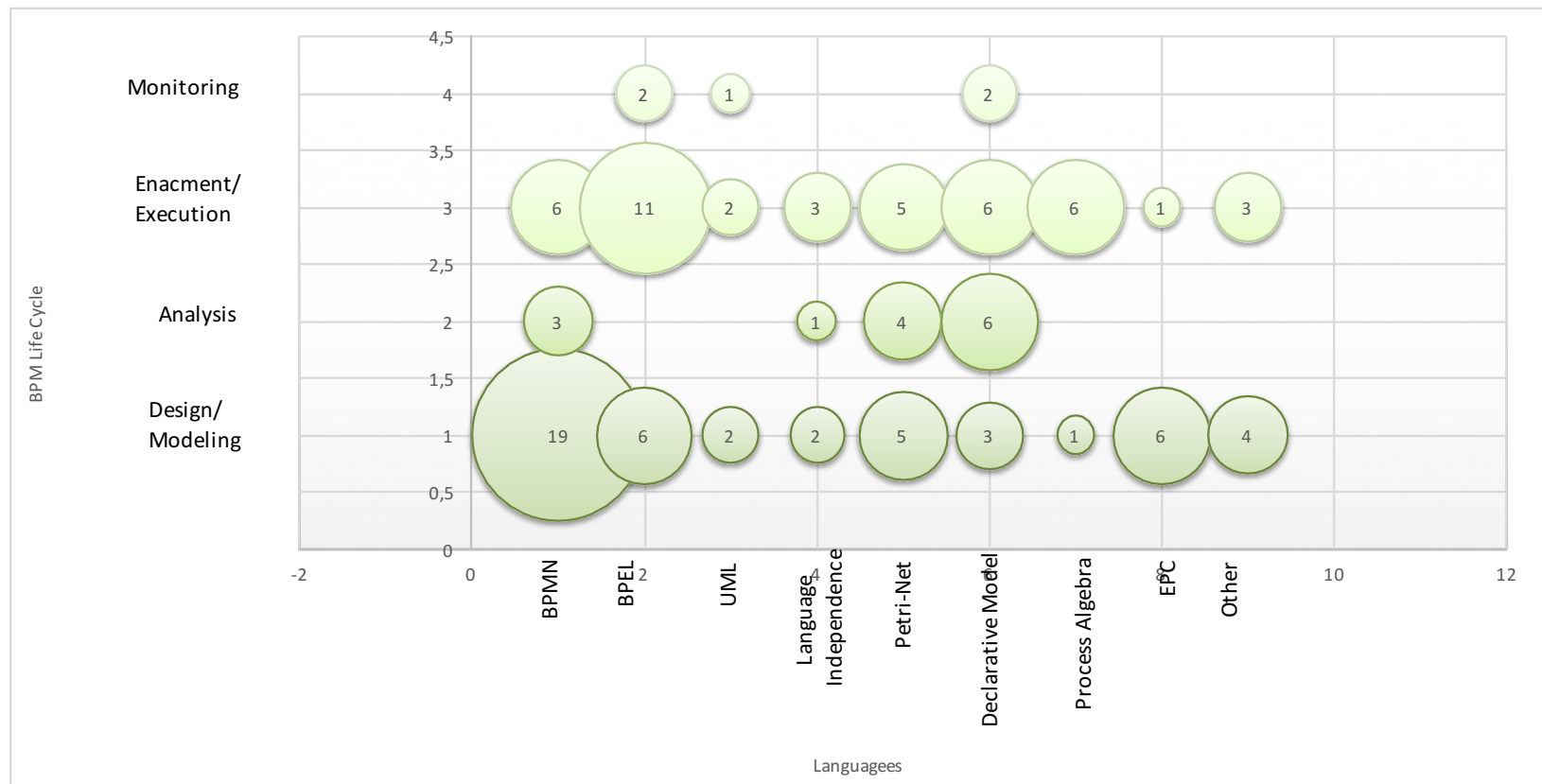
Mechanisms Used in the Different BPM Life-Cycle Phases
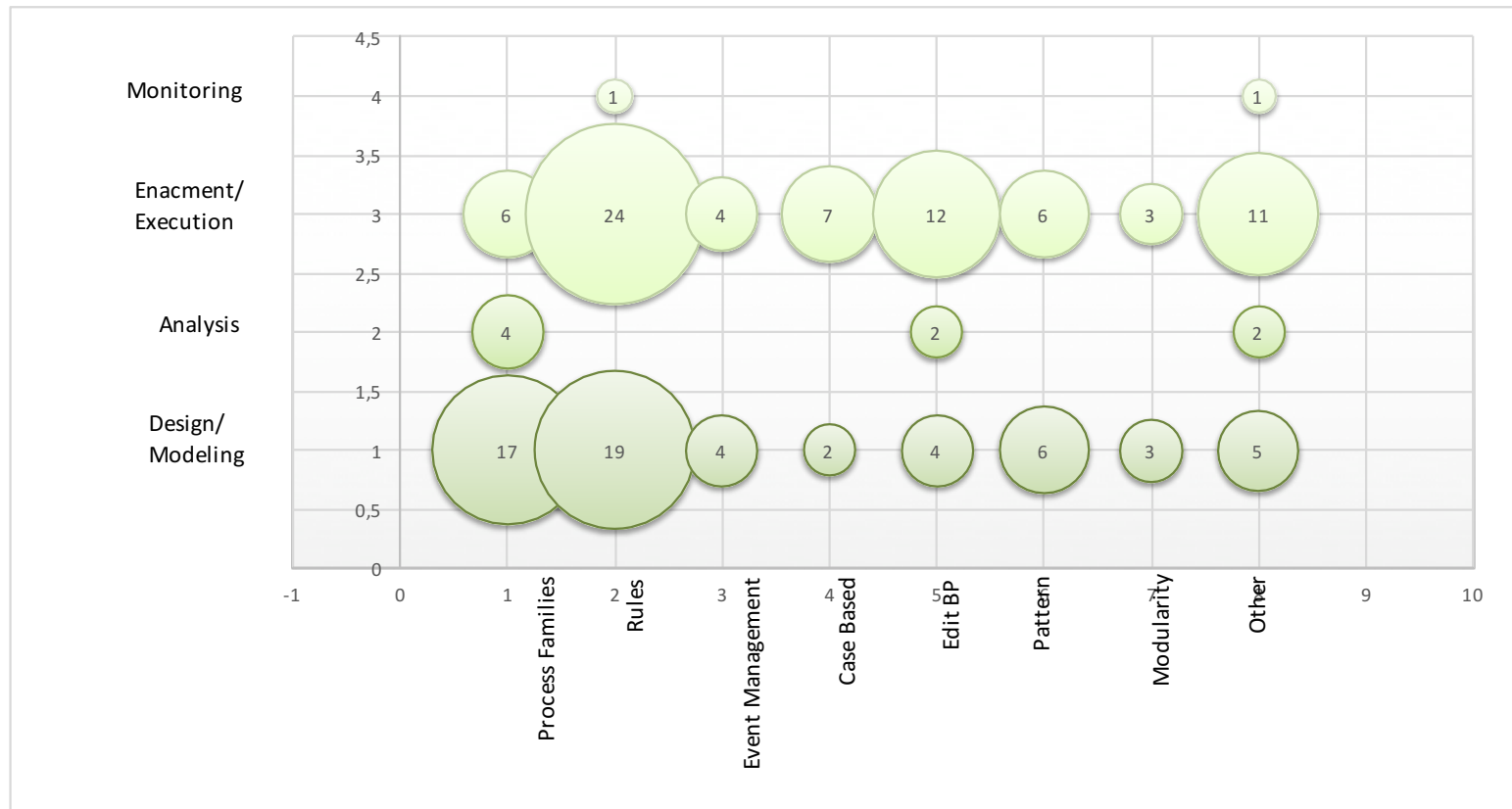
Languages Resulting from RQ3.1 According to the Identified Categories

Mechanisms Resulting from RQ3.2 According to the Identified Categories
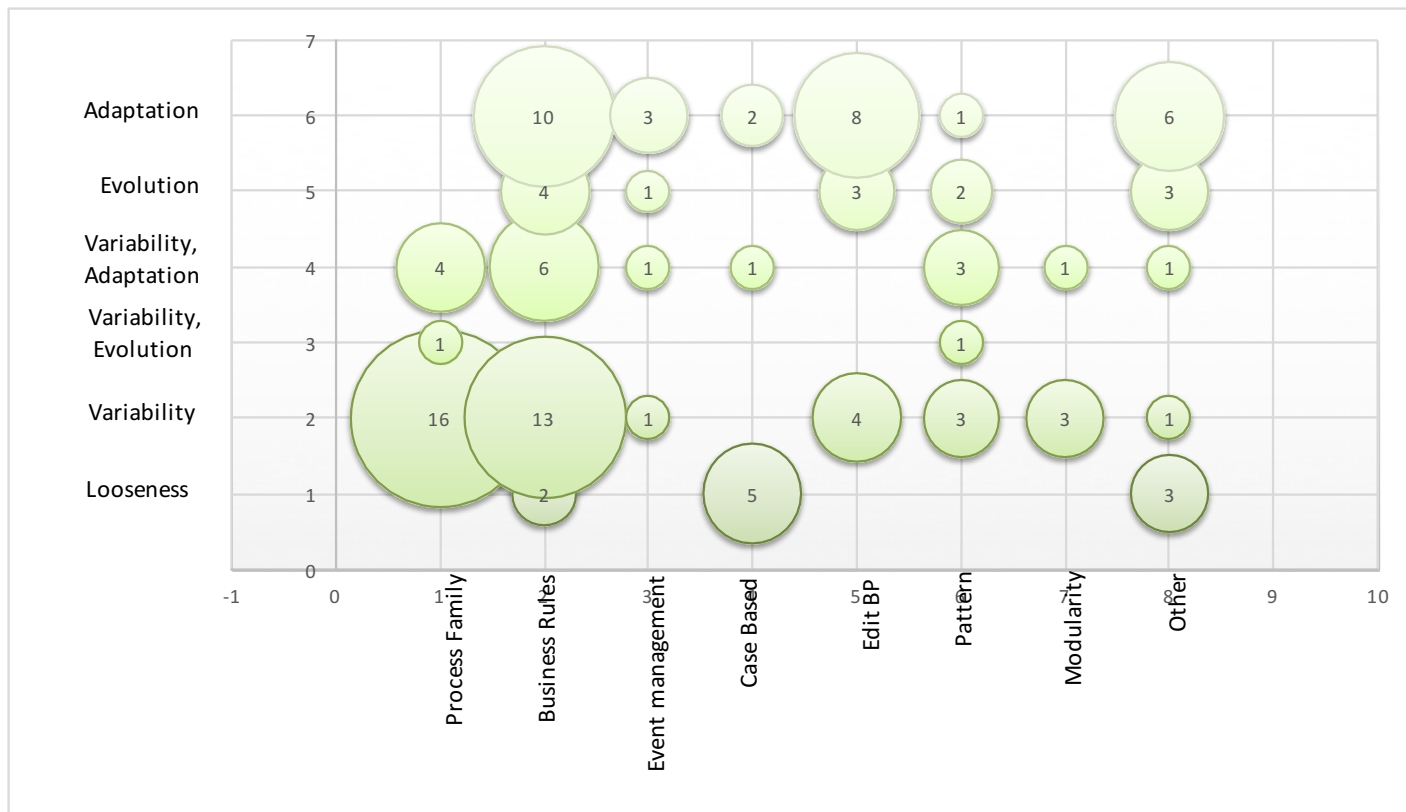
Validation Scenarios (RQ4)

There is a lack of real cases studies on BPs flexibility, most of the papers present toy examples and they do not introduce concrete requirement

- Car logistic BP

- British Telecom BPs of providing a quote to a customer

- Clinical BPs

- Warehouse management

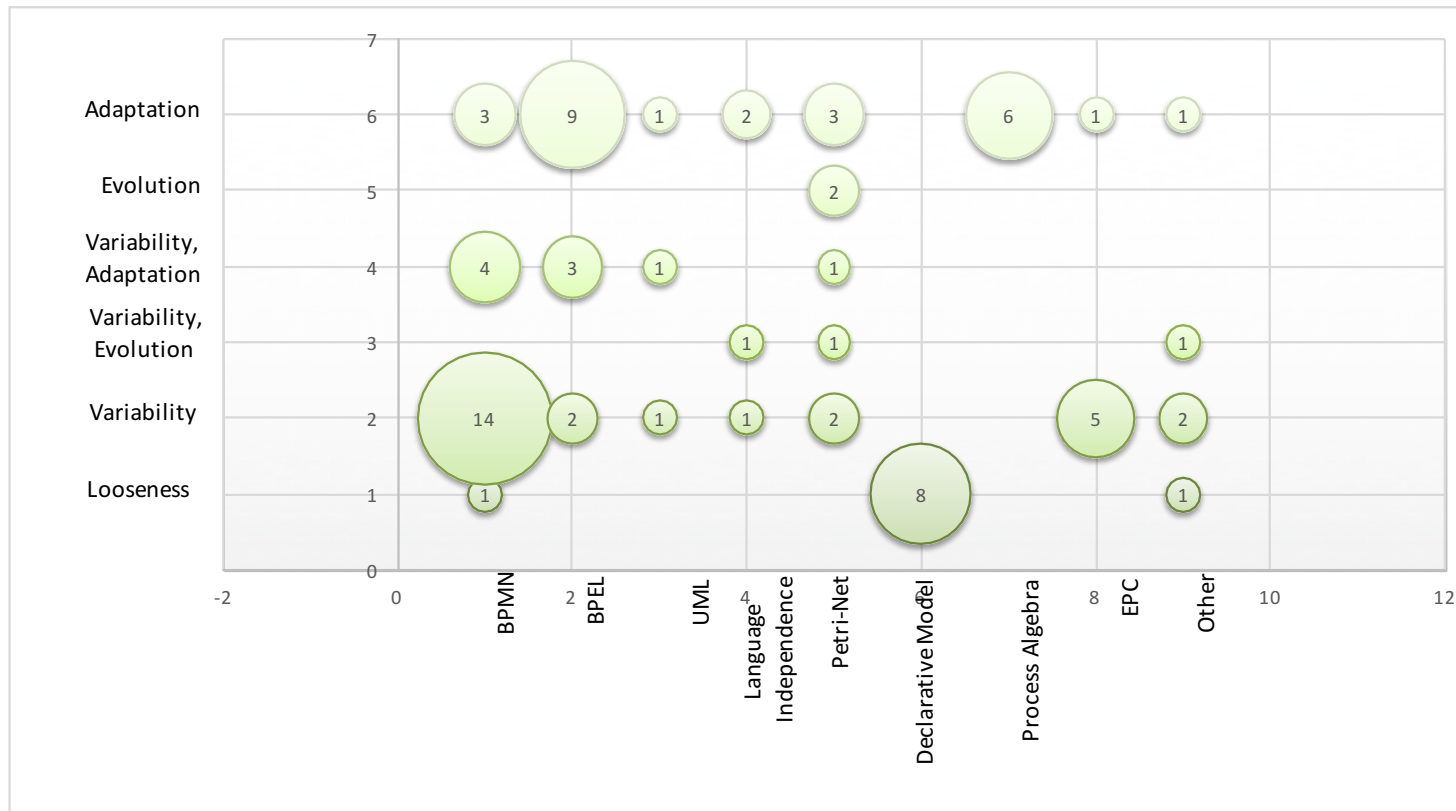|	RQ1 Needs	RQ2 Life Cycle Phases	RQ3.1 Languages	RQ3.2 Mechanisms
Car Logistic	Exception	Design/Modeling, Enacment/Execution	Process Algebra	
British Telecom	Exception	Enacment/Execution		Edit BP
Warehouse Management		Design/Modeling, Enacment/Execution	BPEL	
Clinical Scenario		Enacment/Execution, Analysis		Edit BP

Comparison Among SRL(s) on Flexibility

The considered surveys, plus this one, generate a set of 398 research works

- Ayora, C., Torres, V., Weber, B., Reichert, M., Pelechano, V.: VIVACE: A framework for the systematic evaluation of variability support in process-aware information systems. Information and Software Technology 57, 248-276 (2015)

- Valenca, G., Alves, C., Alves, V., Niu, N.: A systematic mapping study on business process variability. International Journal of Computer Science & Information Technology 5(1) (2013)

- La Rosa, M., van der Aalst, W.M., Milani, F.P., Dumas, M.: Business process variability modeling: A survey. ACM computer Survey - submitted (2013)

- Mechrez, I., Reinhartz-Berger, I.: Modeling design-time variability in business processes: Existing support and deciencies. In: Enterprise, Business-Process and Information Systems Modeling, pp. 378 - 392. Springer (2014)

- Murguzur, A., Intxausti, K., Urbieta, A., Trujillo, S., Sagardui, G.: Process flexibility in service orchestration: A systematic literature review. Int. J. Cooperative Inf. Syst. 23(3) (2014)

- Lang, A.: Flexible business process modeling - a systematic mapping study. Master's thesis, Athabasca University (2012)

- dos Santos Rocha, R., Fantinato, M.: The use of software product lines for business process management: A systematic literature review. Information and Software Technology 55(8), 1355-1373 (2013)

Comparison Among SRL on Flexibility

SRL	Pubblication Year	Context	Period	# of work
Ayora et. al.	2014	Variability Support in PAIS	2004 - 2014	63
Valenca et. al.	2013	BP Variability	2001 - 2011	80
La Rosa et. al.	2013	BP Variability Modelling	2000 - 2012	40
Mechrez	2014	Modelling Design Time Variability in BP	2005 - 2013	18
Murguzur et. al.	2014	Flexibility in Service Orchestration	2006 - 2012	17
Lang	2012	Flexible BP Modelling	2001 - 2012	60
Santos and Fantinato	2013	Software product lines for BPM	2003 - 2012	63
Corradini et al	2016	BP flexibility a Software Systems Perspective	2000 - 2015	164

Papers Distribution by Publication Year Considering all the Review Studies

- Considering **conferences**
  - Conference on Advanced Information Systems Engineering (CAiSE), and the related workshop
  - Business Process Management and the related workshop
  - IEEE SCC - International conference on Service Computing
  - Hawaii International Conference on System Sciences (HICSS) and International Conference of Service Oriented Computing (ICSOC)
  - Enterprise Computing Conference (EDOC), the International Conference of Web Services (ICWS), the On The Move to Meaningful Internet Systems (OTM) and the Software Product Line Conference (SPLC)
- With reference to **journals**
  - Information System Journal
  - Data & Knowledge Journal
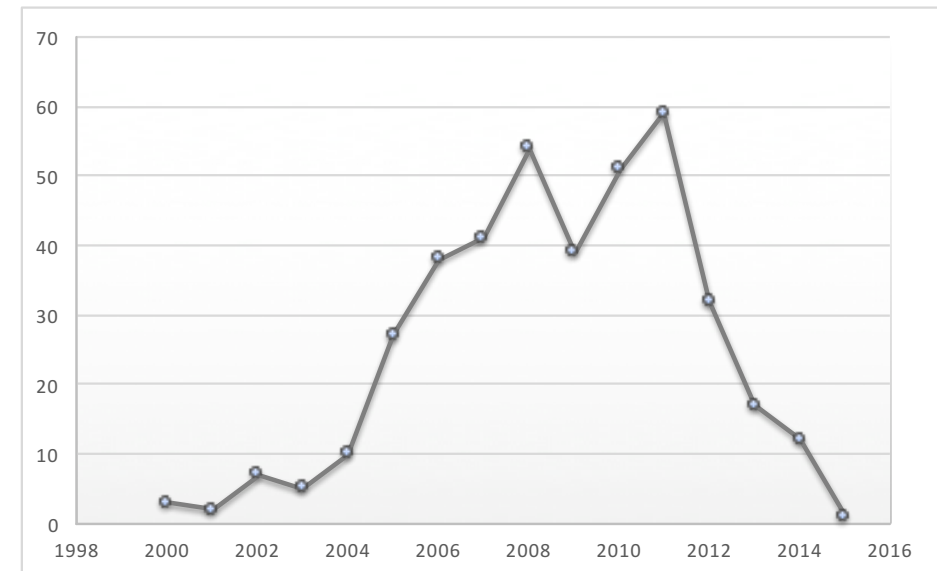
Reference Publications

- **R. Cognini, F. Corradini, S. Gnesi, A. Polini, B. Re. Business Process Flexibility - A Systematic Literature Review with a Software Systems Perspective.** Information systems frontiers, first online, Springer, pp. 1 - 29, July 2016.

- Cognini, R., Corradini, F., Gnesi, S., Polini, A., & Re, B. Research challenges in business process adaptability. In *Proceedings of the 29th Annual ACM Symposium on Applied Computing* (pp. 1049-1054). ACM. (2014).