

Verification of BPMN Models

Mihal Brumbulli - PragmaDev

Emmanuel Gaudin - PragmaDev

Frédéric Berre - DGA

Introduction

- BPMN describes processes and interactions between different participants in a complex organization
 - Air traffic control
 - Satellite constellations
 - Army forces coordination
- BPMN is part of NAF, which is used by the French Army to describe interactions between actors in a mission
- VeriMoB is a research project financed by the DGA (Direction Générale de l'Armement) in collaboration with Eurocontrol and Airbus DS who provided some real use cases

Motivation

- Make sure BPMN models are correct
 - Syntax / semantic - static
 - Logic - dynamic
- Automatically verify given scenarios
 - Record scenarios
 - Replay scenarios
- Automatically verify possible scenarios
 - Model complexity
 - Property verification

Outcome

- BPMN
 - Viewer
 - Executor
 - Explorer
- Use cases
 - DGA
 - Eurocontrol
 - Airbus DS

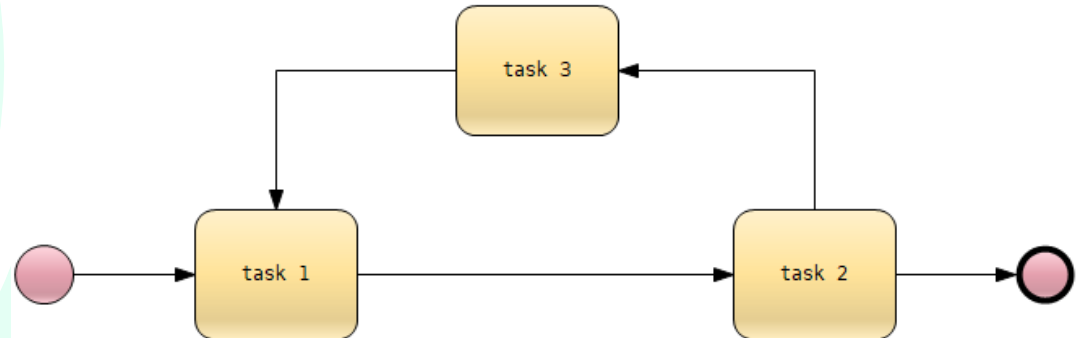
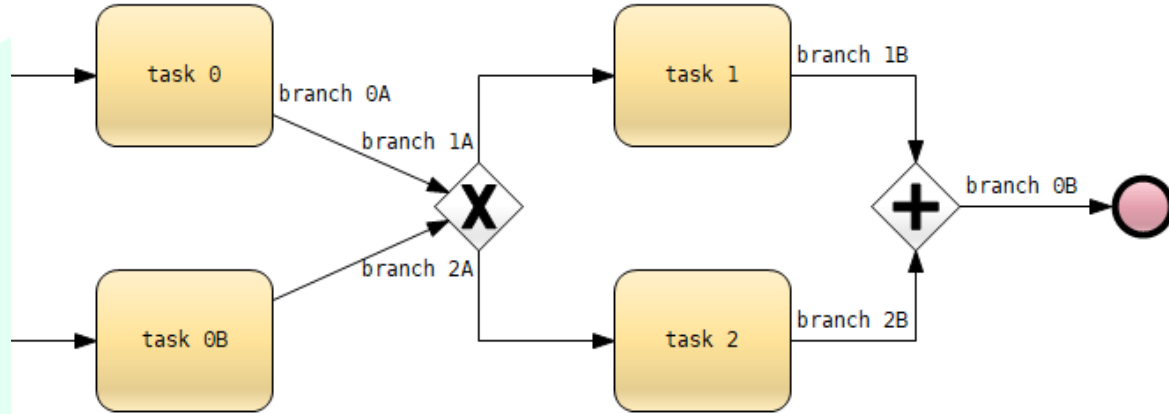
Executor (1st attempt)

- Use existing tool around SDL
 - Map BPMN semantic to SDL
 - Generate byte-code based on SDL semantic
 - Execute byte-code
- Translating BPMN to SDL is very tricky
 - Flow rather than participant oriented
 - Gateways, especially inclusive
 - Multiple flows

Executor (2nd attempt)

- Execute BPMN directly from AST
 - Full control over execution
 - Relatively easier to implement standard execution semantics
 - More flexible in introducing variations later (based on use cases)
- Still tricky, but acceptable
 - BPMN is not so easy at it seems
 - Language used in the standard
 - Room for interpretation

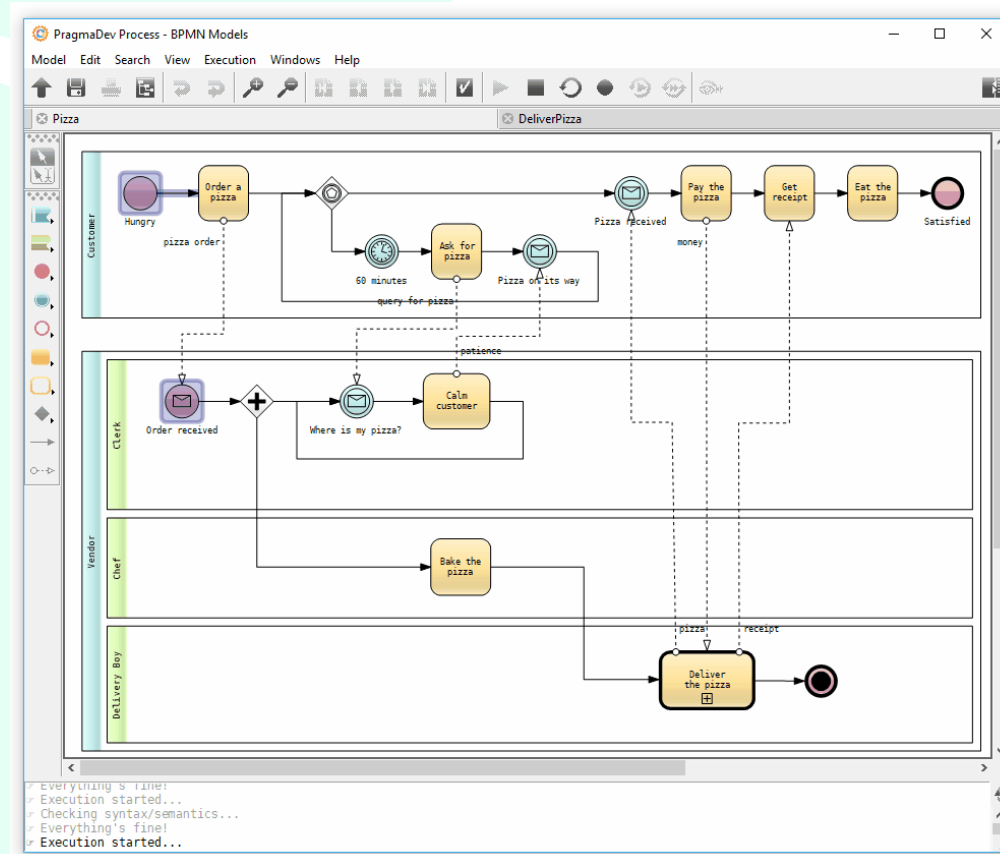
Gateways are tricky



Interactive execution

- User interacts with the BPMN model
 - **Enabling** action
 - **Disabling** action
- Actions can be issued on sequence flows, message flows, and process call-activities
- Each BPMN model element has a state (shown in color)
 - **None**: the element does not accept any action, and it has never been enabled or disabled
 - **Active**: the element is waiting for either an enabling or disabling action
 - **Ready**: an enabling action was issued, but the element cannot be enabled yet because it depends on the state of other elements
 - **Enabled**: an enabling action was issued, and all enabling conditions have been fulfilled
 - **Disabled**: a disabling action was issued on the element

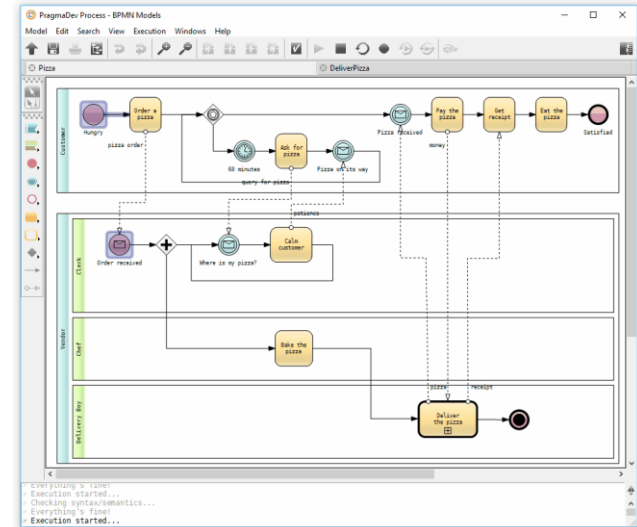
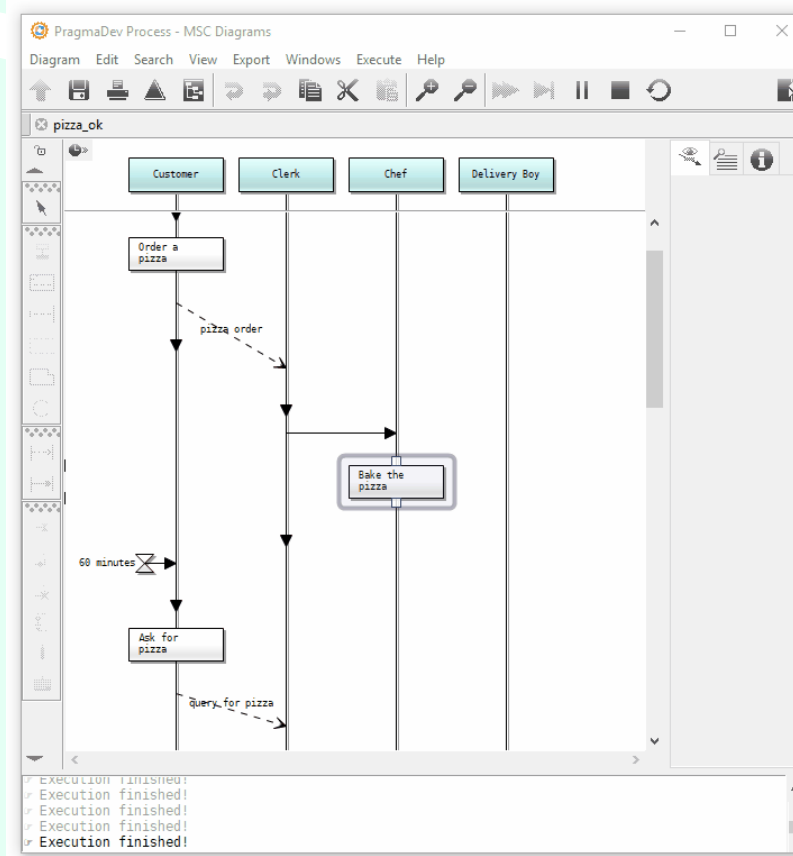
Interactive execution



Recording & Replaying

- Scenarios can be recorded in MSC
- Scenarios can be replayed
 - Single scenario mode
 - Step-by-step
 - Run-to-end
 - Multi scenario mode
- Make sure there is no regression

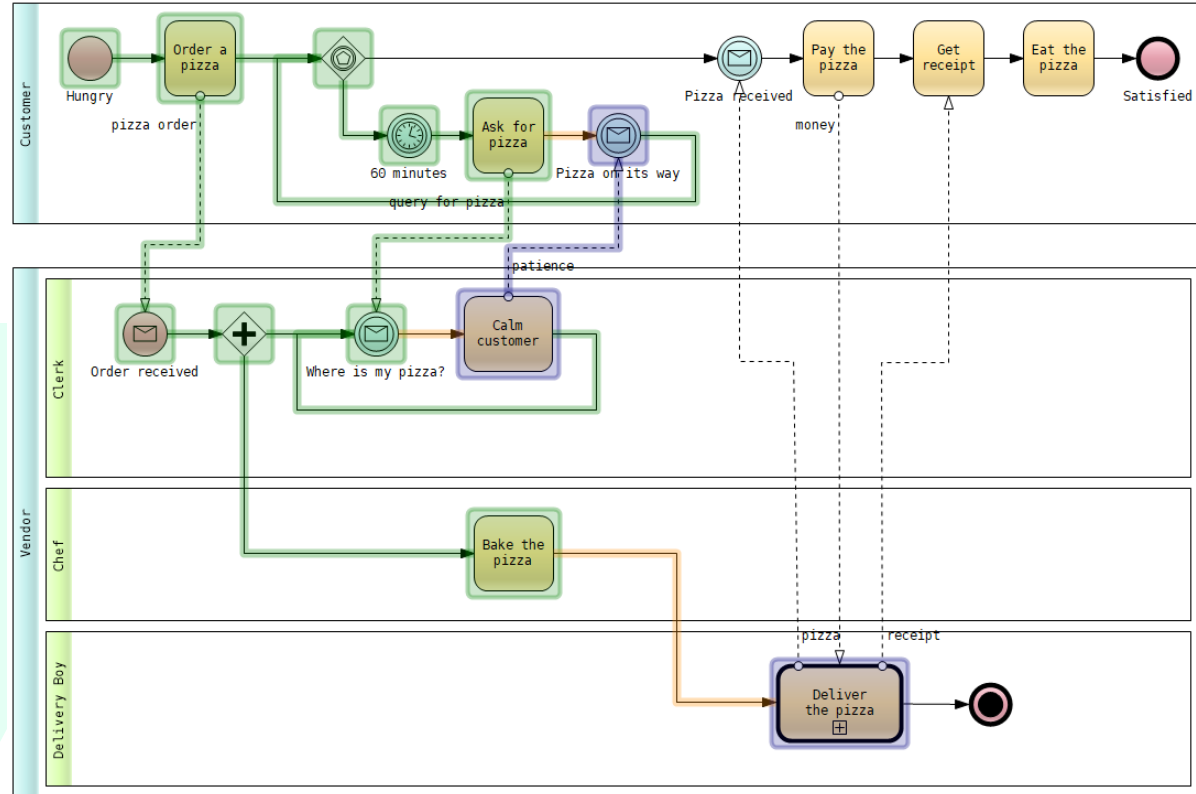
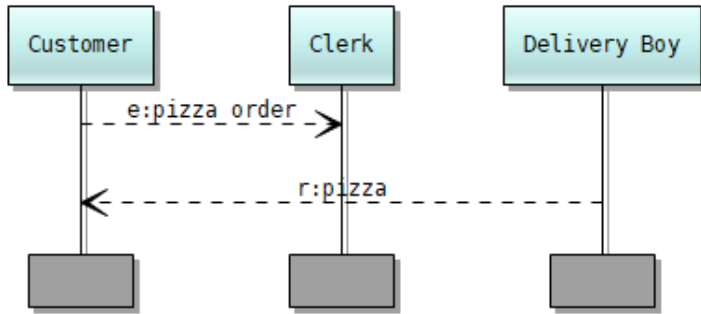
Recording & Replaying



Explorer

- The executor is coupled with OBP tool from ENSTA Bretagne research lab
- The tool can explore the different paths of execution automatically
- **Complexity index:** the number of possible paths is a rough indicator that can alert on possible flaws in the model
- **Property verification:** a property can be automatically verified at each step of execution; the tool will automatically generate the scenario leading to a violation

Property violation



Conclusion

- VeriMoB project was aiming at verifying BPMN models
- A set of tools have been developed including a viewer, an executor, and an explorer
- BPMN models can be verified statically and dynamically, and properties can be checked while exploring the model
- The tools made possible identifying problems in all use cases involved in the project