Business Process Modelling

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Contents

1 Overview

In the present project it is requested to model the scenario of a music school which has to manage the students' requests. Since the scenario involves two distinct Business Processes that need to communicate, it was decided to use a BPMN notation with two pools so as to represent a choreography between the student and the school. Since there are distinct responsibilities for the secretary's office and the teacher, the latter pool consists of two lanes pertaining to each of them. Furthermore, it was possible to identify two distinct subprocesses, one for the calendar and one for the lesson.

2 BPMN

The Business process starts with the student who contacts the music school. The school sends him the courses' list and the student chooses an instrument. After communicating his choice to the school, the first subprocess is about fixing the calendar.

2.1 Calendar

The school contacts the music teacher and he sends the student the lesson date and place proposal. After receiving the proposal, the student can accept it or make a counterproposal for different time and place. The eventbased gateway in the teacher's lane models his attendance for the student's choice. At this point, the roles reverse. Now the teacher can either accept the proposal or send a new one to the student. The latter waits for the teacher's choice. If the teacher decides to accept the new proposal, the music lesson is fixed, otherwise the student receives a new proposal and the cycle restarts until the student accepts the proposal and they can fix the lesson.

2.2 Lesson

As the music lesson begins, the music teacher proposes an exercise to the student, who receives the proposal and executes the exercise. Now the teacher must check its correctness: if the feedback is positive, the teacher communicates this to the student and the latter goes back to the beginning of the subprocess, so that the teacher can propose him the execution of a new exercise. If the feedback is negative, the student goes back in the process, so that he must execute the exercise again. When there is no new proposal of exercise from the teacher, he decided to announce the end of lesson and as soon as the student receives this communication, the lesson ends.

At this point the student sends the electronic payment. The school sends the confirmation to the student who has two choices: if he sends a request for a new appointment the calendar and lesson subprocesses must be executed again, otherwise the student sends a request for the course conclusion and the process ends.

The BPMN diagram and also the modified one were made by using the software Camunda.

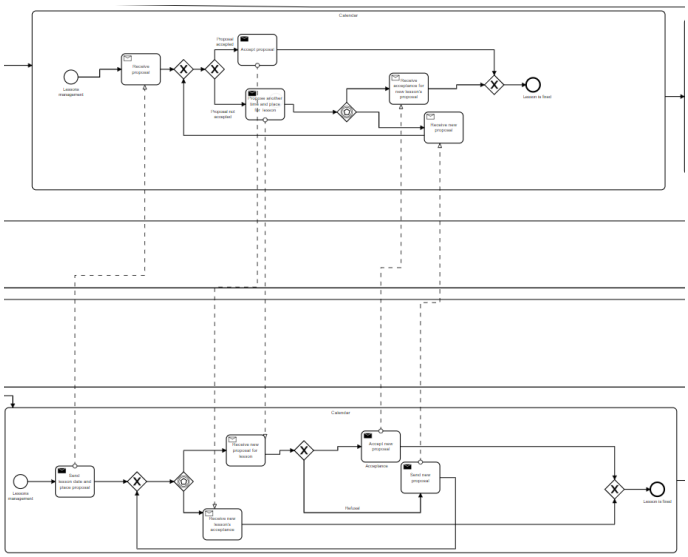

Figure 1: Calendar subprocess

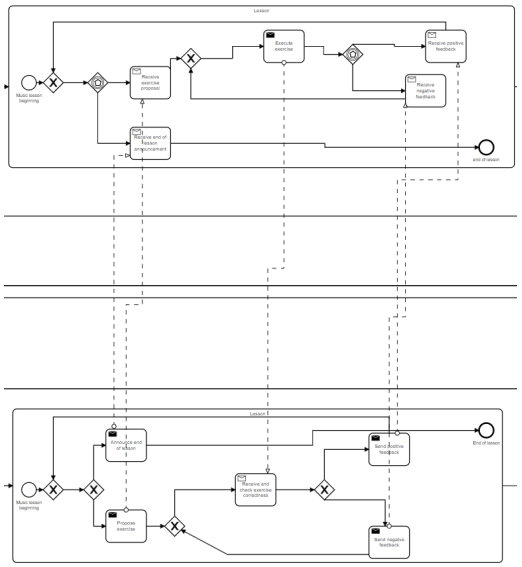

Figure 2: Lesson subprocess

3 From BPMN to Petri Net

After the BPMN construction, the Net was converted to a Petri Net by using Woped. Both the School and the Student Nets were translated into Workflow Nets and also the Workflow System. In particular, two single initial and final places were created and all the message flows became places.

4 Semantical Analysis

4.1 Student and school

In the current section some behavioural and structural properties regarding both the Student and the School nets are analyzed. Since they are similar, the following analysis can be considered for describing both.

- Student Net : The net is composed by 34 places, 31 transitions of which 5 are xorjoin operators and 2 xorsplits and 69 arcs.
- School Net: The net is composed by 36 places, 32 transitions of which 5 are xorjoin operators and 3 xorsplits and 72 arcs.
- Workflow net: Both the nets are Workflow net, because they have a single initial and final place and every place and transition belongs to a path between these two.
- Initial Marking: Both the workflow nets have a token in the initial place.
- Boundedness: It is important to remark that the boundedness analysis on Woped considered the N* net. It is possible to observe that the nets are bounded. This assertion can be made, also because Woped tells us that the whole net is an S-component. By definition, an S-component is a strongly connected S-net and as a consequence of the fundamental property of S-systems, any S-system is bounded. In addition, since by the fundamental property the overall number of tokens in the S-net is an invariant under any firing and since we only have one initial token, it is possible to say that the net is one-bounded.

- Liveness: Both the nets are live, as reported by Woped.
- Invariants: Since we are dealing with two s-nets, it is possible to notice that any vector I = [k ... k] can be an S-invariant for the nets for k being a positive integer and all the k must have the same value, because the number of incoming and outgoing arcs for every transition is the same. It is not possible to make the same reasoning for T-invariants; having multiple xor split, xor joins and event based gateways causes the net not to be a T-net. Thus, it is not so easy to find a T-Invariant for the nets.
- Free-choice: Both the nets are free-choice. We can assert this, also because every S-net is also free-choice.
- S-components: Both the whole two nets are S-components. Furthermore, since each net has an s-component which is the net itself, they are S-coverable.
- Soundness: Since N* is live and bounded in both nets, they are sound.
- PT and TP - handles: Since in the present nets there are no AND-splits and no AND-joins, there cannot be any respectively TP nor PT-handles. Therefore, by definition of well-structured nets, N*s are well-handled and Ns are well-structured.
- Connectedness: Since both the nets are Workflow nets, N* is strongly connected for both.

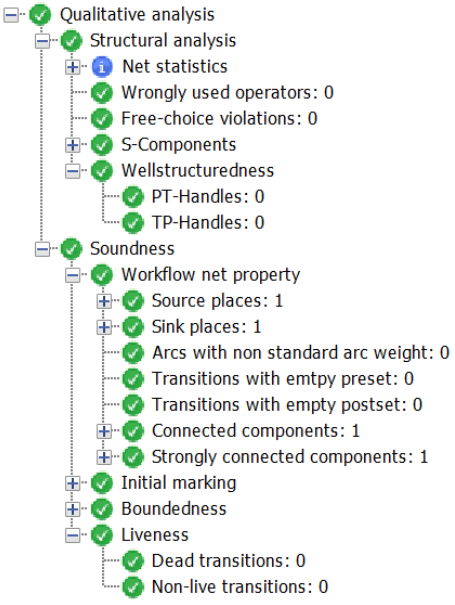

Figure 3: Student's semantical analysis

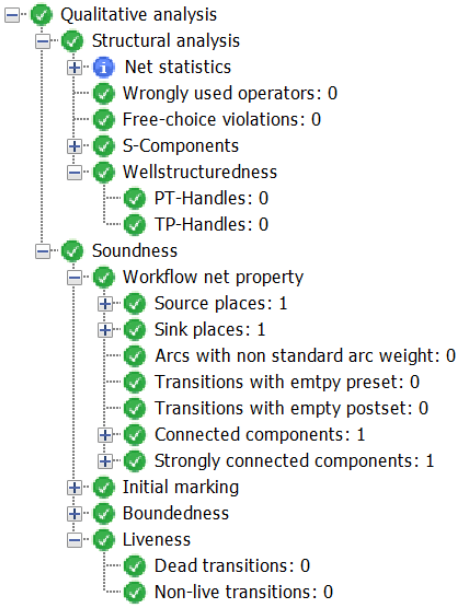

Figure 4: School's semantical analysis

4.2 Workflow system

Due to the complexity of the system, it was not possible to use Woped for its semantical anlysis. Instead, Woflan was used. The Workflow system contains 93 places and 84 transitions.

- Workflow net: The workflow system is a workflow net. In fact, it contains exactly one initial and one final place and each place or transition belongs to a path from the initial to the final place.
- Soundness: N is sound, as reported by Woflan.

- Boundedness: The net is sound, therefore N* is live and bounded (by the main theorem).
- Liveness: N* is live as reported by Woflan.
- Free-choice: The workflow systems is not free choice: in fact, adding the extra places to make the two systems interact causes some transitions to have neither the same nor disjoint presets.

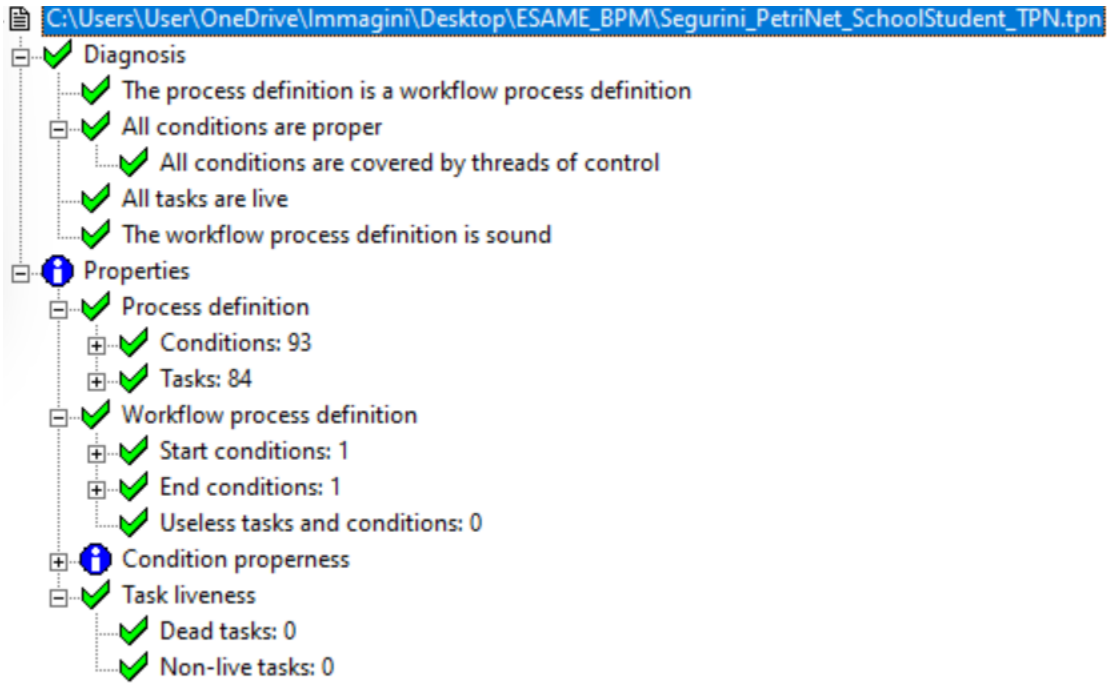

Figure 5: System's semantical analysis

5 Modification

The track also requests to modify the processes so that at the end of the course the student has the possibility to begin a new course. For this reason, at the end of the student's pool, he has one additional possibility with respect to the previous net: he can send a request for a new course. Furthermore, the student's pool has one more xor-gateway. It was possible to insert it before or after the activity "choose an instrument". However, giving the possibility to the student to receive the courses' list again seemed a more realistic solution. Regarding the school's process, the secretary's office receives a request for a new course and then sends the courses' list again. The relative BPMN and Petri Net were also developed on the Camunda, Woped and Woflan softwares. The properties previously identified still hold.