Azienda di trasporti

Business Process Modelling Project

Authors

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1 Introduction

1.1 Assignment

Si consideri lo scenario della gestione delle consegne di un vettore di un'azienda di trasporti. Il processo inizia quando il vettore riceve un ordine di trasporto con data, luogo e contatto di origine, e data, luogo e contatto di destinazione. Se il vettore non è in grado di effettuare il trasporto il processo termina. Altrimenti il vettore inserisce l'ordine nel piano delle consegne ed effettua il prelievo, il trasporto e la consegna nei tempi indicati. Se il mittente o il destinatario non sono presenti al momento del prelievo o della consegna il vettore li contatta per negoziare una nuova data di prelievo e consegna. Durante le negoziazioni vengono proposte a turno nuove date fino a quando l'ultima data proposta viene accettata. Al momento del prelievo e della consegna vengono fatti firmare i documenti di trasporto al mittente e al destinatario, rispettivamente. Il processo termina quando il destinatario restituisce il modulo firmato. Progettare opportuni processi che rispecchino fedelmente lo scenario sopra descritto e siano compatibili. Modificare i processi in modo che, in caso di un ritardo imprevisto, il vettore contatti preventivamente il destinatario per negoziare una nuova data di consegna

1.2 Utilities

The project employed Camunda, a fast and effective online service offering error-checking capabilities, for process modeling and implementation of the BPMN model. Additionally, WoPeD was used to construct and analyze the Petri net during development. For the final analysis, WoFLAN was chosen to ensure faster execution, addressing crashes and structural constraints within the net.

2 BPMN model

The BPMN model was constructed based on the specifications provided for a vector delivery service. Three actors were identified: the carrier (primary actor), sender, and receiver. While these actors are inherently interconnected due to potential delivery error and rescheduling cycles, the BPMN model adopted a choreography approach, utilizing three separate pools connected by message flows. During the transformation from BPMN to workflow net, places were used to connect the flow of messages between the three actors, so tokens represent the message flow.

2.1 Carrier Pool

Initiating at the core of the orchestration, the carrier pool, the process initiates when the carrier receives the order details, including the date and location of both origin and destination. The carrier's initial step involves consulting their calendar and the received information to assess their availability for the delivery and estimate the required time. This evaluation leads to a decision point represented by an XOR (exclusive OR) gateway. If the carrier is unavailable, the process terminates, and the order is discarded and archived.

Conversely, if the carrier confirms availability, the delivery is scheduled in their calendar for tracking purposes. Subsequently, the carrier initiates the parcel retrieval process by sending a message flow to the sender to verify their presence (the initial delivery date was determined by the sender). Another XOR gateway emerges here, delineating two possible scenarios.

Should the sender confirm their presence, the carrier obtains the necessary transportation documents and proceeds with the delivery. However, if the sender is absent, the carrier proposes an alternative date, initiating a date proposal cycle that is also engaged when an error occurs during delivery and the carrier is unable to complete the task. This cycle entails both actors suggesting dates until a mutually agreeable one is found, considering their respective calendars. The actors communicate via message flows, accepting or rejecting proposed dates. The process advances seamlessly if the sender proposes a date, implying their availability. If the carrier proposes a date and the sender accepts, the process reiterates from the sender presence verification stage.

From the carrier's perspective, the interaction with the receiver mirrors the process with the sender, with the key distinction that the process concludes upon the receiver's acceptance and signature of the transportation documents, leading to the order's archival.

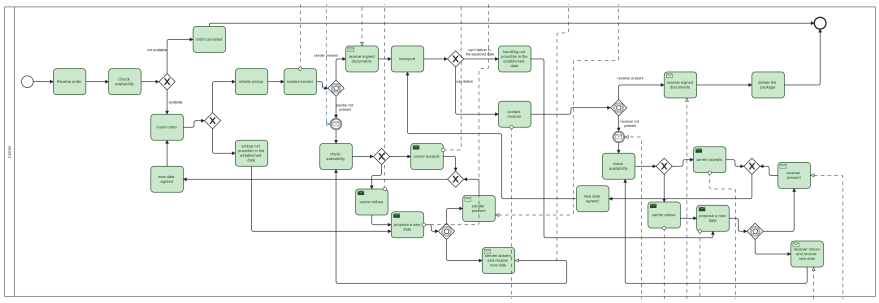

Figure 1: Carrier's Pool

2.2 Sender and receiver Pool

The sender and receiver pools are analyzed jointly due to their inherent similarity. Both involve the same date cycling process, as either party may be unavailable for the parcel's delivery or pickup. The process commences with a message flow. If the sender or receiver is present, they sign the necessary documents, and the confirmation is relayed to the carrier for further processing. Conversely, if absent, they consult their calendars and either propose a new date or accept the carrier's suggestion. This response is communicated back to the carrier pool, enabling the continuation of the order process.

The following page presents a comprehensive snapshot of the complete BPMN diagram.

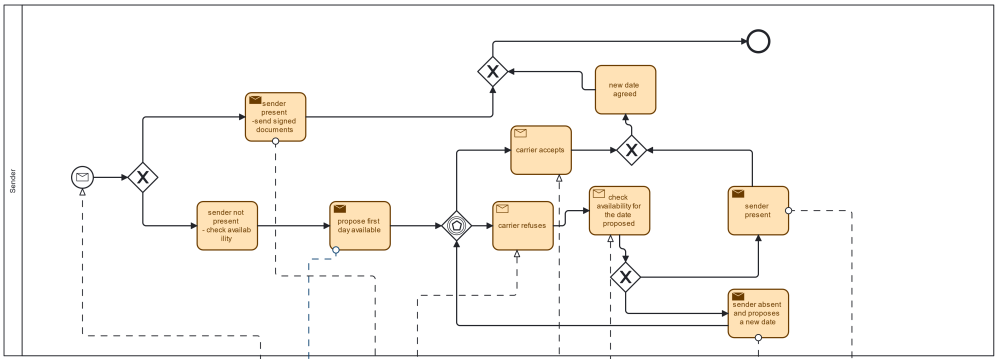

Figure 2: Sender's Pool

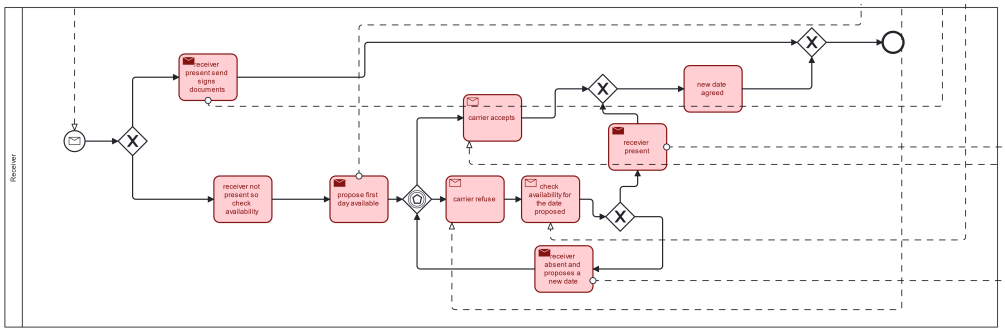

Figure 3: Receiver's Pool

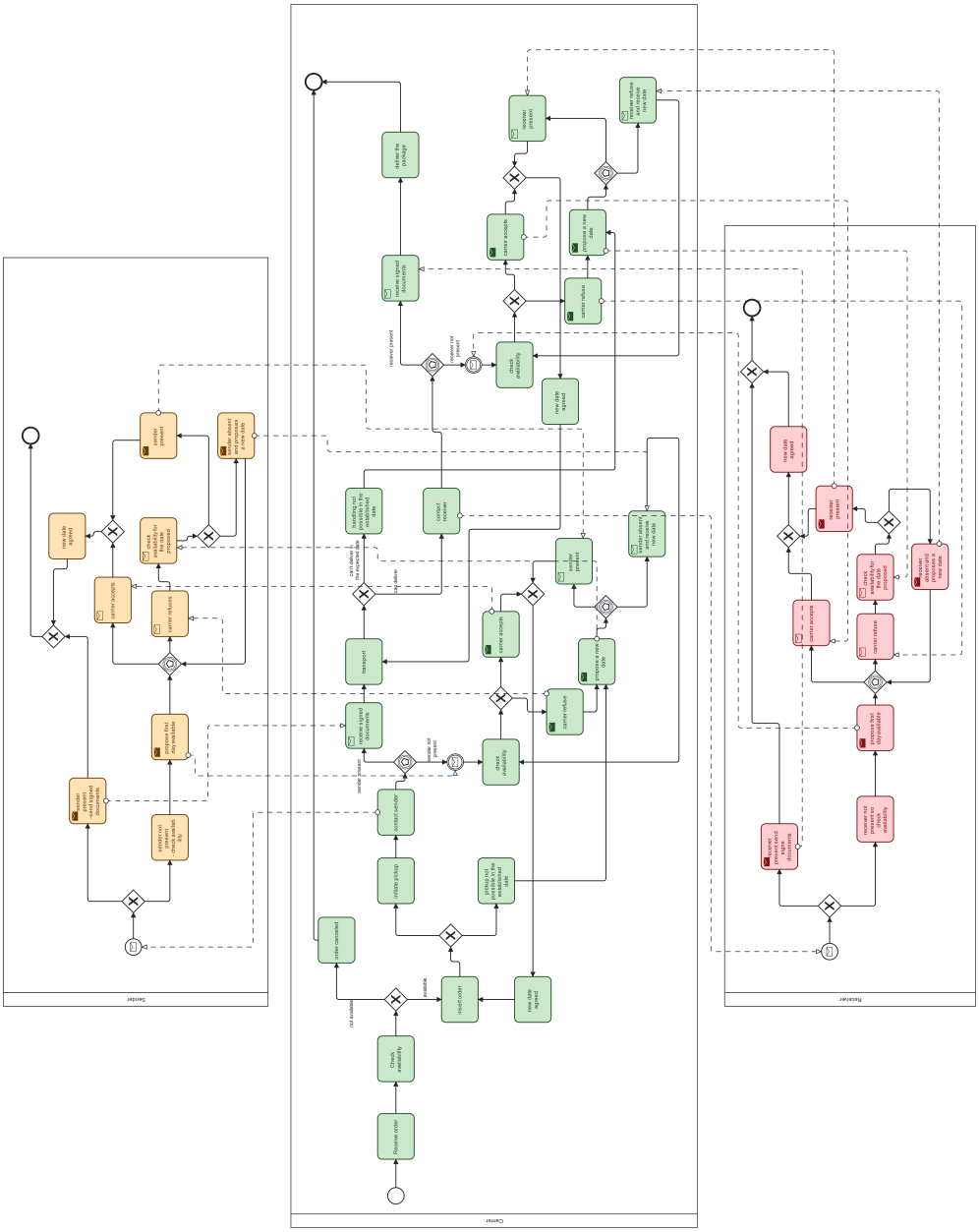

Figure 4: Complete BPMN diagram

3 Petri Net

3.1 Main techniques and challenges

For the transformations applied during Petri net construction, the following steps were consistently performed for all transformed items:

1. An initial and a final place were added;
2. Places and transitions were added to capture the control flow of gateways;
3. Activities and events were transformed into transitions.

As mentioned in section 2, a the workflow nets were connected by control places that send information back and forth. These processes primarily focus on confirming the presence of the sender or receiver and, if present, retrieving the necessary documentation to proceed with the delivery order process.

The primary challenge lies in the iterative date proposal cycle between the carrier and the sender/receiver.This cycle, intrinsically linked to the carrier's process, necessitates continuous interaction among the actors.

3.2 Analysis

3.2.1 Structural analysis - Carrier

1. It is a workflow net
   (a) Has a source and a sink place
   (b) It is strongly connected
   (c) It is well-handled
2. N is an S-Net (it's sound) and it's Safe
   (a) It's deadlock free and bounded and free choice
   (b) It has Option to complete and Proper termination
3. It's S-Coverable by 1 S-component
4. It's Well-structured
5. The net has 21 places, 29 transitions and 58 arcs
6. The coverability graph has 21 vertices and 29 edges

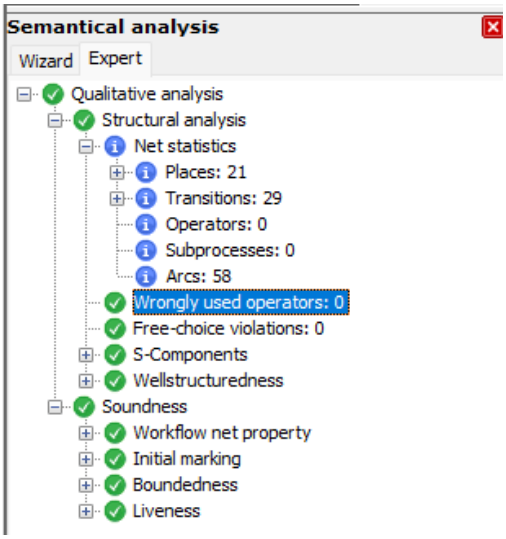

Figure 5: Semantical analysis

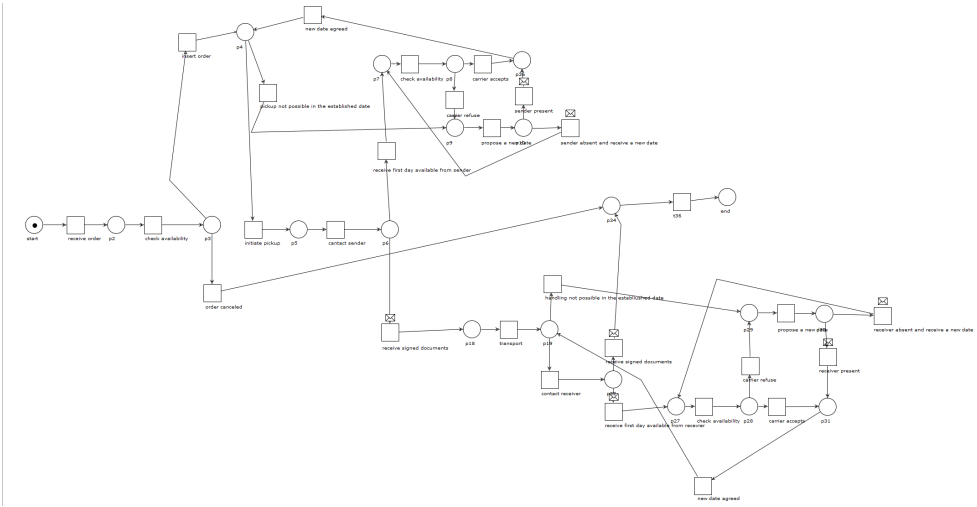

Figure 6: Carrier's Pool

3.2.2 Structural analysis - Sender and Receiver

1. It is a workflow net
   (a) Has a source and a sink place
   (b) It is strongly connected
   (c) It is well-handled
2. N is an S-Net (it's sound) and it's Safe
   (a) It's deadlock free and bounded and free choice
   (b) It has Option to complete and Proper termination
3. It's S-Coverable by 1 S-component
4. It's Well-structured
5. The net has 9 places, 11 transitions and 22 arcs
6. The coverability graph has 9 vertices and 11 edges

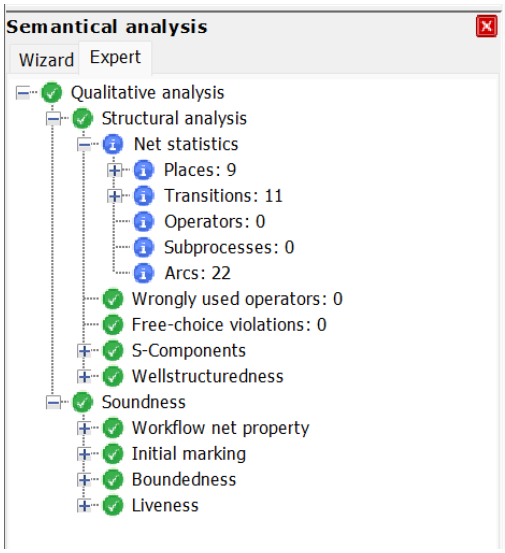

Figure 7: Semantical analysis

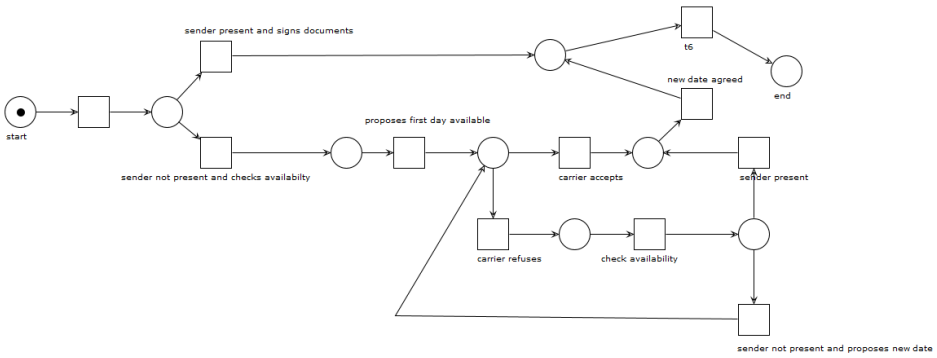

Figure 8: Sender's Pool

3.2.3 Structural analysis - Complete

1. It is a workflow net
   (a) Has a source and a sink place
   (b) It is strongly connected
   (c) It is well-handled
2. N is an S-Net (it's sound) and it's Safe
   (a) It's deadlock free and bounded and has free choice violations
   (b) It has Option to complete and Proper termination
3. It's S-Coverable by 1 S-component
4. It's Well-structured
5. The net has 48 places, 47 transitions and 124 arcs
6. The coverability graph has 44 vertices and 57 edges

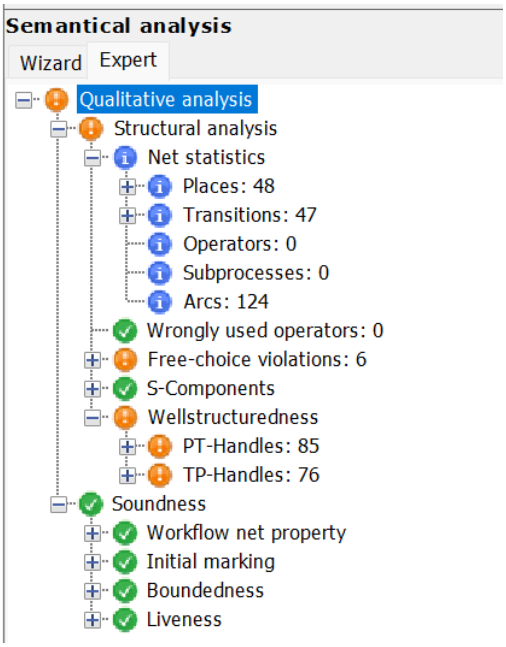

Figure 9: Semantical analysis

3.2.4 Free choice violations groups and PT/TP handles

The presence of the sender/receiver, which is not freely chosen, and also the communication between the actors results in the creation of different free choice violation. These groups exhibit reachable places/transitions contingent upon the presence of the sender/receiver. Consequently, numerous PT/TP handles remain unstructured, as restructuring them to mitigate this issue proves challenging.

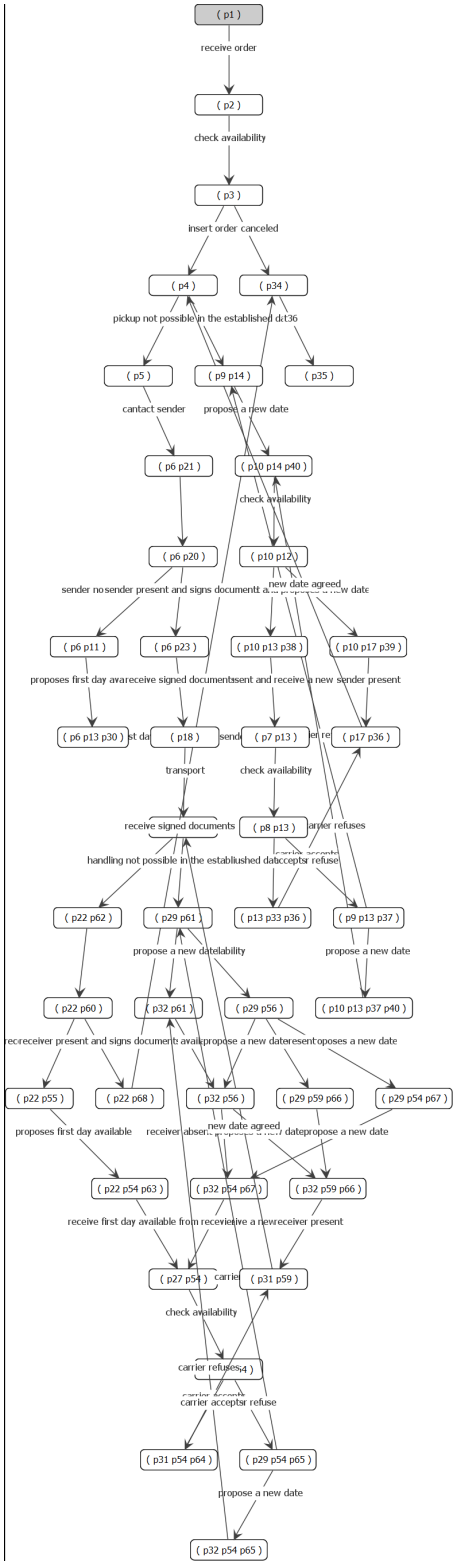

Figure 10: Coverability graph

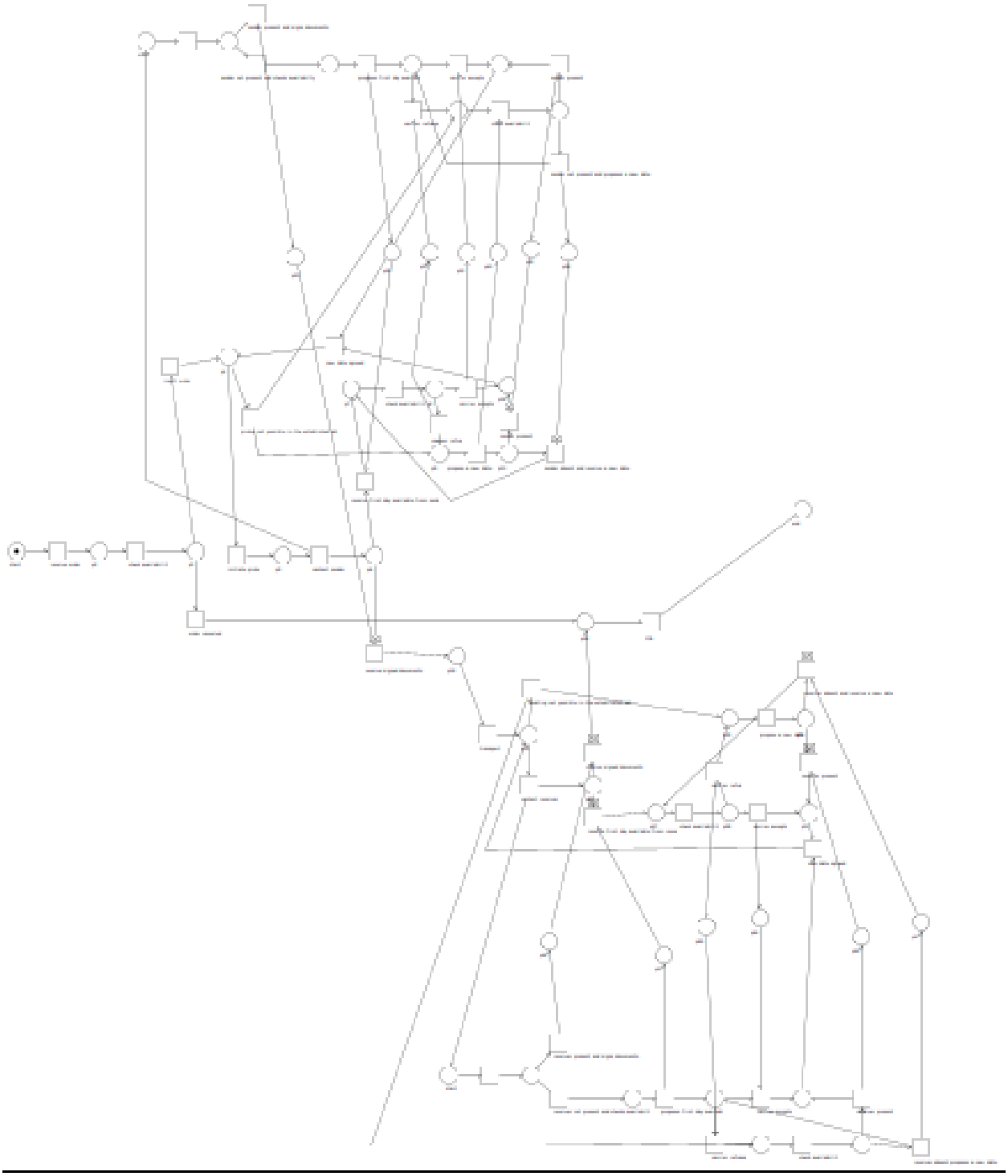

Figure 11: Workflow net