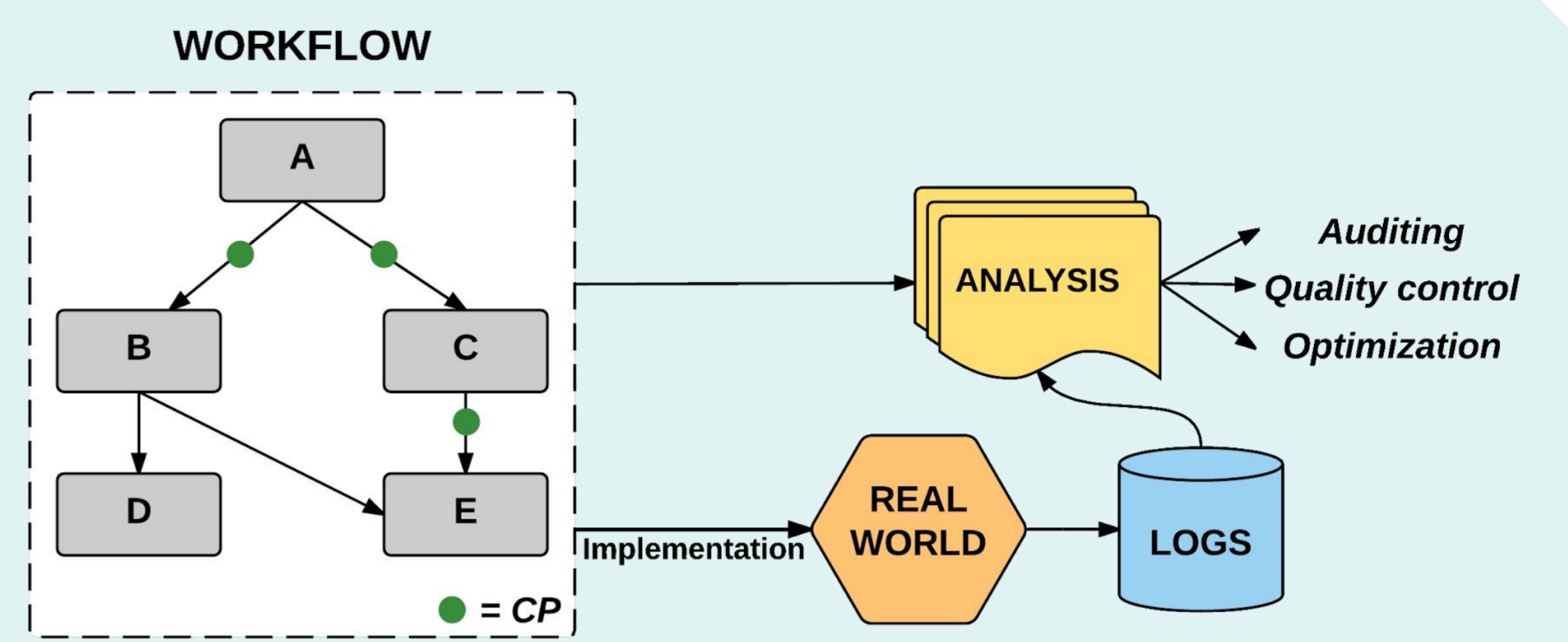


# CONTRIBUTION TO DEVELOPMENT OF TELEMATIC SERVICES FOR DATA ANALYSIS IN TECHNOLOGY AREA. APPLICATION TO E-HEALTH FIELD.

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## MOTIVATION

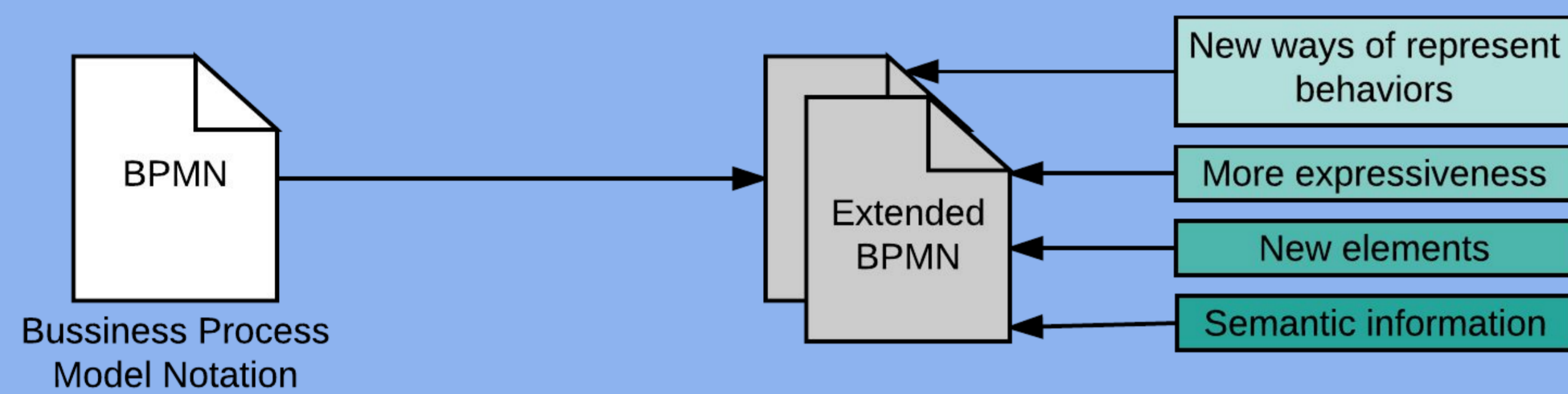
- In some contexts, such as the health domain, process monitoring is very important. It is necessary to control, check and verify the implementation of workflows in actual scenarios.
- Currently, ICT-based implementations and analysis techniques are gaining momentum providing a large set of advantages in auditing, quality control and optimization of procedures.
- Process Mining techniques are in continuous growing. It is a relatively young discipline and a lot of researches and futures lines are open. This PhD research tackles some shortcomings identified:
  - Some techniques are thought for workflows in which all the activities are monitorized. What happens with non-monitored activities?
  - Limited expressiveness of modeling languages. There is information that it is not represented in a machine interpretable format (therefore it can not be used in analysis).
  - It is necessary to improve the detection, prediction and recommendation of different behaviors.
  - Usability and understandability of these techniques are only reserved to experts.



## THESIS OBJECTIVES

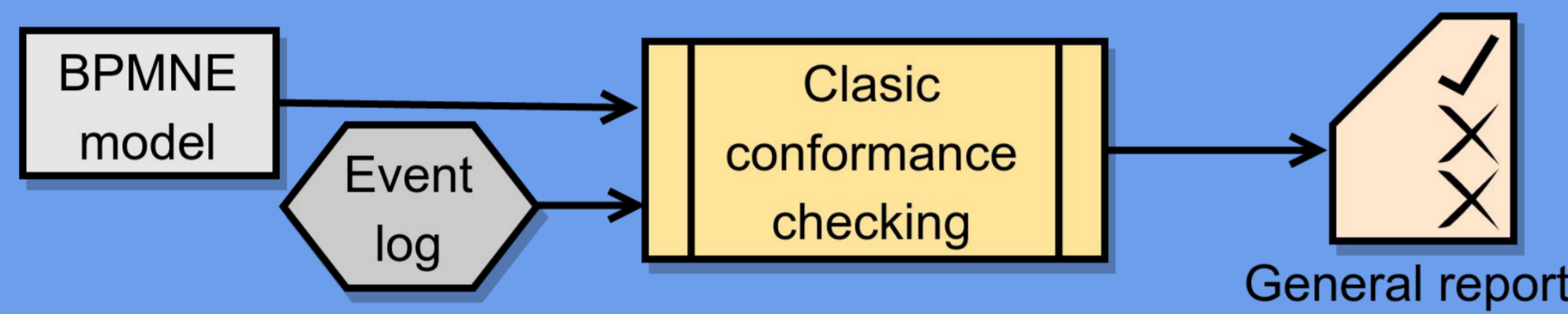
### Modeling languages:

- Extension of current modeling languages for improving its expressiveness.
- Current standards does not support the representation of many pieces of information provided in accompanying natural language documents. The extension must take into account all kinds of information available.

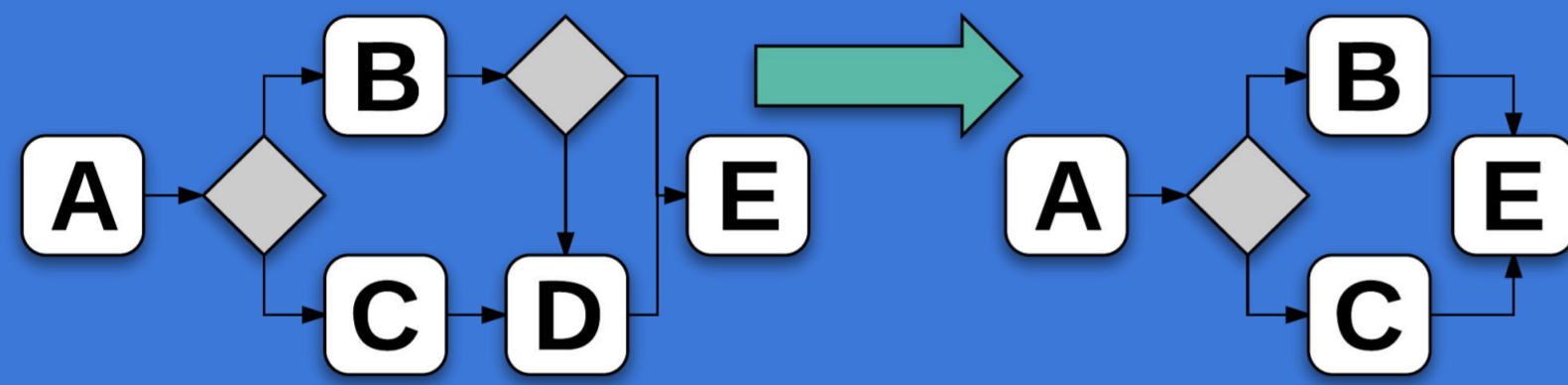


### Improve current adherence to protocols techniques by taking into account:

- Non-monitored activities.
- New semantic and context information provided by extended languages.

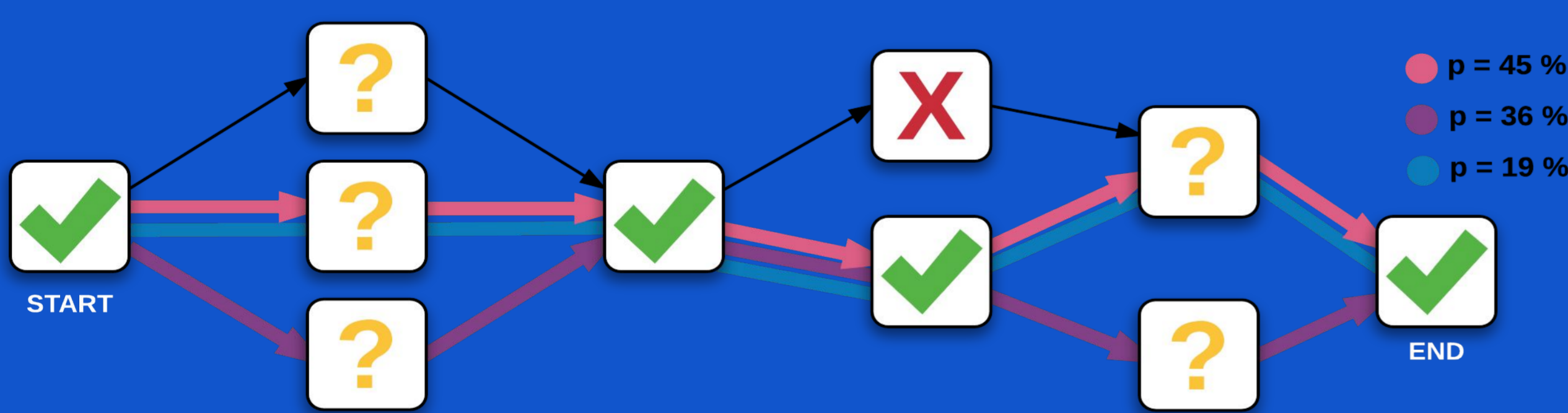


### Protocol effectiveness (e.g. simplicity) and understandability for humans users.



### About new types of analysis and results:

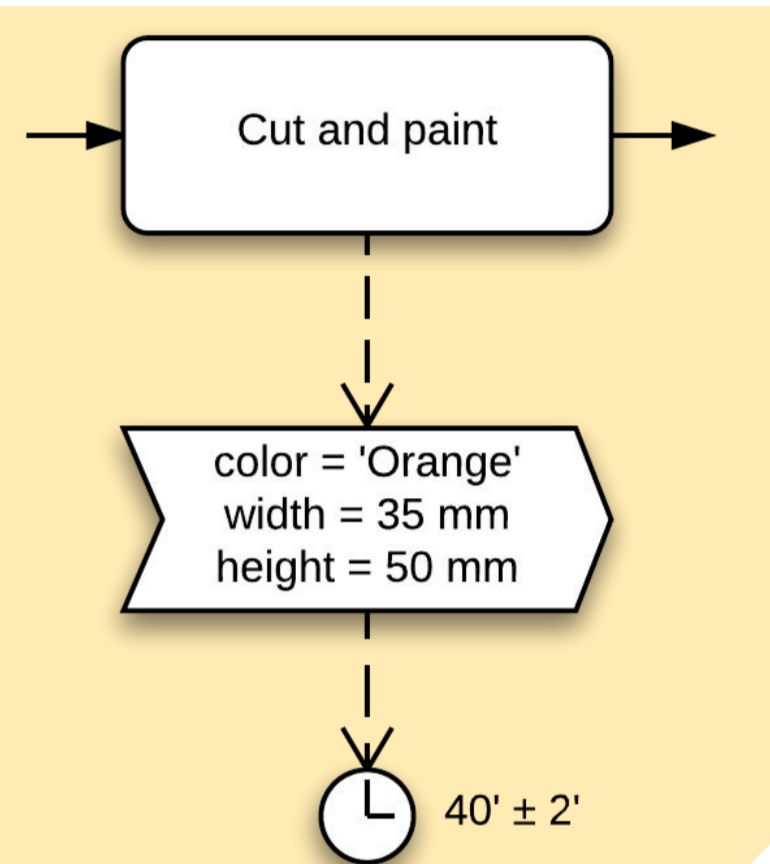
- Detection, recommendation and prediction of different behaviors.
- Analysis of "probability of taken paths" for non-monitored activities using semantic information about the context and state of products.



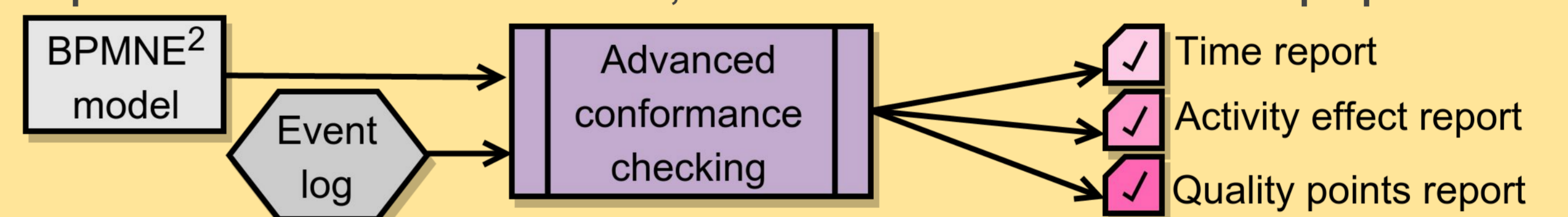
## RESULTS & DISCUSSION

Contribution to two JCR articles ([6, 7]) about the traceability process for process control using mobile devices. A real test of the system was carried out on a healthcare environment (about Parenteral Nutrition mixes).

- Improve the BPMN expressiveness with new elements.
- **During last year** the proposed extension was significantly improved. The proposal was sent to two JCR journals and the reviewers' comments has been considered. Also, ProM plugins were implemented in order to integrate the BPMN extension in current Process Mining techniques.
- Two research papers: one was presented at WORLDCIST'16 conference, the other was sent to a JCR journal (currently, a major revision is undergoing).



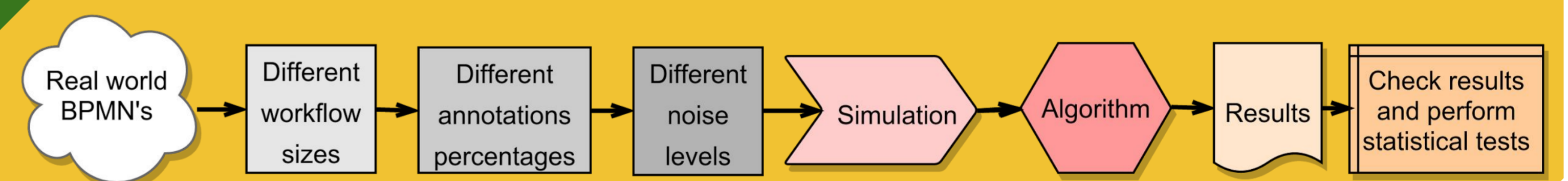
- **During last year** new advanced conformance checking analysis for generating more complex reports were designed. The objective is to improve the reports generated by current techniques.
- A research paper was presented at CISTI'15 conference. It gives a theoretical perspective of different architectures, automatic tools and new models proposed.



- A pattern based method for simplifying a BPMN process model. An iterative algorithm to achieve this objective is discussed, validated and implemented as a ProM plugin.
- **During last year** the algorithm was improved and tested with 70.000 simulation cases.
- A research paper was sent to a JCR journal. Currently waiting for a first decision.



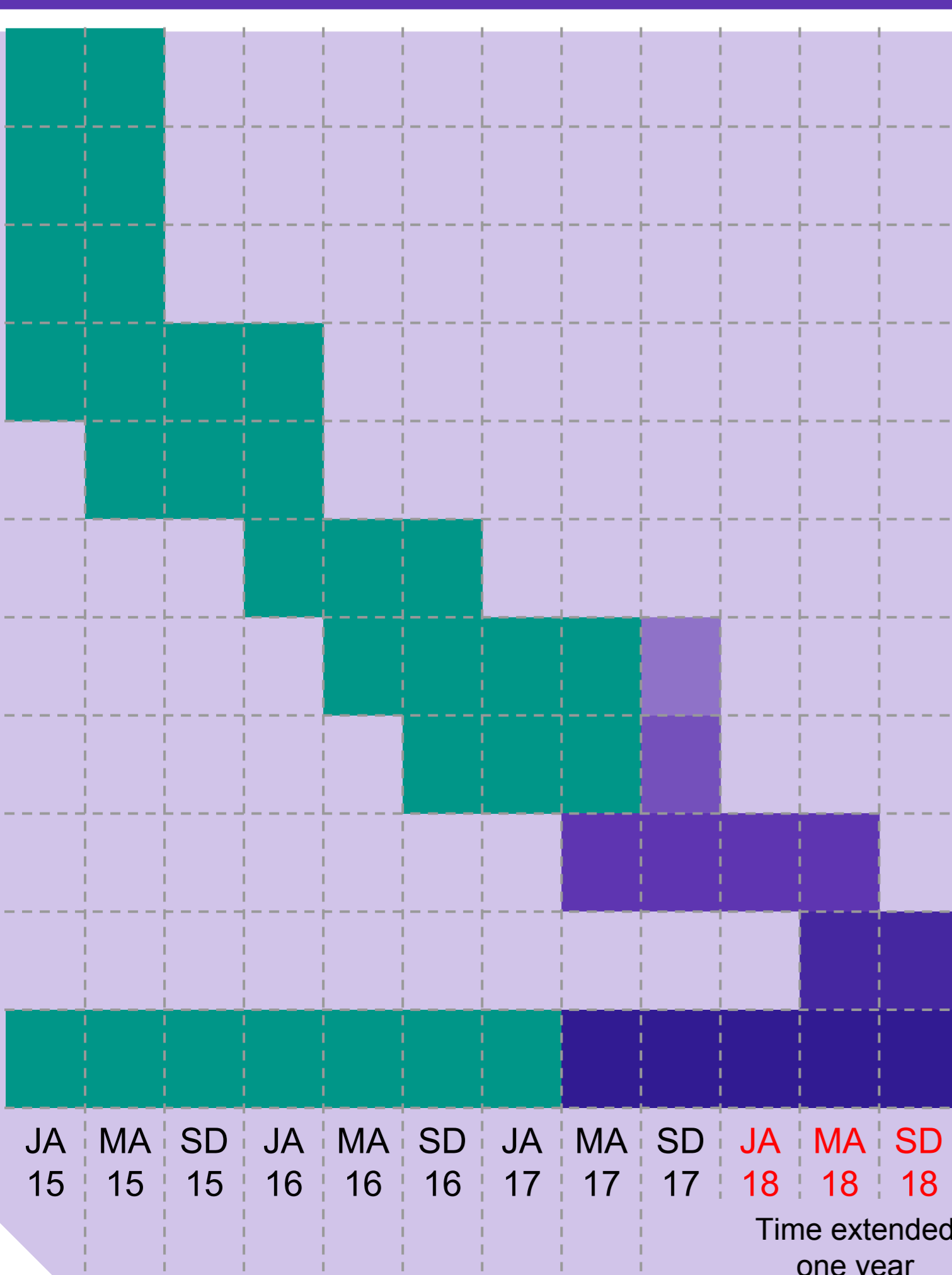
- Currently completing a research work about "probability of taken paths"
- At first, it is not possible to know the path taken by a product (different possibilities)
- It is used semantic information about the model given by the BPMN extension.
- **During last year** an implementation and testing of the algorithm was completed. A validation was carried out applying simulation techniques to real BPMN environments. Using 225.000 simulations the precision and robustness were checked.
- A paper is ready to be submitted for its consideration to a JCR journal.



## RESEARCH PLAN

**First steps in the research:**  
 → Motivation and objectives  
 → Informal courses  
 → Communications  
 → Review of the state of the art

Review modeling languages  
 Extension of modeling languages  
 New process mining developments  
 Design, develop & test developments  
 Validate final system in real scenarios  
 Writing and defending the PhD work  
 Disseminate partial and final results



## NEXT YEAR PLANNING

- Proof-of-concept tests in **real health scenarios** using the works and research proposed
  - Application of the research to health scenarios.
  - Validation of different architectures, models, algorithms and techniques proposed.
  - To be conducted in the frame of a eHealth project (Instituto de salud Carlos III)
- Dissemination of final results and discussions about research in international journals.
- Elaboration of final conclusions and writing and defending the PhD work.



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