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DEPARTMENT OF COMPUTER SCIENCE
Data Science and Business Informatics

Business Process Modeling Project

Business Workflow Performance Analysis

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1 Introduction

The scenario that is depicted in the report has two individuals as the main actors, which after various exchanges of information and in a completely informal context, they organize their meeting for the purpose of carrying out activities together, in this specific case fishing.

The business process represented here that abstracts normal activities of the actors consists of a first part composed mainly of exchanges of availability, proposals and counter-proposals in order to get an initial agreement regarding the date, and then moving before the departure in which different scenarios appear, being able to conclude with either a final agreement and a departure or with a cancellation dictated by the will of the second actor.

In fact, recall that it is primarily **Alex** (the first actor) who will be the proactive part of the process, while it will be up to **Bob** (second and last actor) to have the final word on the outcomes of the event. As anticipated, the process will consist of two pools, each containing the activities and decisions of the respective actors, joined through links between the various interactions to form a single final workflow where each module communicates freely with the other and where.

The Collaboration Diagram created was developed with a **BPMN** basis, the analysis of the structure and operation of the processes was also translated into **Petri Net** with the help of software such as **Wopet** and **Woflan**

2 BPMN Process

2.1 Alex Flow

In the very first part of the process we observe Alex initialize the exchange by sending a Availability list of dates and initiating the back-and-forth with his friend.

Alex will wait for one of the possible responses from Bob (**Event Base gateway**), three to be precise, covering several possibilities: receiving a proposal, direct cancellation of the process due to other commitments, or a neutral response inviting Alex to send a proposal. If Alex receives a proposal, he can accept it, moving immediately to the second part of the system or provide a Counter-Proposal that will have to be processed below:

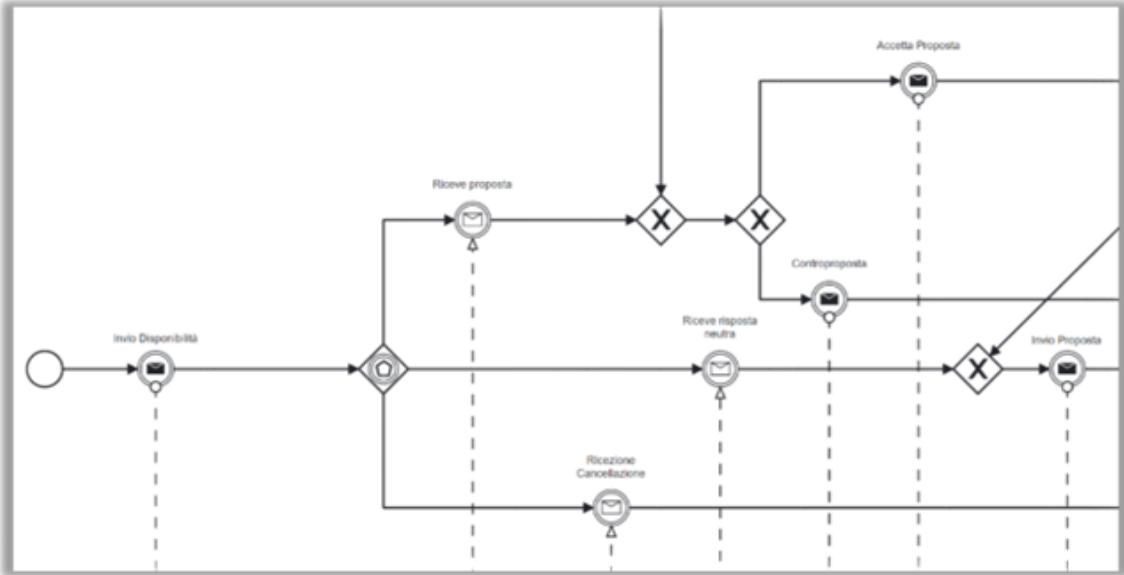


Figure 1: Alex BPMN Starting

Alex's sending of a proposal, be it a counterproposal or a first proposal, leads the scene to spiral toward an **Event Base Gateway** with branches later toward waiting for Bob to decide how to respond to Alex's offers. The latter can then receive a rejection directing the flow toward the negative term, receive a confirmation leading to an initial agreement between the two, or receive in turn a counteroffer from Bob. This last scenario eventually leads to two developments: a first where Alex accepts the proposal and moves things forward, or a return to a state where the proposal is rejected by Alex, the same proposes another one, and with a loop we repeat the scenario.

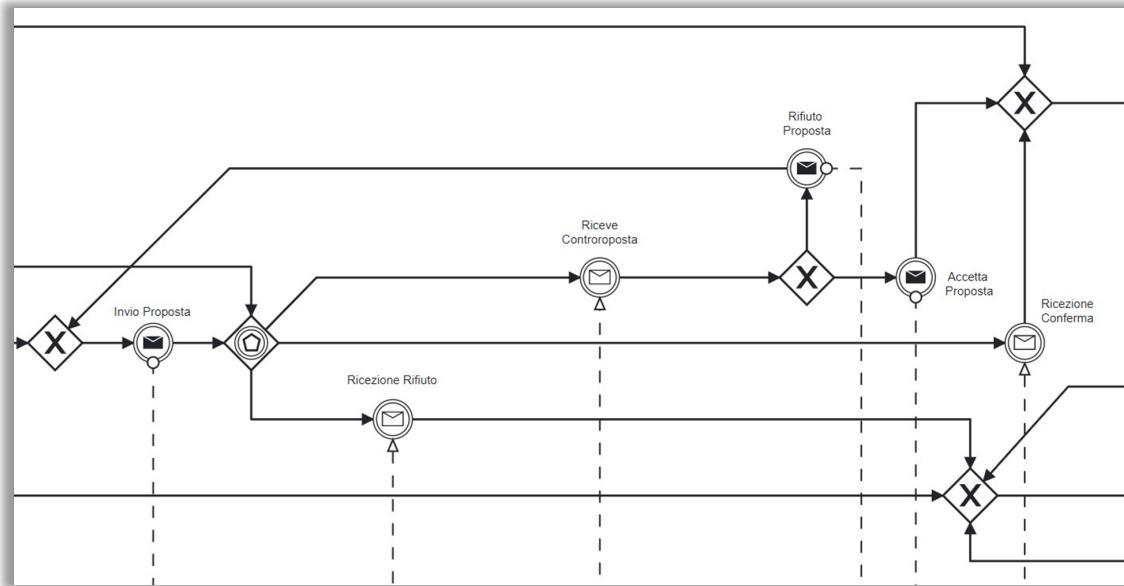


Figure 2: BPMN proposal and counter-proposal Alex

The scene then shifts to the second part where either an agreement has been made or where it moves toward an annulment that ends the process in toto.

In the first case then Alex will initiate a boat maintenance that can end in two ways: in the worst case, in fact, there will be problems and Alex will be forced to communicate this to Bob effectively canceling the arrangements and the process or, alternatively Alex will communicate the Place and time to Bob as a prelude to the last part of the process.

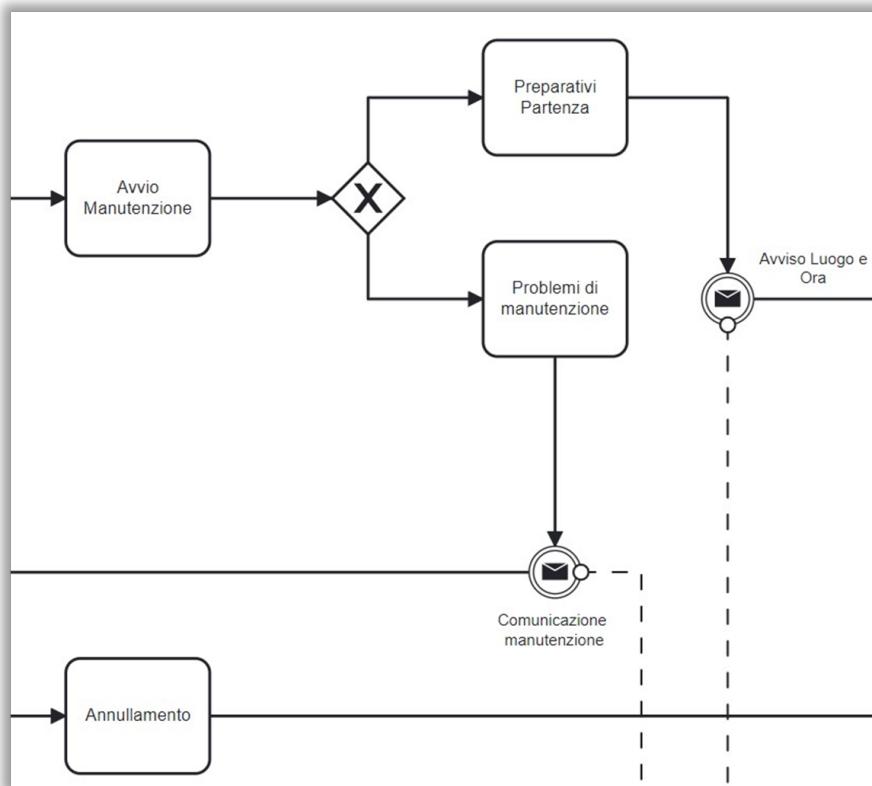


Figure 3: Starting maintenance or cancelling BPMN Alex

In the final phase leading up to departure Alex will be waiting for Bob, who until the last day before departure will be able to cancel the appointment bringing the process to a negative final state, or request a change returning to the earliest stages of the system where he will be able to re-opt for a back-and-forth between the two actors.

Alternatively, Bob will be able to simply complete the process by sending final appointment confirmation toward Alex concluding with a positive outcome.

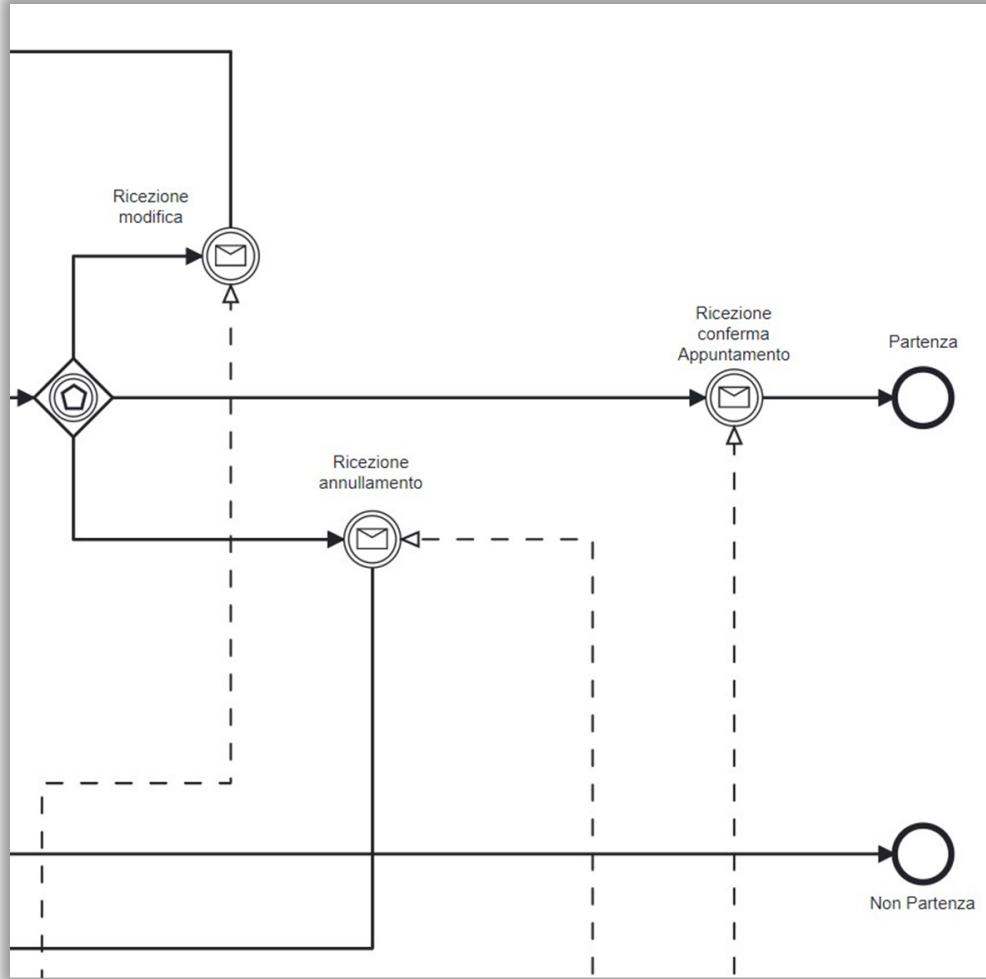


Figure 4: Final event gate waiting for Bob BPMN, Alex

2.2 Bob Flow

In a Workflow Module perspective, Bob's process begins with the receipt of the list of availability and immediately moves to an **XOR-Split** that defines the various choices that the same can take:

End the process immediately, send carte blanche asking Alex to decide, or Propose a date himself. In the latter case he will wait for (**Event Base Gateway**) a simple confirmation or a counterproposal.

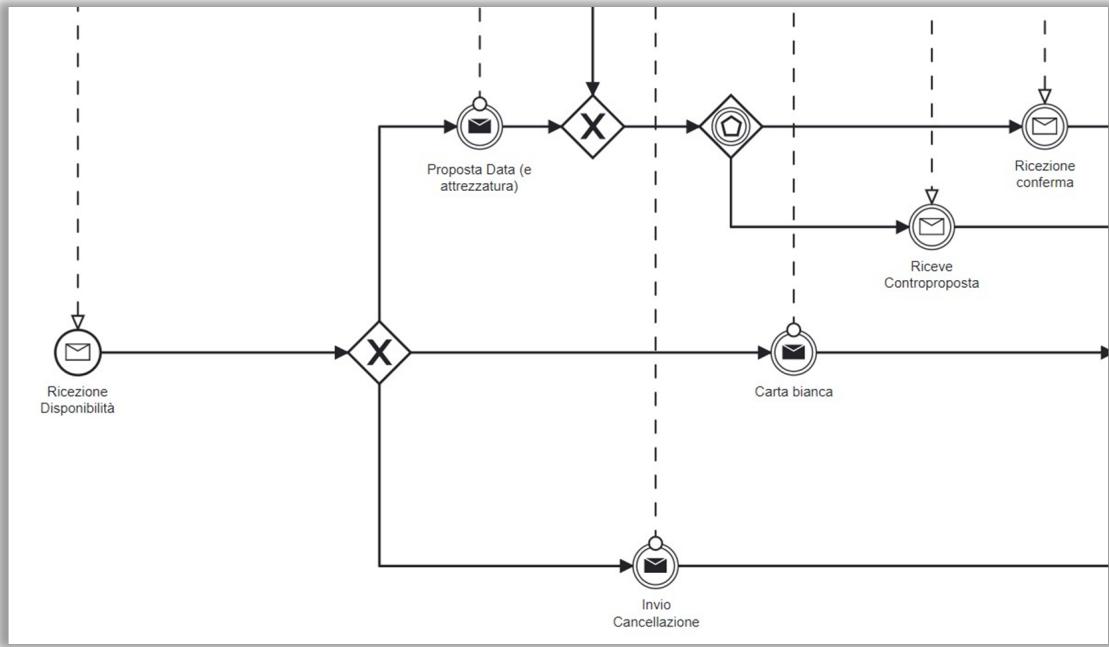


Figure 5: Bob BPMN Starting

Alex's eventual proposals will end in an **XOR-Gate** that will allow Bob to make subsequent decisions. He may in fact decline, cancelling the process, accept by carrying it forward, or resubmit a counterproposal. The latter case will generate two options for Alex, accept, or decline by sending another proposal thanks to a loop. Bob will remain on hold via Event Base Gateway.

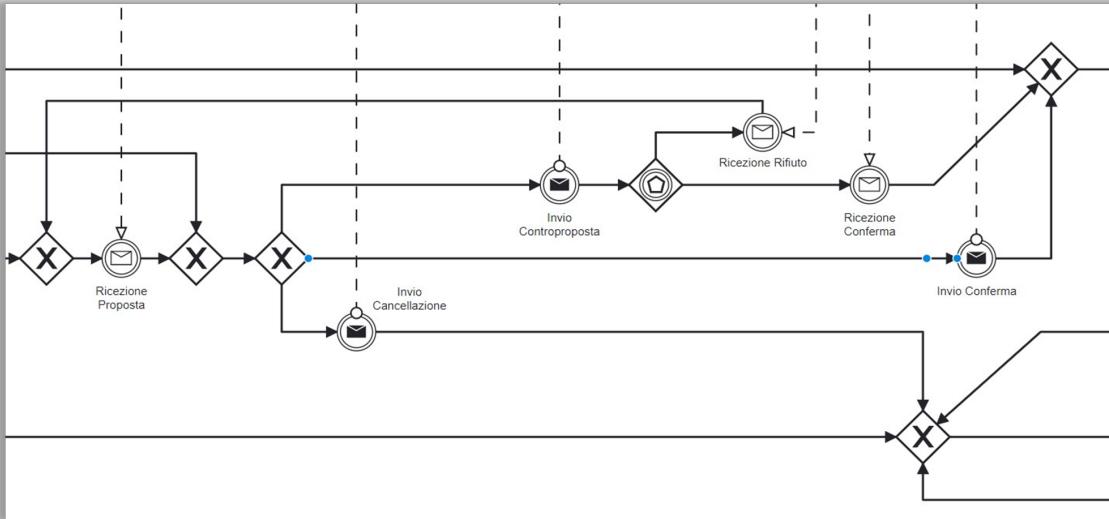


Figure 6: BPMN Bob proposals and counterproposals.

The second part of Bob's flow starts immediately after precisely finding an agreement or canceling the appointment and negatively ending the process.

Bob will prepare himself waiting for Alex's maintenance: if the latter is successful, it is continued, otherwise it is terminated.

In the former case Bob will receive Time and Place of the meeting and he will have time, as outlined above, until the last day before the departure to make a decision (hence the use of a **Timer Boundary Event**).

He may in fact deliberately decide to go ahead by officially confirming the appointment and successfully ending the process, or Reconsider and Cancel the process or request a change of date, which in the BPMN model translates in a return to the very first exchanges of proposals.

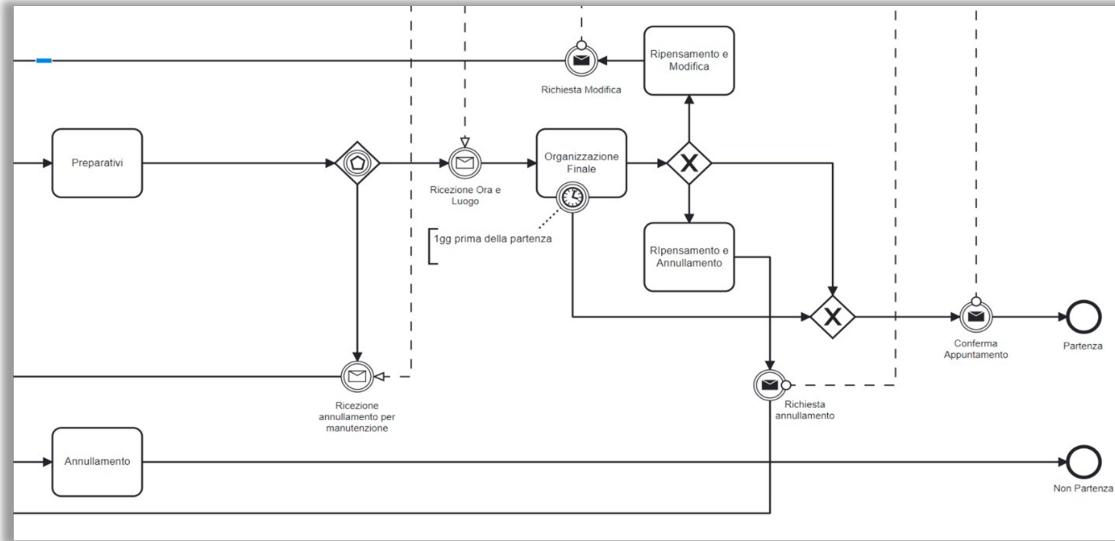


Figure 7: Preparations or cancellation BPMN Bob

2.3 Complete BPMN Process

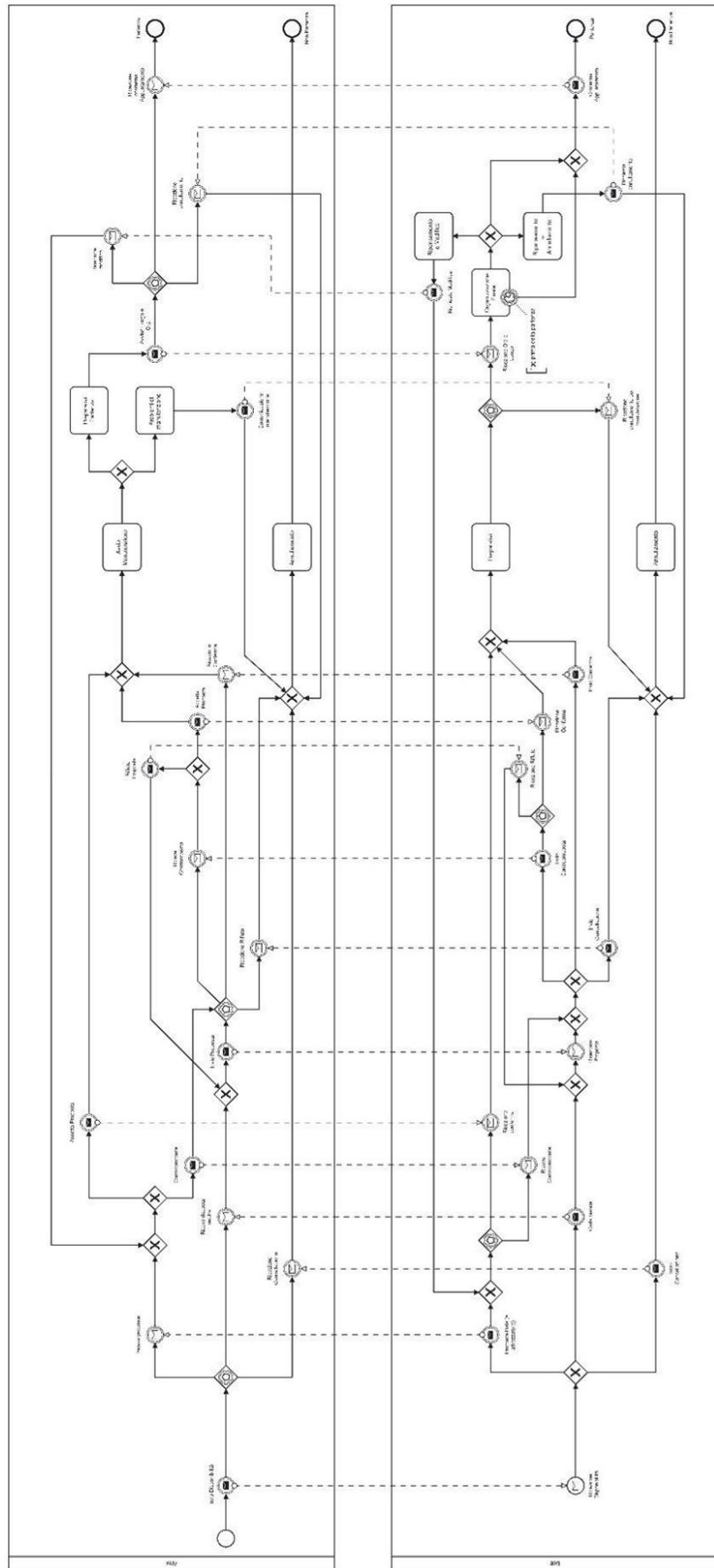


Figure 8: Workflow Module Alex and Bob

3 PETRI Net Analysis

The BPMN diagram was subsequently translated into Petri Net in order to be able to carry out a structural and semantic analysis of the process. To carry it out, the following steps:

- a) The arcs of the BPMN were transformed into **Places**.
- b) The activities and events of the BPMN were transformed into **Transactions**.
- c) The different gates (**XOR Split - Join**) were "De-Sugarized."
- d) Due to the presence of a double ending for both subjects (Departure- Non Departure) an additional transaction with subsequent final place were added in order to channel the flow into a single dummy final output, useful to the analysis structural analysis of the Petri-Net.
- e) The process with Bob's "Final Organization" timer was split into two transitions, one of them with a time trigger.

3.1 Alex Petri Net

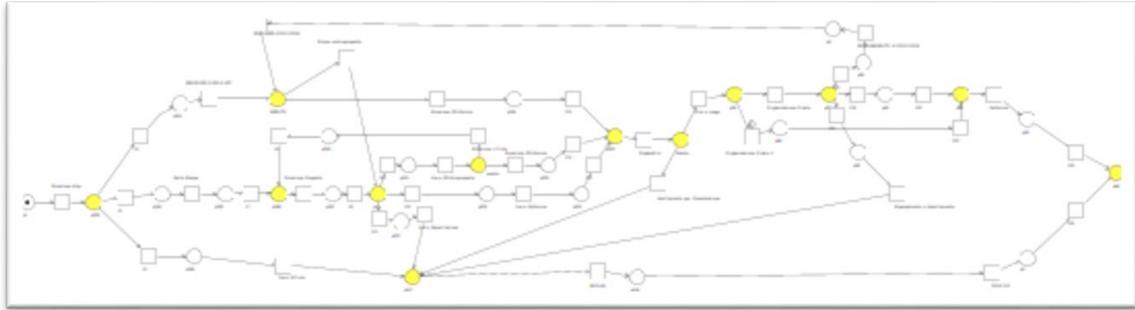


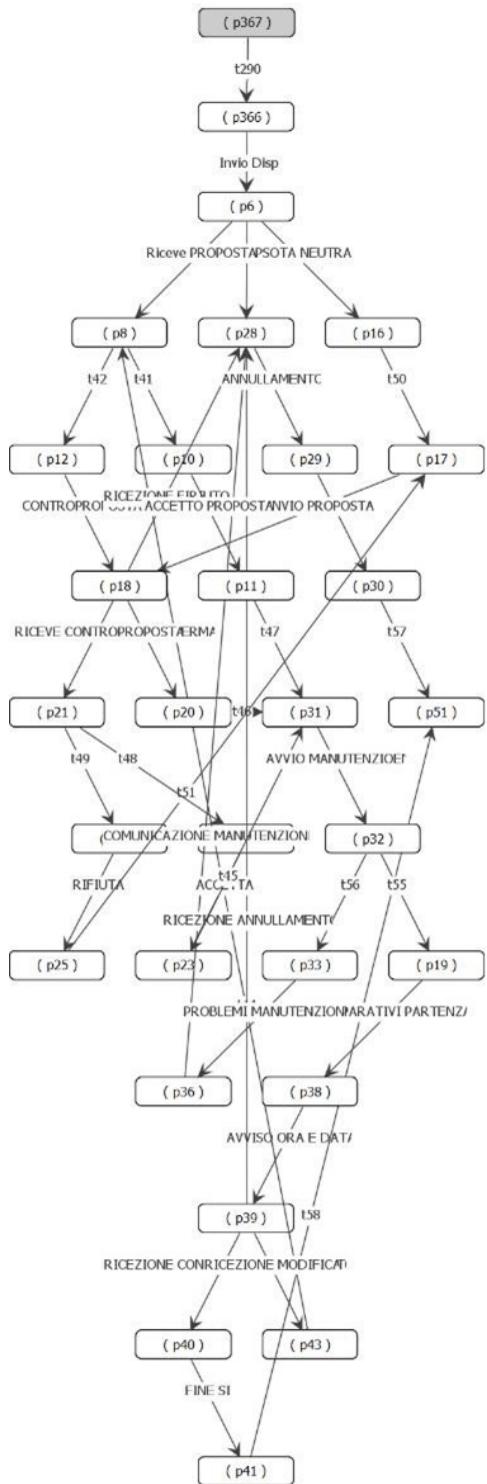
Figure 9: De-sugarized PETRI Net Alex

By performing a semantic analysis we obtain a network with 30 places, 38 transitions and 76 arcs. In addition to this, it is a Workflow Net because:

- a) The initial Place has no transition preceding it; therefore, its preset is empty.
- b) The Final place has no transition afterwards; therefore, its preset is empty
- c) The above places are connected by a path that joins them.

3.1.1 Structural Analysis and Soundness Capability

- **Sound:**
 - *No Dead Tasks*
 - *Option to Complete*
 - *Proper Completion.*
- **Deadlock Free & Bounded.**
- **Free Choice.**
- If N is Live, N^* is also Live.
- **Wellstructured:** the network contains no **PT-Handles** or **TP-Handles**, therefore there will be no ambiguities or any issue.
- **S-Coverable:** each place belongs to an **S-Components** defining its coverability.
- **Coverability Graph \equiv Reachability Graph.**



Semantical analysis

Wizard Expert

- Qualitative analysis
- Structural analysis
 - Net statistics
 - Places: 30
 - Transitions: 38
 - Operators: 0
 - Subprocesses: 0
 - Arcs: 76
 - Wrongly used operators: 0
 - Free-choice violations: 0
 - S-Components
 - S-Components: 1
 - Places not covered by S-Component: 0
 - Wellstructuredness
 - PT-Handles: 0
 - TP-Handles: 0
- Soundness
 - Workflow net property
 - Initial marking
 - Boundedness
 - Liveness

Figure 10: Coverability Graph and Semantical Analysis ALEX

3.2 Bob Petri Net

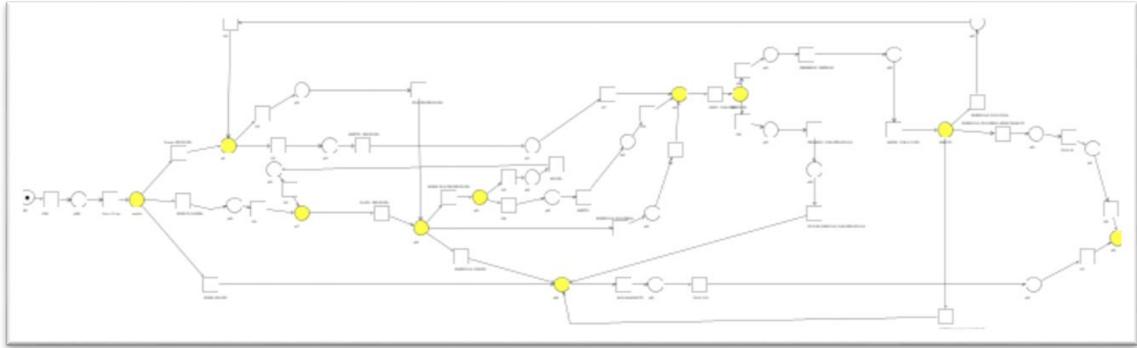


Figure 11: De-sugared PETRI Net Bob

The analysis of the second process [11] produces the following scenario: the network has 33 places, 42 transitions and 84 arcs. It is also a Worflow Net because:

- a) The initial Place has no transition preceding it; therefore, its preset is empty.
- b) The Final place has no transition afterwards; therefore, its preset is empty.
- c) The above places are connected by a path that joins them.

3.2.1 Structural Analysis and Soundness Capability

- **Sound:**
 - *No Dead Tasks*
 - *Option to Complete*
 - *Proper Completion.*
- **Deadlock Free & Bounded.**
- **Free Choice.**
- If N is Live, N^* is also Live.
- **Wellstructured:** the network contains no **PT-Handles** or **TP-Handles**, therefore there will be no ambiguities or any issue.
- **S-Coverable:** each place belongs to an **S-Componets** defining its coverability.
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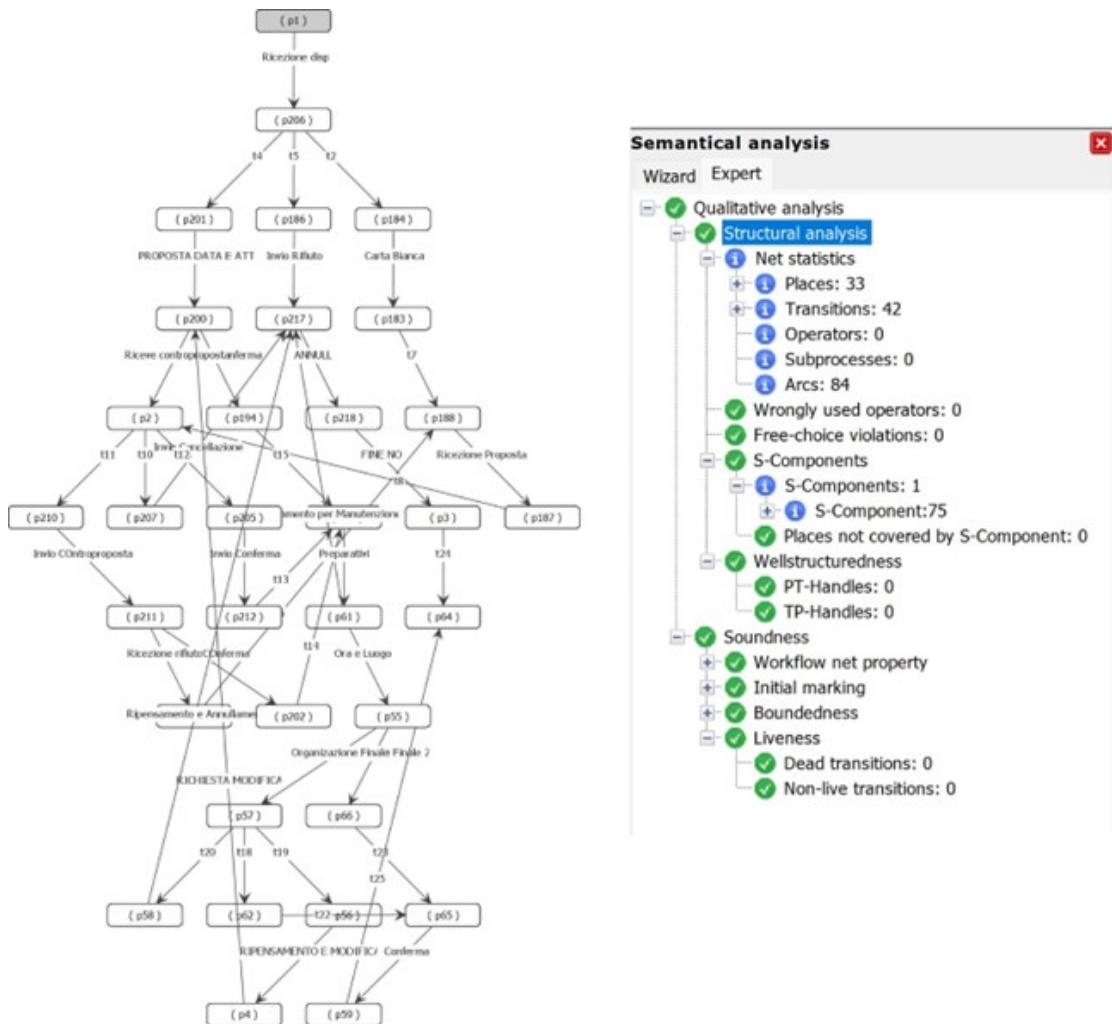


Figure 12: Coverability Graph Semantical Analysis BOB

3.3 PETRI Net Complete Process

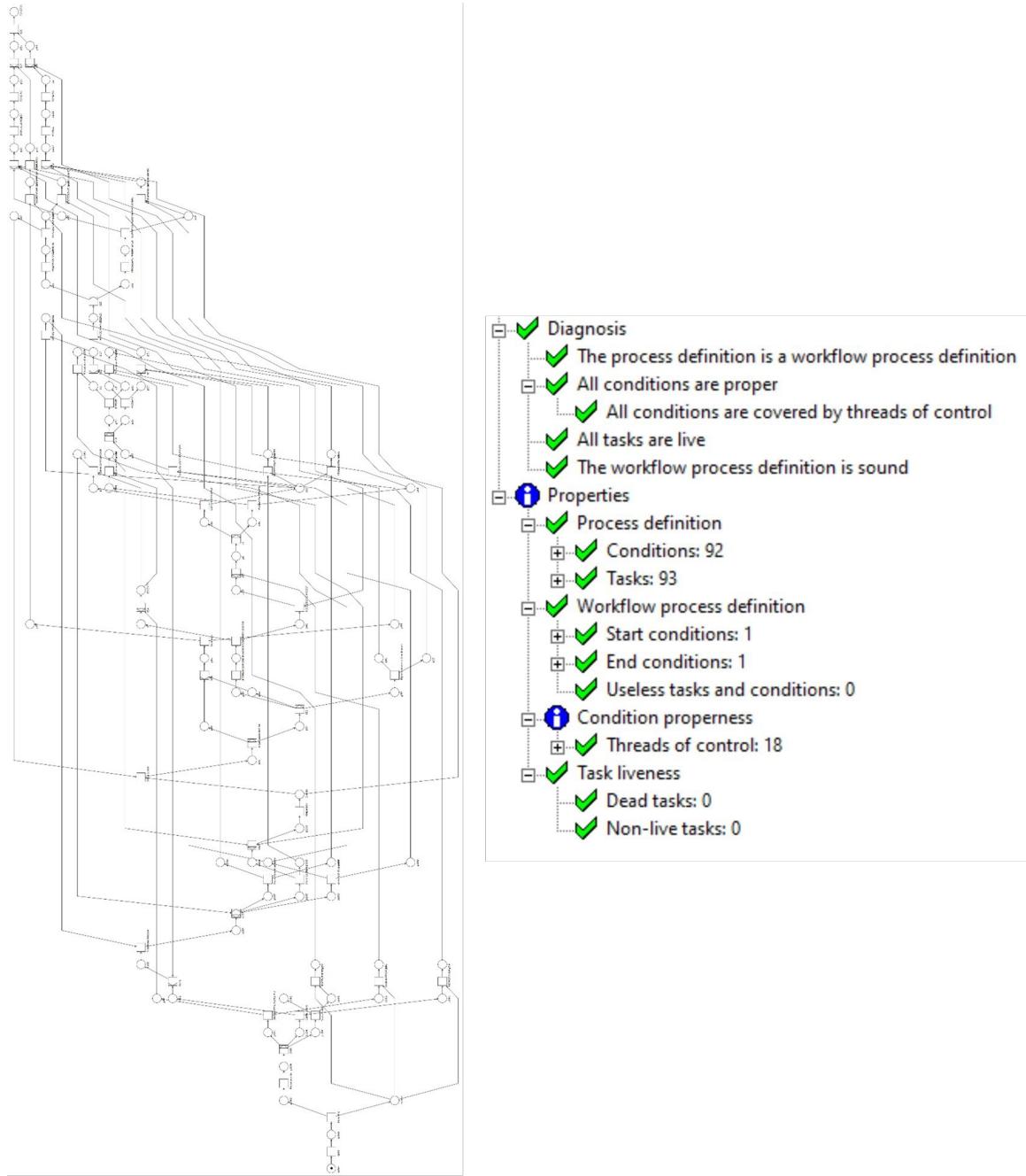


Figure 13: Alex Bob union Petri net WOFLAN analysis

4 Conclusion

The softwares used for the implementation of the project are **WoPeD** for the creation of the PetriNets and in parallel **Woflan** for the analysis of more complex structures that the former has much difficulty in handling [13]. The two nets were then merged into a single Workflow Module containing the two pools.

Message flows were translated with the inclusion of places useful for linking the outgoing and incoming transactions. Since the networks taken individually are sound, it was possible to analyze the soundness of the composed network, again confirming that this is a system that complies with the rules of no **Dead Tasks**, **Option To Complete** and **Proper Completion** being therefore **Sound**.

Finally, it is reported that although Alex and Bob were systems without any issues, the introduction of links leads to case with possible**Free-Choiceness** revisits.