

# Leveraging BPI with NLP and Organizational Semantics

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# INTRODUCTION

Continuous improvement is essential.

3 Challenges:

- Resolving requirement conflicts
- Impact analysis
- Actionable BPI planning

Automation with NLP and organizational semantics may help.

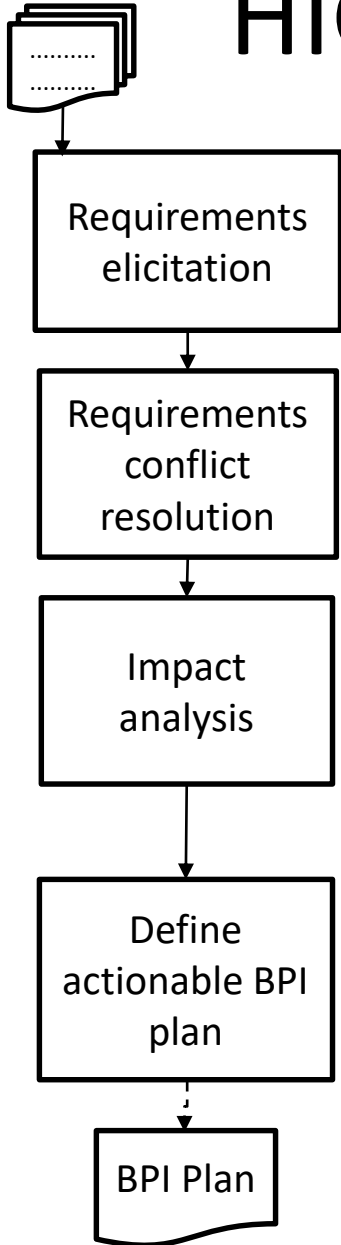
# INTRODUCTION

Large and complex organizations have hundreds of business processes

Automation promises:

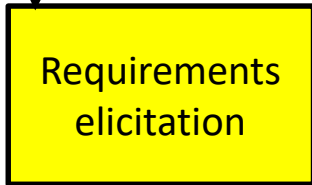
- Significant savings in effort
- Improvement in quality

# HIGHLIGHTS OF P.I. PROCESS

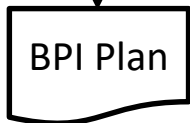
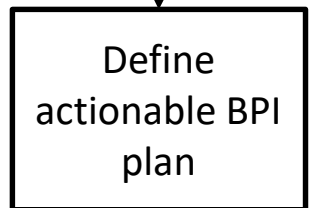
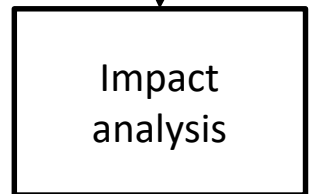
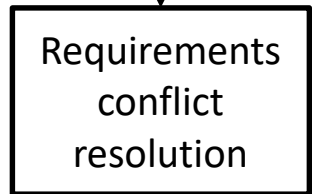




# HIGHLIGHTS OF P.I. PROCESS

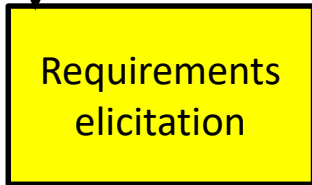


- Requirements are gathered from various sources,
- Different parties, different goals, unique perspectives.

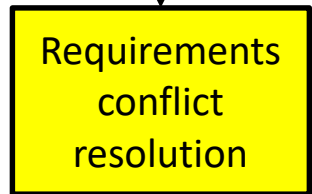




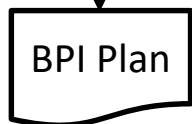
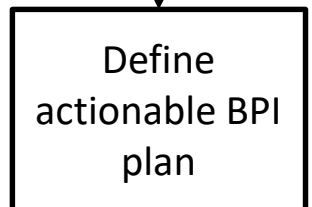
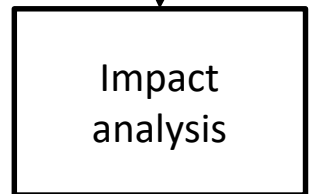
# HIGHLIGHTS OF P.I. PROCESS



- Requirements are gathered from various sources,
- Different parties, different goals, unique perspectives.



- Conflicts and duplicates may occur,
- Business analysts detect and resolve these conflicts among a large set of requirements.



# HIGHLIGHTS OF P.I. PROCESS



Requirements elicitation

Requirements conflict resolution

Impact analysis

Define actionable BPI plan

BPI Plan

- Identify the existing processes and systems that may be affected by these requirements,
- effort-intensive, manual, requires wide organizational knowledge.

# HIGHLIGHTS OF P.I. PROCESS



Requirements elicitation

Requirements conflict resolution

Impact analysis

Define actionable BPI plan

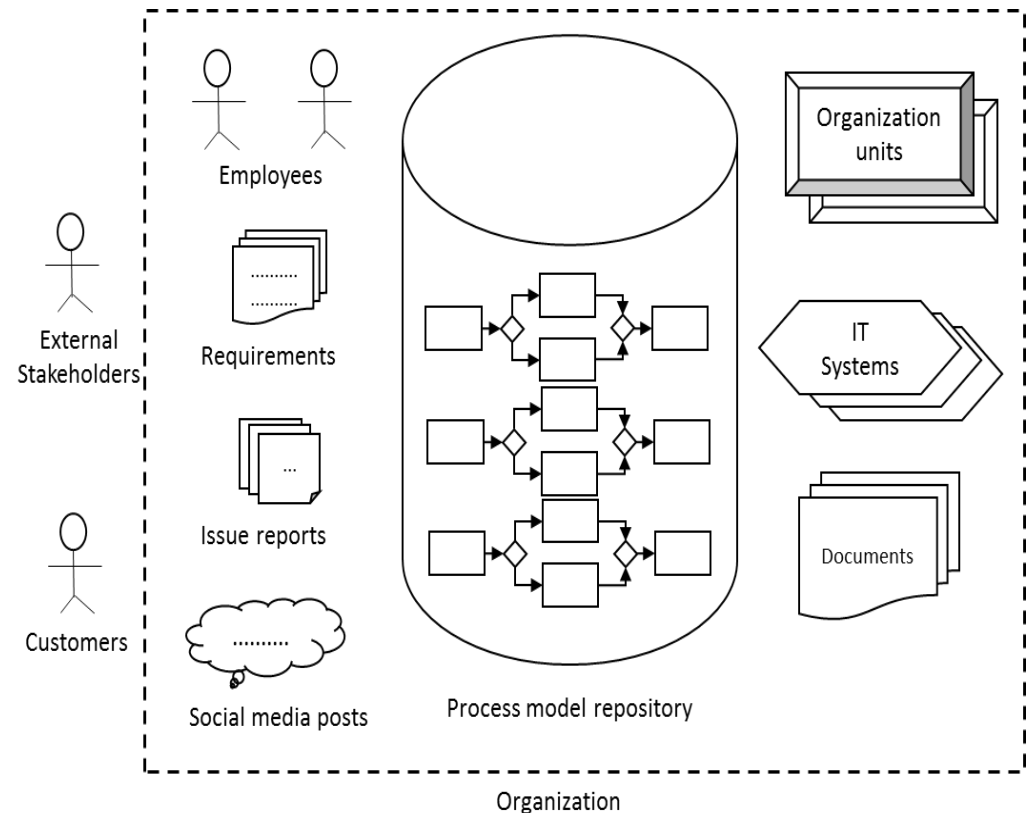
BPI Plan

- Define the scope of the BPI and an actionable plan



# SOLUTION APPROACH

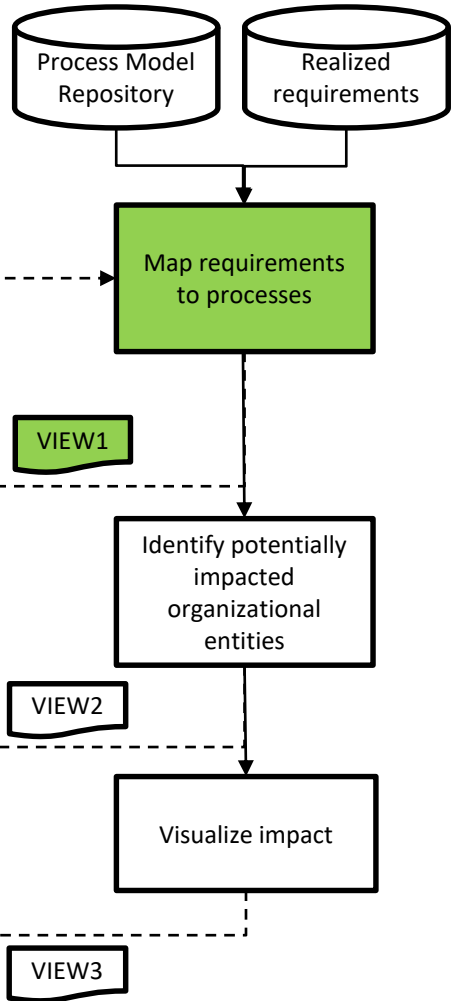
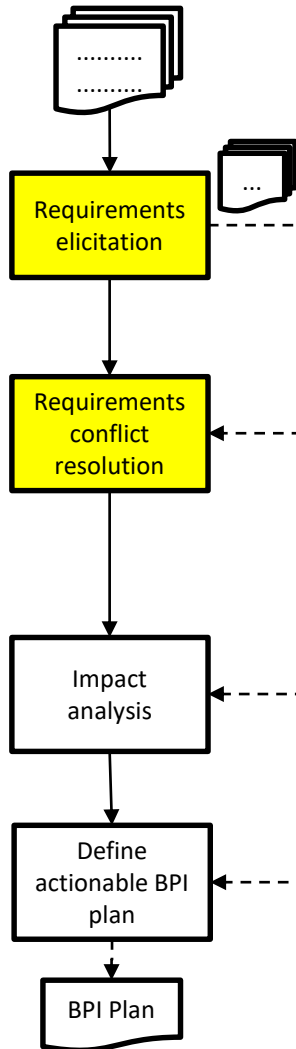
- Processes in the focus
- Process Models contain rich, linked data
- We extract and process this data
- Match requirements and various other artifacts to processes



# SOLUTION APPROACH

BPI Stages

Proposed approach



Process A ▼

Process model

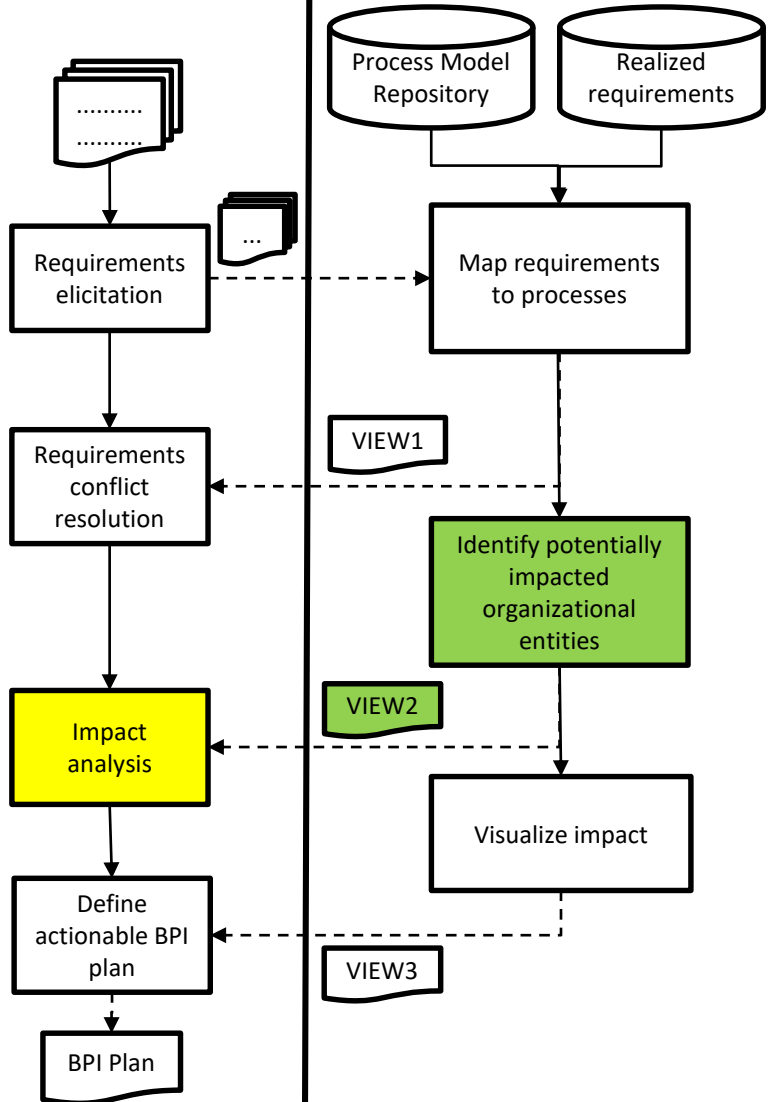
Associated requirements

| Requirement   | Owner  |
|---------------|--------|
| Requirement 1 | Role X |
| Requirement 2 | Role Y |
| Requirement 3 | Role Y |
| Requirement 4 | Role Z |

# SOLUTION APPROACH

BPI Stages

Proposed approach



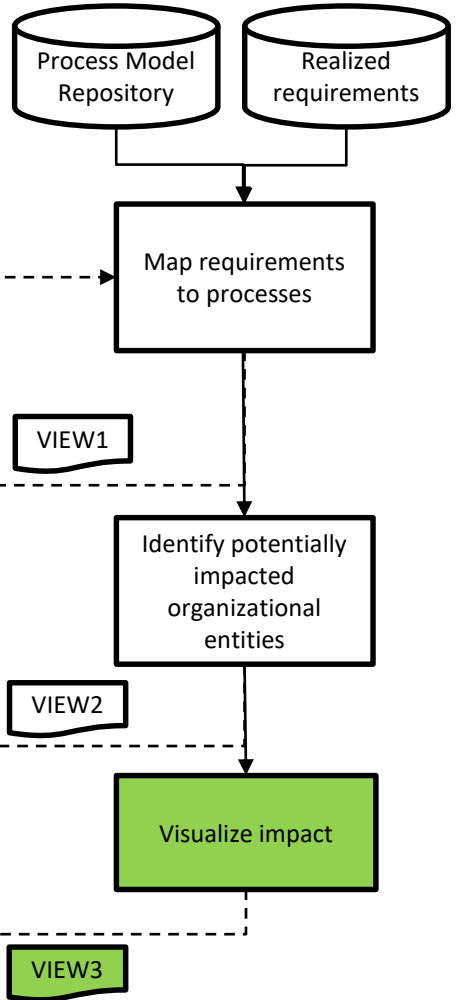
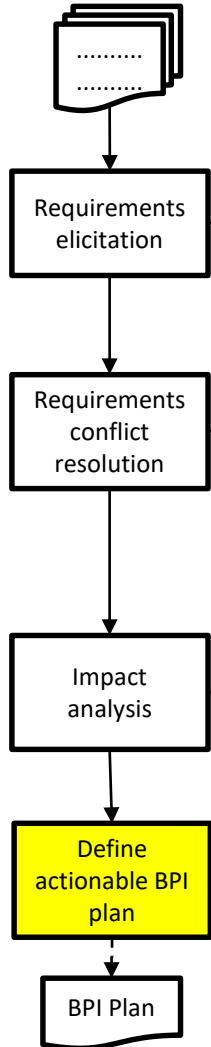
## Impacted entities

| Processes     | Impact                              | Magnitude |
|---------------|-------------------------------------|-----------|
| Process A     | <input checked="" type="checkbox"/> | ++        |
| Process B     | <input type="checkbox"/>            | +         |
| Process C     | <input checked="" type="checkbox"/> | +         |
| Roles / Units | Impact                              | Magnitude |
| Role 1        | <input checked="" type="checkbox"/> | +++       |
| IT Systems    | Impact                              | Magnitude |
| System 1      | <input type="checkbox"/>            | ++        |
| System 2      | <input checked="" type="checkbox"/> | ++++      |

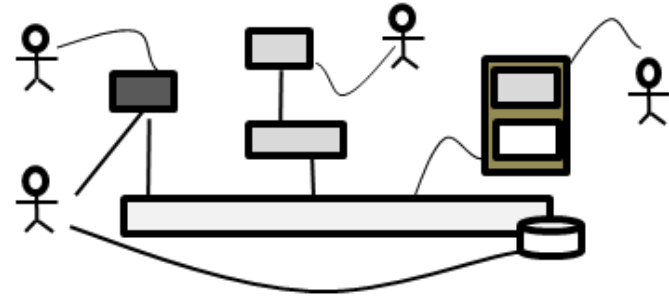
# SOLUTION APPROACH

BPI Stages

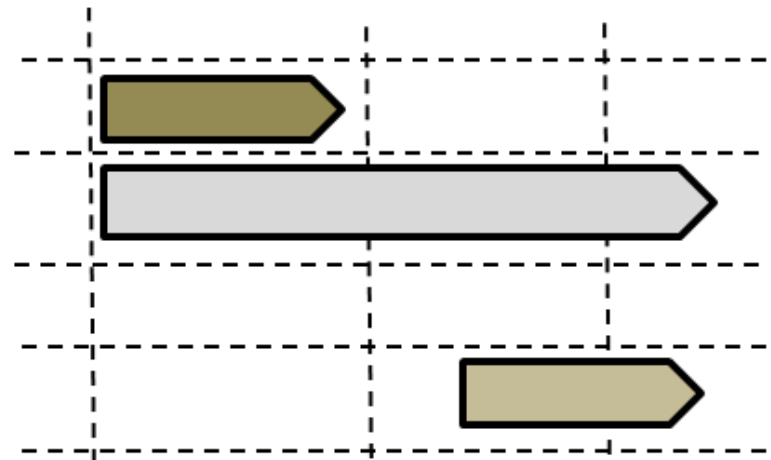
Proposed approach



Organization impact



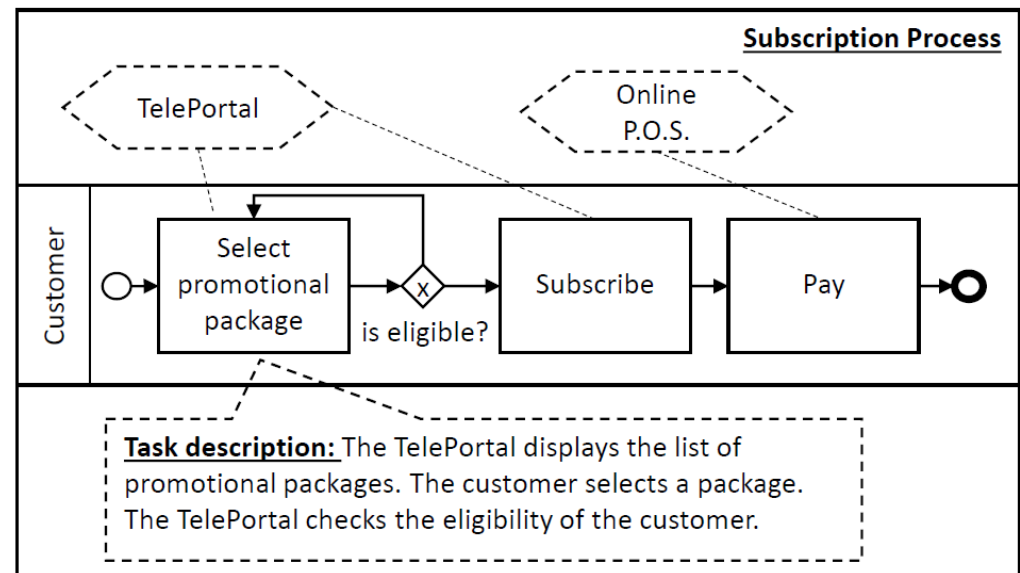
Process impact

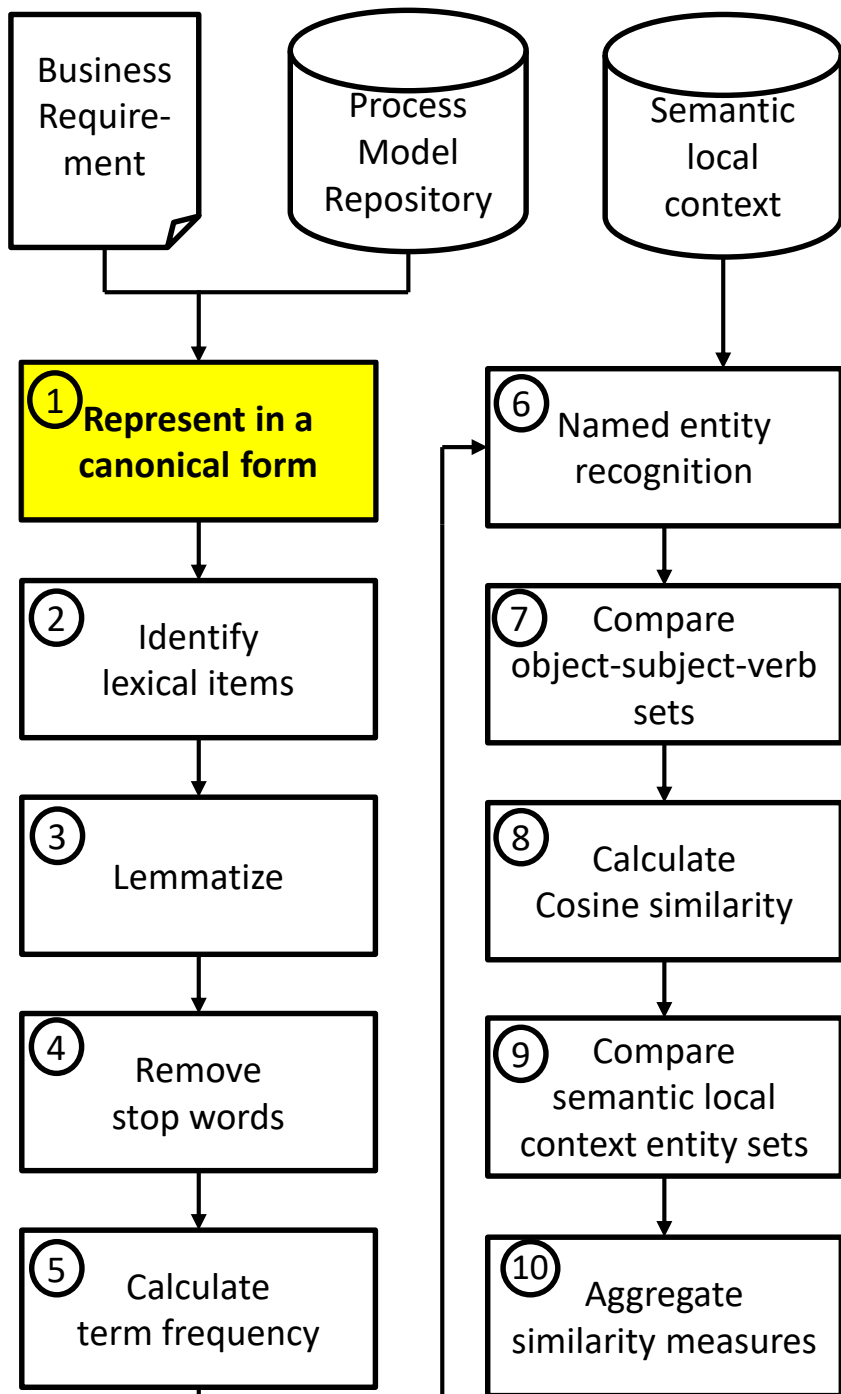


# NLP FOR MATCHING

| ID | Requirement   | Owner              |
|----|---|--------------------|
| R1 | Customers shall be able to select multiple promotional packages for subscription  | Marketing Dpt.     |
| R2 | StudentPack promotional package subscribers cannot subscribe to Senior package at the same time                                       | Legal Dpt.         |
| R3 | Easy-CRM must display customers' contact information and the history of promotional packages subscribed, to the sales representative. | Customer Relations |

| ID | Entity      | Type      |
|----|-------------|-----------|
| E1 | Easy-CRM    | IT System |
| E2 | TelePortal  | IT System |
| E3 | Online POS  | IT System |
| E4 | StudentPack | Product   |
| E5 | Sales Rep.  | Role      |

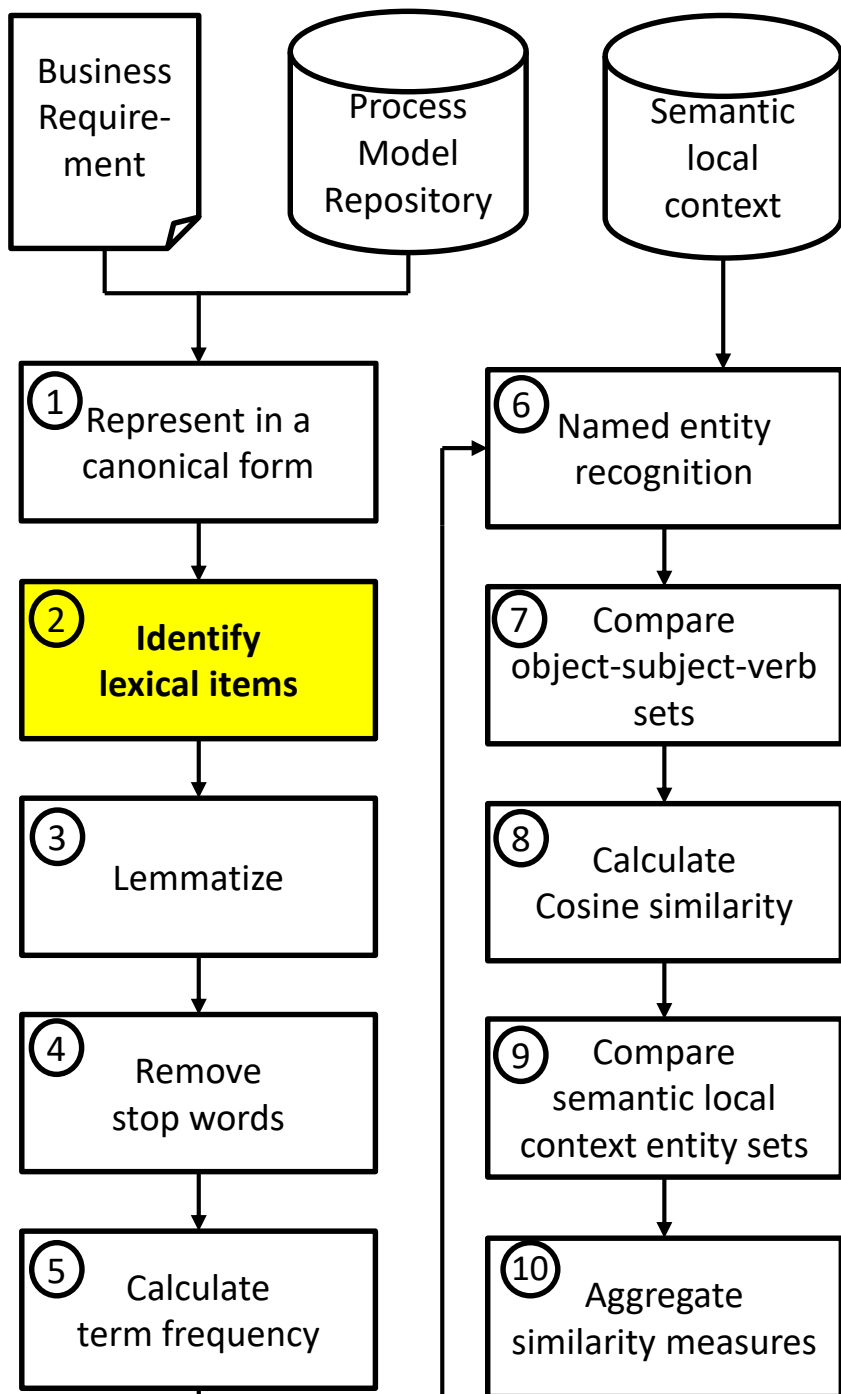




## EXAMPLE

**Requirement statement:**  
*“Customers shall be able to select multiple promotional packages for subscription.”*

**Subscription Process:**  
{Subscription Process},  
{TelePortal displays the list of promotional packages...},  
{Select promotional package},  
{TelePortal}, {Customer},...



## EXAMPLE

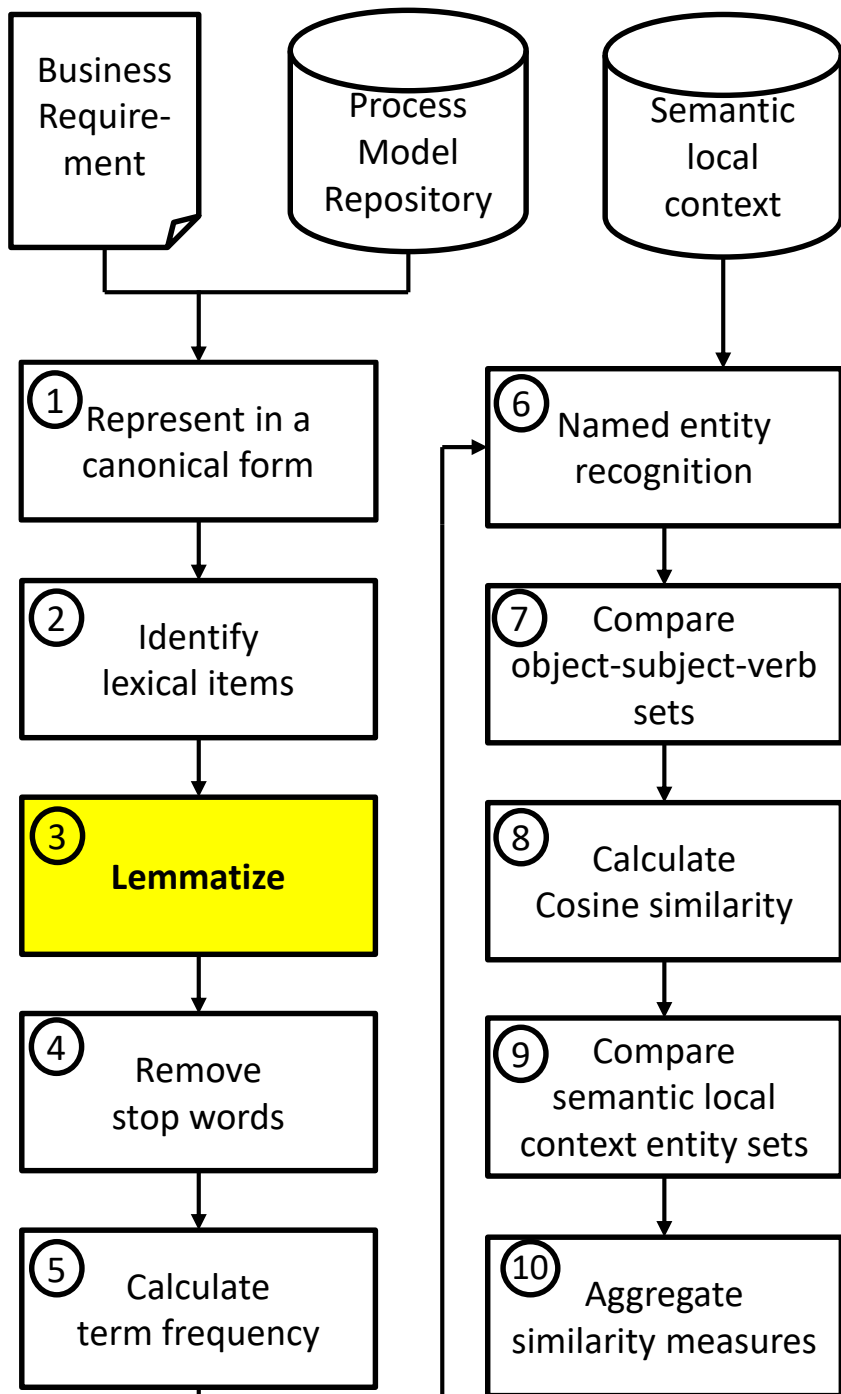
**Requirement statement:**  
*«Customers shall be able to select multiple promotional packages for subscription»*

**Objects/Subjects/Verbs:**

**Objects:** {package, promotional packages, multiple promotional packages}

**Subjects:** {customers}

**Verbs:** {able, select, subscribe}



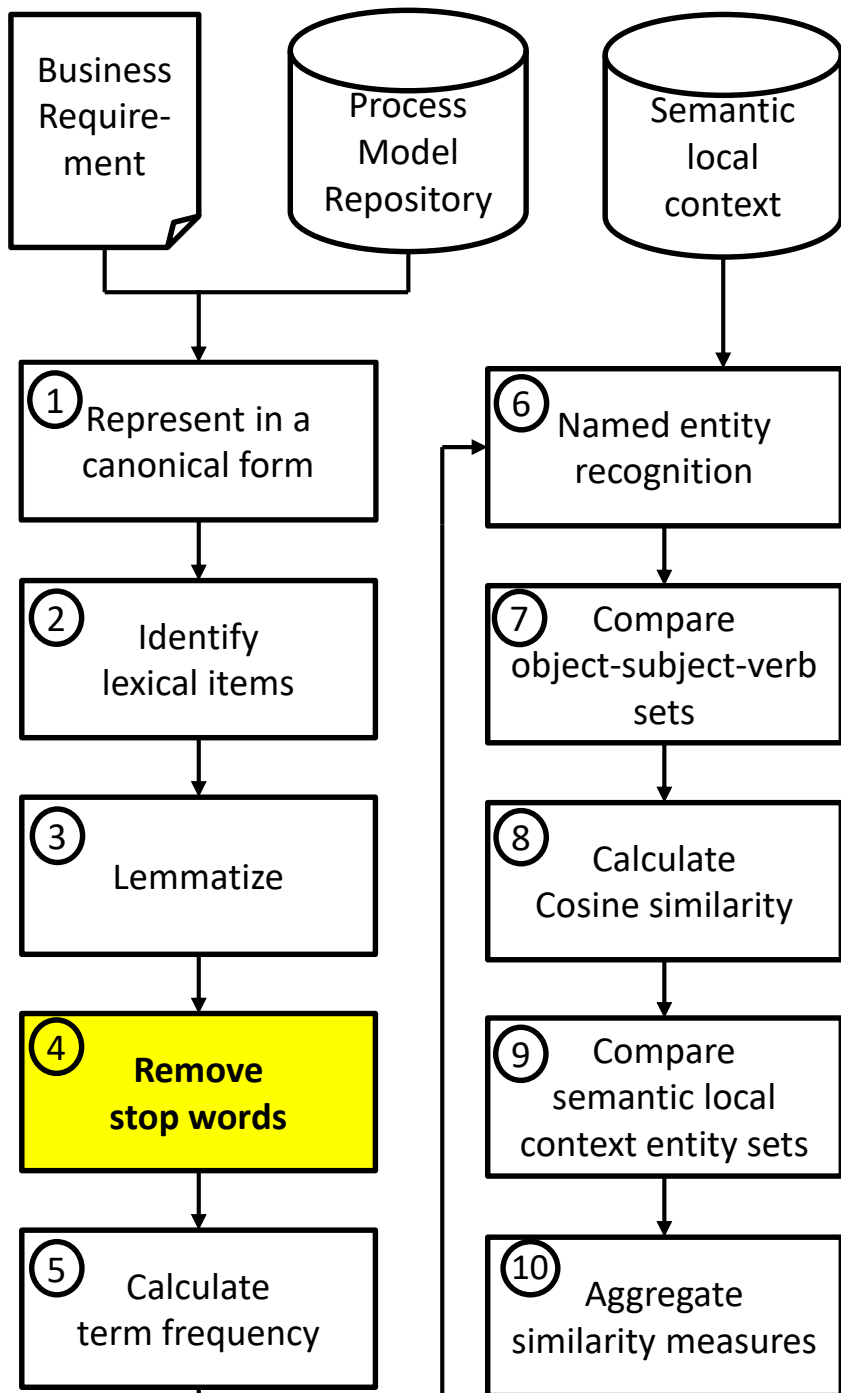
## EXAMPLE

**Requirement statement:**  
«StudentPack promotional package subscribers cannot subscribe to Senior package at the same time»

### Bag-of-words:

“StudentPack”, “promotional”, “package”, “subscribe”, “cannot”, “subscribe”, “to”, “Senior”, “package”, “at”, “the”, “same”, “time.”

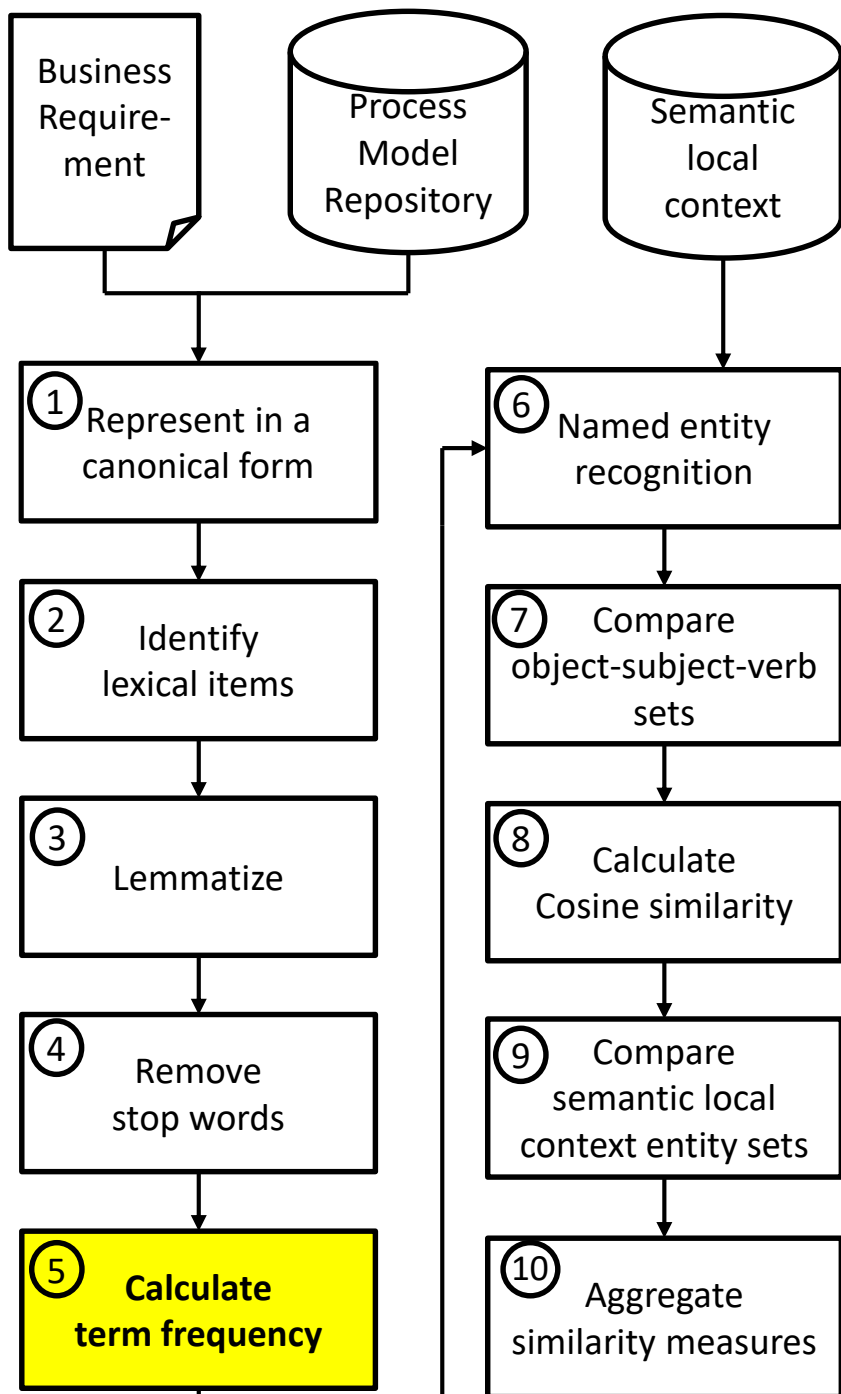




## EXAMPLE

**Requirement statement:**  
«StudentPack promotional package subscribers cannot subscribe to Senior package at the same time»

**Sanitized Bag-of-words:**  
“StudentPack”,  
“promotional”, “package”,  
“subscriber”, “subscribe”,  
“senior”, “package”, “time”

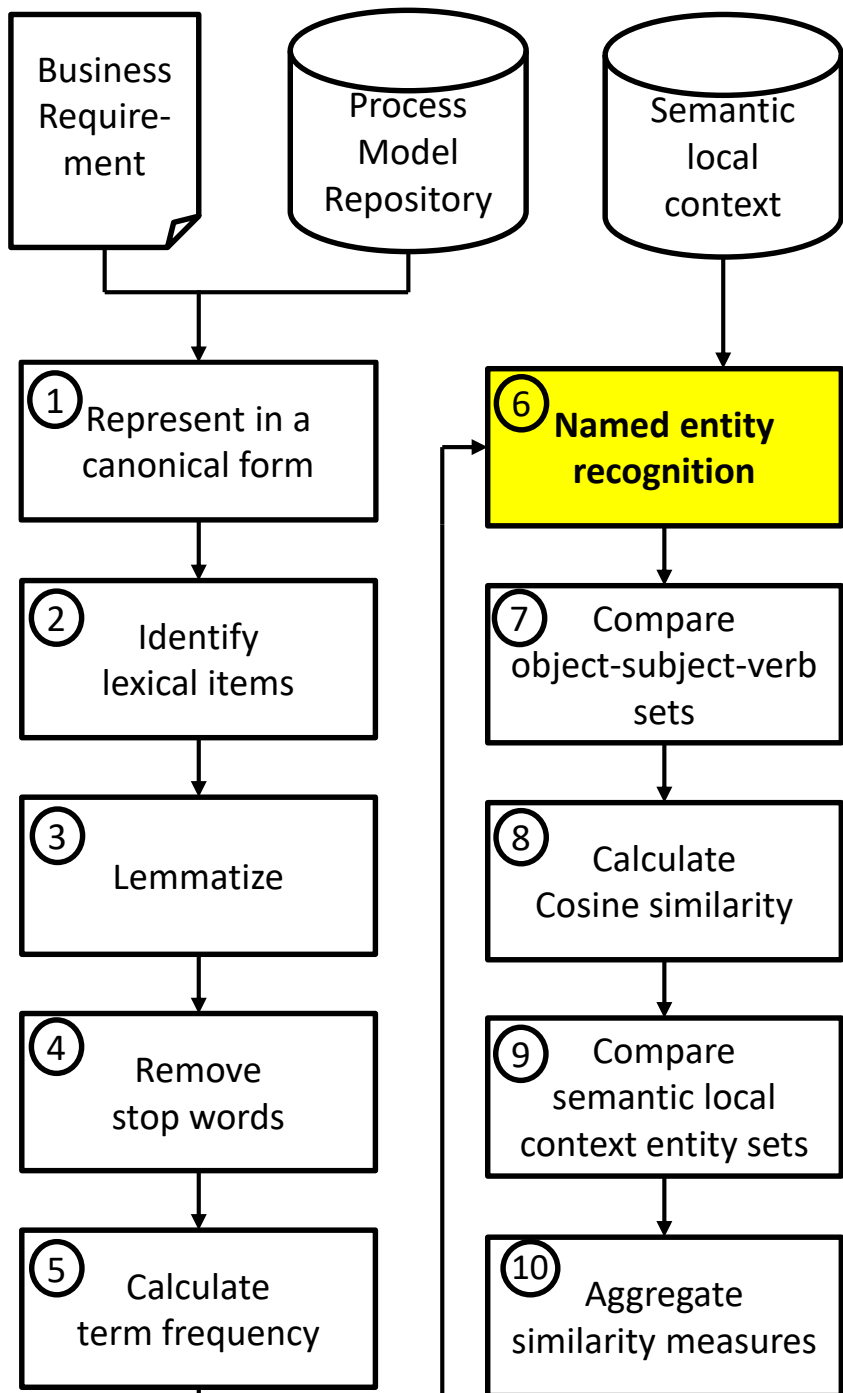


## EXAMPLE

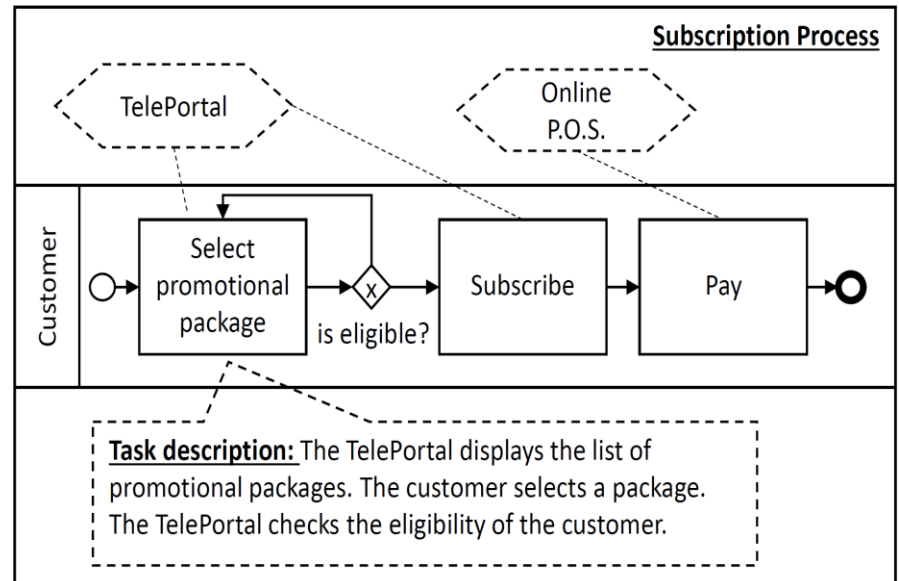
### Sanitized Bag-of-words:

“StudentPack”, “promotional”, “package”, “subscriber”, “subscribe”, “senior”, “package”, “time”

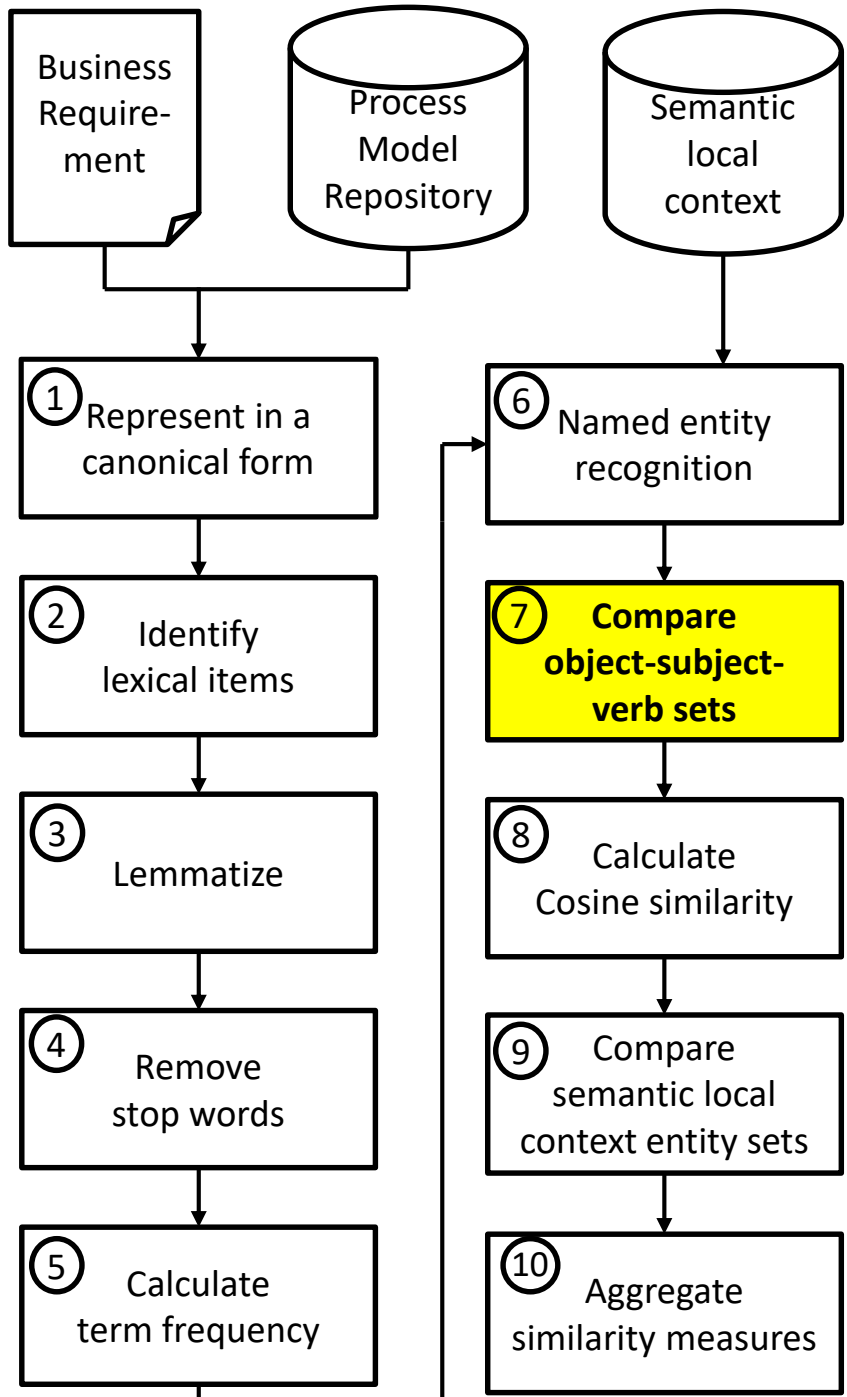
| Word        | Tf | Idf  | Tf x Idf |
|-------------|----|------|----------|
| StudentPack | 1  | 1/25 | 1/25     |
| Promotional | 1  | 3/25 | 3/25     |
| Package     | 2  | 4/25 | 8/25     |
| Subscriber  | 1  | 1/25 | 1/25     |
| Subscribe   | 1  | 3/25 | 3/25     |
| Senior      | 1  | 1/25 | 1/25     |
| Package     | 1  | 3/25 | 3/25     |
| Time        | 1  | 1/25 | 1/25     |



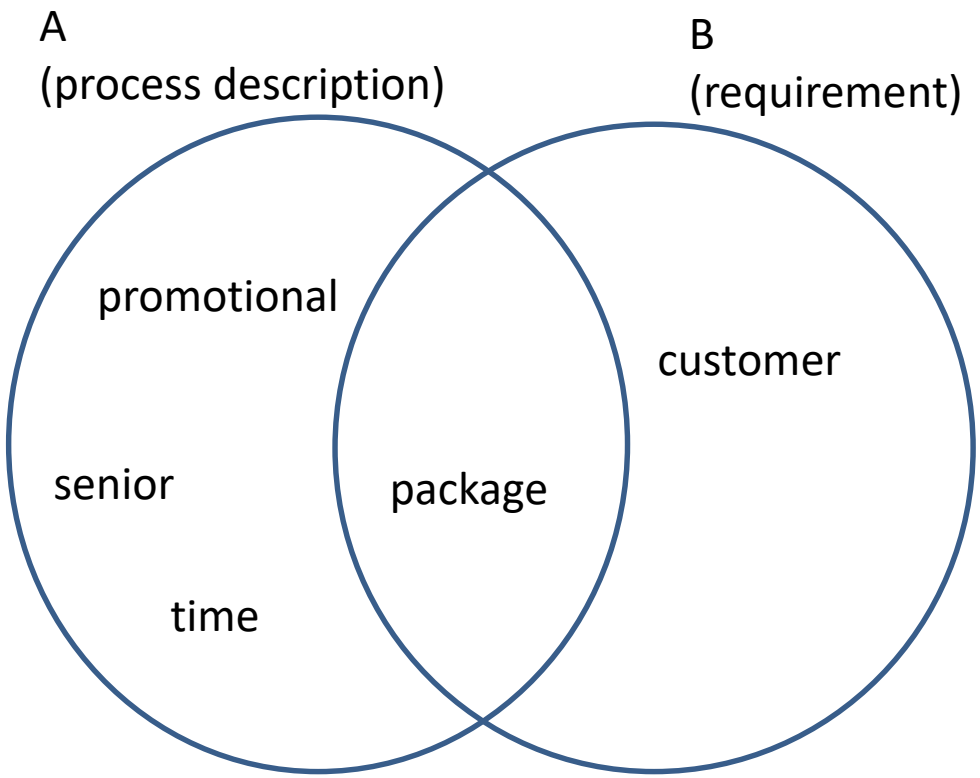
## EXAMPLE



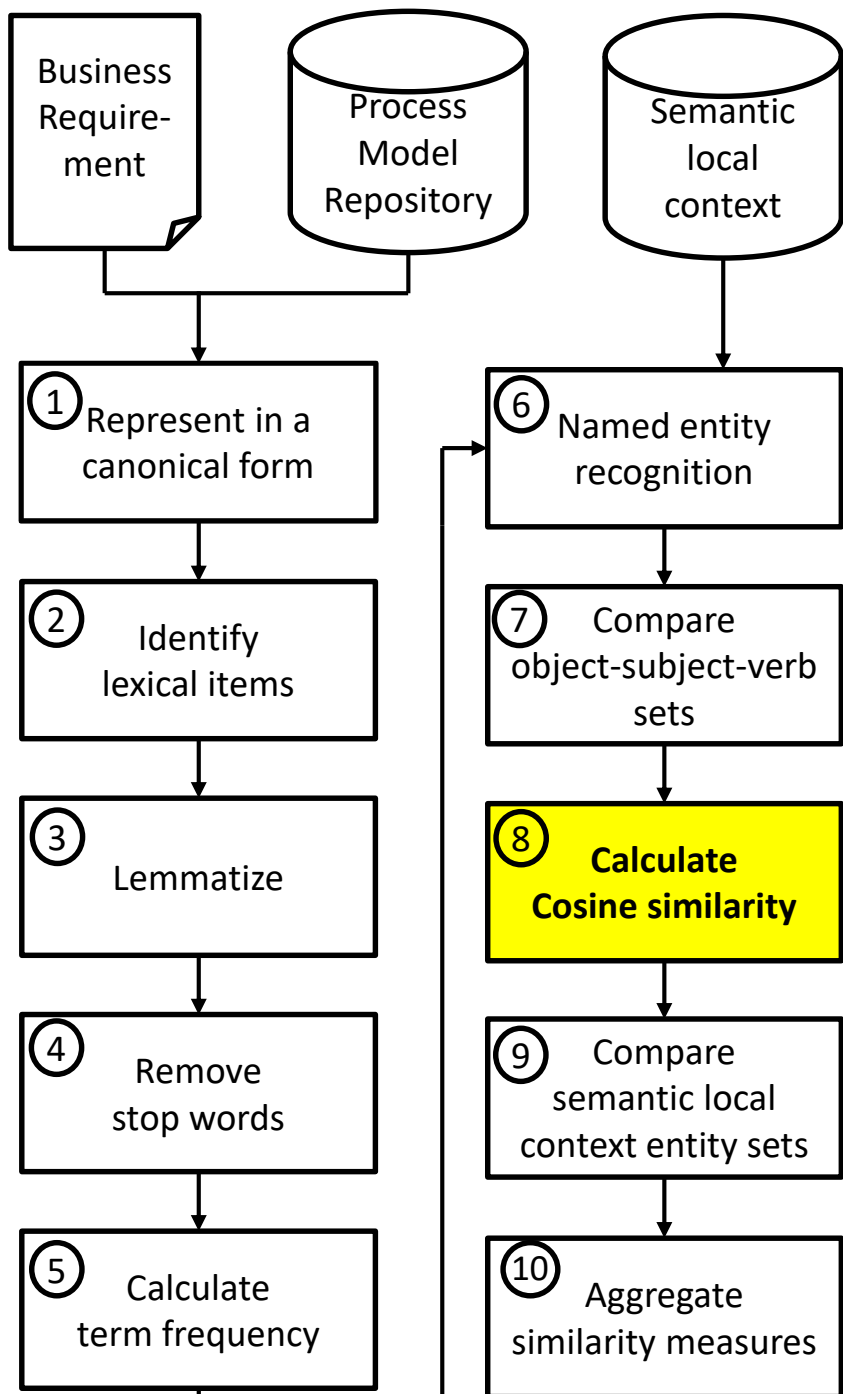
| ID | Entity               | Type      |
|----|----------------------|-----------|
| E1 | Easy-CRM             | IT System |
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| E3 | Online POS           | IT System |
| E4 | StudentPack          | Product   |
| E5 | Sales Representative | Actor     |



# EXAMPLE



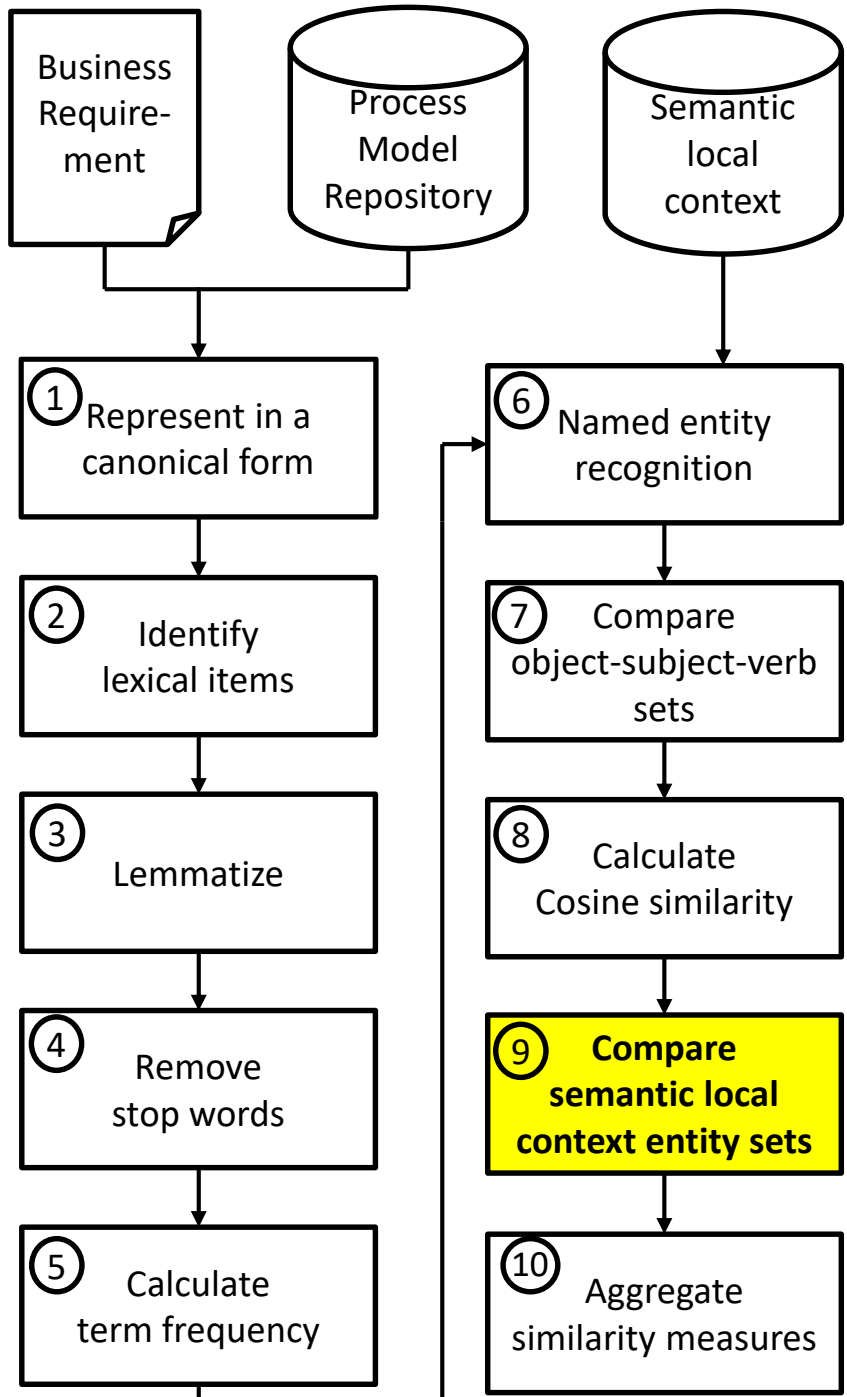
$$JI'(A, B) = \frac{|A \cap B|}{\min(|A|, |B|)}$$



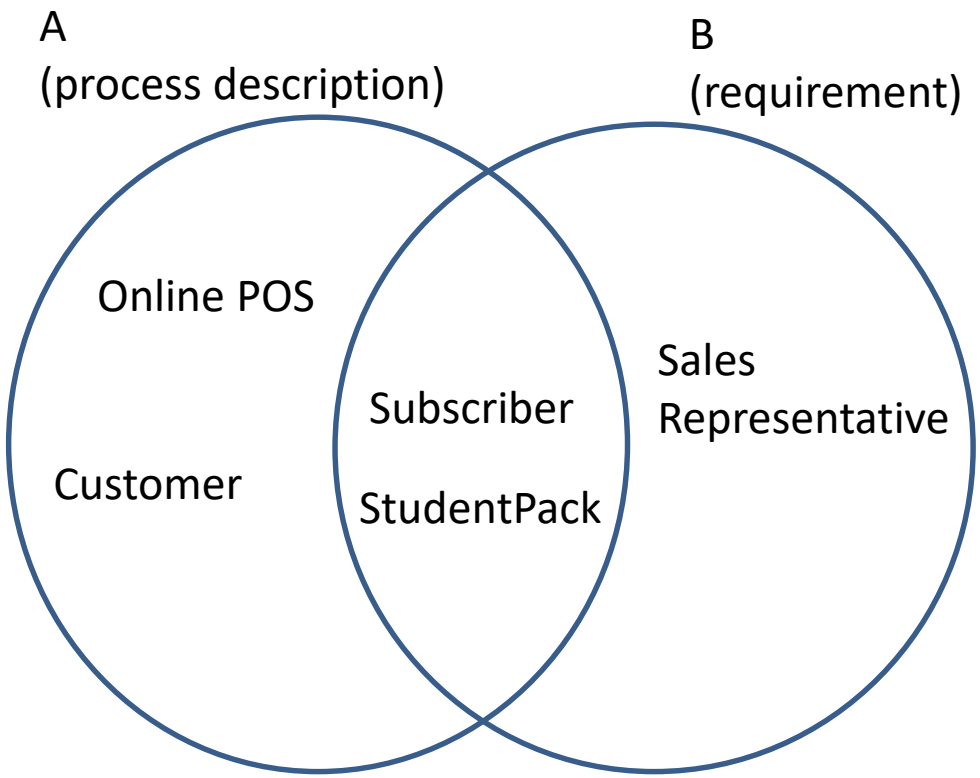
## EXAMPLE

| Word  | promotional | package | Senior | ... |
|-------|-------------|---------|--------|-----|
| BoW-1 | 1/25        | 1/25    | 0      | ... |
| BoW-2 | 0           | 0       | 3/25   | ... |
| BoW-3 | 0           | 1/25    | 0      | ... |
| BoW-4 | 1/25        | 0       | 0      | ... |

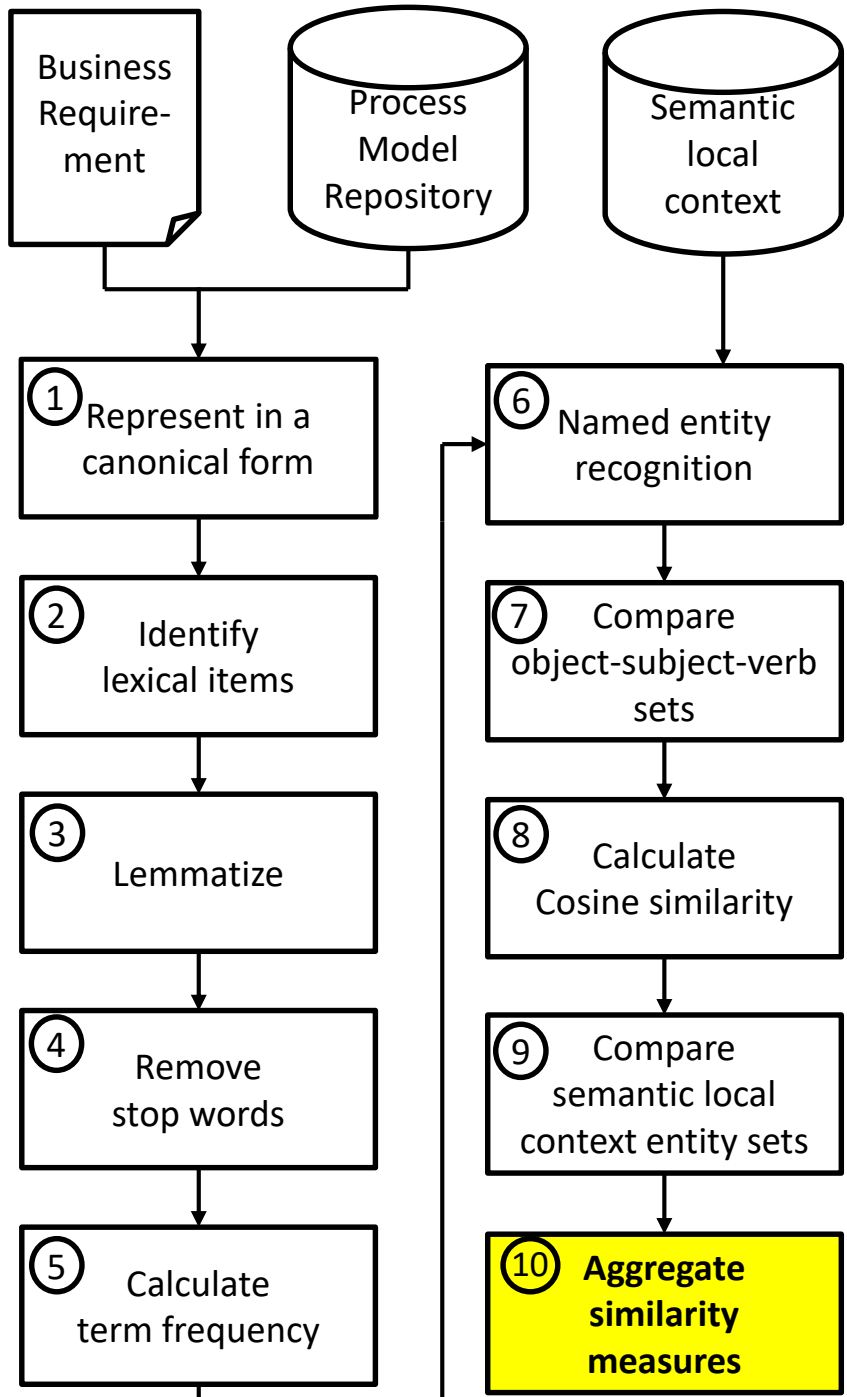
$$Sim_{Cos} = \frac{\sum_{i=1}^n A_i B_i}{\sqrt{\sum_{i=1}^n A_i^2} \sqrt{\sum_{i=1}^n B_i^2}}$$



# EXAMPLE



$$JI'(A, B) = \frac{|A \cap B|}{\min(|A|, |B|)}$$



# EXAMPLE

$$Sim = \frac{C_1.Sim_{Cos} + C_2.Sim_{LC} + C_3.Sim_{OS} + C_4.Sim_V}{C_1 + C_2 + C_3 + C_4}$$

# EVALUATION

- Environment:
  - Real-life business setting (major telecom company)
  - BPMN repository (620 process models)
  - 8000 linked entities (local context)
  - 200 unique requirement statements
- Quantitative
  - Comparing the outputs of the automated approach with a gold standard manually created by business analysts.
  - Reporting Precision and Recall values
- Qualitative
  - Semi-structured interviews



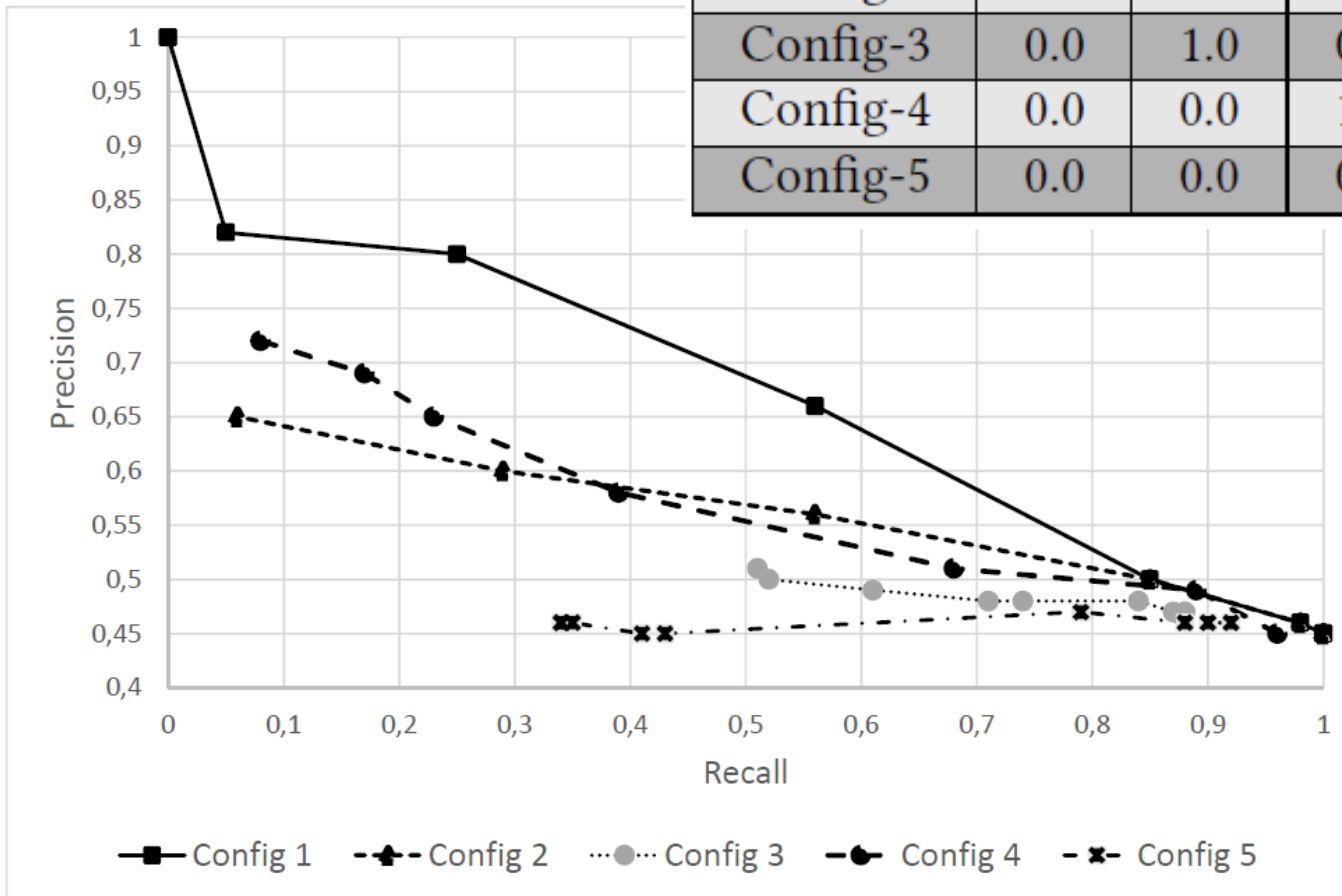
# QUANTITATIVE EVALUATION

- Gold Standard:
  - Matching between requirements and high-level processes
- Configuration:
  - 5 different configurations with different weight constants

|          | CS  | LC  | OS  | V   |
|----------|-----|-----|-----|-----|
| Config-1 | 0.6 | 0.2 | 0.1 | 0.1 |
| Config-2 | 1.0 | 0.0 | 0.0 | 0.0 |
| Config-3 | 0.0 | 1.0 | 0.0 | 0.0 |
| Config-4 | 0.0 | 0.0 | 1.0 | 0.0 |
| Config-5 | 0.0 | 0.0 | 0.0 | 1.0 |

# QUANTITATIVE EVALUATION

|          | CS  | LC  | OS  | V   |
|----------|-----|-----|-----|-----|
| Config-1 | 0.6 | 0.2 | 0.1 | 0.1 |
| Config-2 | 1.0 | 0.0 | 0.0 | 0.0 |
| Config-3 | 0.0 | 1.0 | 0.0 | 0.0 |
| Config-4 | 0.0 | 0.0 | 1.0 | 0.0 |
| Config-5 | 0.0 | 0.0 | 0.0 | 1.0 |



# SEMI-STRUCTURED INTERVIEWS

| Interviewee      | Years of BPI Experience |
|------------------|-------------------------|
| Senior Analyst 1 | 17                      |
| Senior Analyst 2 | 5                       |
| Analyst          | 2                       |

Interviews consisted of two stages  
1) Walkthrough  
2) Q/A session

- Description of the business analysts' tasks in different BPI stages
- Effort requirements for these tasks
- Knowledge and expertise requirements to carry out these tasks
- The risks associated with these stages
- Opinion of analysts regarding the automated approach

# SEMI-STRUCTURED INTERVIEWS

## Conflict Resolution Phase

- Usually conducted by experienced analysts
- 30 – 45 person-minutes per requirement statement
- 20 minutes improvement is estimated per statement
- Increased consistency and quality, and reduced errors

# SEMI-STRUCTURED INTERVIEWS

## Impact Analysis Phase

- Effort-intensive, time-consuming, and prone to errors
- Task was measured to take 120 person-hours
- An estimated 50% to 70% efficiency increase through automation

# SEMI-STRUCTURED INTERVIEWS

## BPI Planning and Scope Determination

- For a small-medium size project this task takes approximately 80 person-hours
- 30% - 40% gain in time, and 20% decrease in errors are expected
- Enables less experienced personnel

# SUMMARY

## Punchline

- We achieved measurable improvement in time and quality

## Future work

- Continuous requirements engineering for agile business settings?

## Collaboration opportunities

- Contact

# Questions / Contact Info

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