The role of subprocess-connector in business process modeling

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Abstract

The paper presents several aspects of Petri Nets as a tool for surmounting the deadlocks in a system. Emphasis is placed on the importance of the correct and consistent business process planning. The most important objective in business process generation is the proper execution of the activities in a business organization and studying the links between them. To visualize all business processes in a system a subprocess – connector has been created that helps to detect: the deadlock markings in a system. It is impossible to change a component without interfering the operation with the others.

Keywords: business process; Petri nets; simulation; connector; subprocess

1. Introduction

Each enterprise is based on models representing its inside processes. A company success is determined by the rational organization of its business processes that are subject to in-depth analyses and continual optimization, which is within the priorities of the business processes management but not a single-time initiative.

A business process can be defined as a sequence of activities distinctly specified within an organization involving people, equipment, applications, information and other resources, aiming to create products, respectively, values.

Figure 1 shows a three dimensional view of a business process including:

- case dimension;
- process dimension;
- resource dimension.

The case dimension signifies that all cases are handled individually. From business process point of view, cases do not interact directly. They influence each other indirectly by sharing resources and data. The process dimension specifies the activities in the workflow process, i.e. the tasks and routing along the tasks. The resource dimension signifies the resources, their roles as well as the organizational units. A business process can be visualized by a number of nodes in a three-dimensional view as shown in Figure 1. Each node represents either a work item (case + task) or an activity (case + task + resource). It can be seen from Figure 1 that the business process management is an adhesive of cases, tasks, and organization [1].

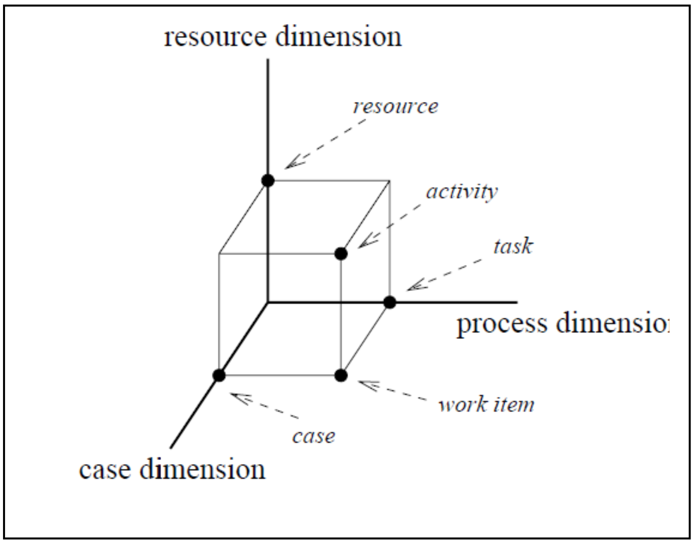

Fig. 1. A three-dimensional view of a business process [1].

2. Petri nets

Petri nets were introduced by Carl Adam Petri in 1962. They became the first standard adopted for business process modeling. Since then Petri nets have been used to model and analyze different processes with applications ranging from embedded systems to flexible manufacturing systems, user interaction, and business processes. Petri nets offer a graphical representation of stepwise processes including choice, iteration and concurrent execution. They are distinguished with an exact mathematical definition of their execution semantics, and a well-developed mathematical theory for process analysis. Petri nets are recognized as one of the known techniques for describing business processes in a formal and abstract way [5], [6], [8], [9].

Over the last three decades the classical Petri net has been extended with color, time and hierarchy specifications [2], [4]. These extensions facilitate complex process modeling, where data and time are important factors. Petri nets are used as a powerful tool in business process modeling for several reasons. They offer:

- formal semantics;
- graphical language;
- support of basic primitives needed to model business processes;
- analysis based on four general approaches:
    - Reachability Analysis: involves the enumeration of all reachable markings, but it suffers from the state-space explosion issue;
    - Matrix Equation Approach: in many cases it is applicable only to special sub-classes of Petri nets or special situations;
    - Invariant Analysis: determines sets of places or transitions with special features, as token conservation or cyclical behavior;
    - Simulation: discrete-event simulation is an option to check system's properties.

While modeling refers to the development of mathematical representation of modeled object processes, simulation concerns data processing by means of algorithms and procedures for solving all mathematical calculations related to the model, i.e. computer simulation is a system's representation by its model activation.

Business processes' simulation based on Petri nets is a way to show the system characteristics. The main idea is to use an appropriate execution algorithm in order to detect its unwanted properties.

Studies in [3] and [7] helped to compile a list of over 200 different techniques and tools for business processes simulation using Petri nets. Regretfully, a significant number of websites are out of operation being without support and updates for more than 15 years, or they are just source-codes lacking any descriptions, which fences off the understanding of their functions.

In result of the initial filtering, the list was reduced to 47 techniques appropriate for further examination and comparative analysis. Even these are too many for the purpose of detailed investigation, and speaking about an effective software product, at least it is expected to have gained minimum popularity within society and scientific communities. As there is no information about a worked out comparison, a number of Google Scholar results and Google search results were used.

The above stated approach reduced the filtering criteria to:

1. The tool was created or updated over the last 16 years (after year 2000).
2. There is an operational website of the tool that can be used in reality, and it is provided with relevant documentation, help menus or other scientific papers.
3. The tool has minimum 200 citations in scientific papers (ascertained with Google Scholar search).
4. The tool has minimum 5000 results ascertained with Google search.

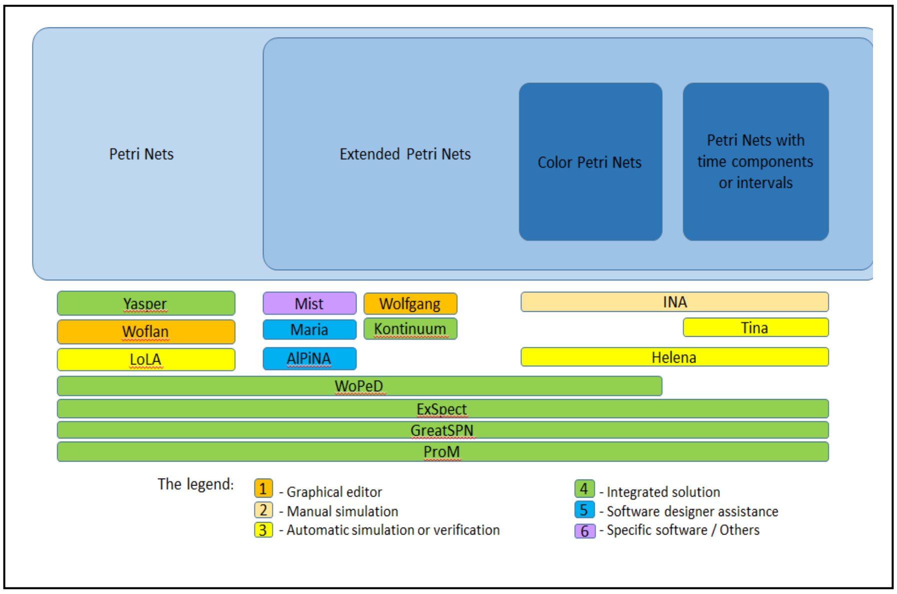

Fig. 2. Tools for business process analyses and transformations.

Concluding filtering, the final list includes 15 tools ranked by the number of Google search results:

1. Kontinuum
2. Maria
3. Wolfgang
4. Mist
5. INA
6. Yasper

7. ProM
8. LoLA
9. Tina
10. Helena
11. WoPeD
12. GreatSPN
13. ExSpect
14. Woflan
15. AlPiNA

After multiple filtering and exploring different tools for business processes simulation based on Petri nets, a comparative analysis was worked out (Figure 2), and they were placed in categories: graphical editor, tools for manual simulation, tools for automatic simulation or verification, integrated solution combining previous solutions, as well as tools for software designer assistance and tools for specific software development.

The analysis confirms that Petri nets can be regarded as an appropriate tool for business processes modeling and simulation.

A main task in business process modelling is the verification of process models regarding syntactical and structural errors. A syntactical error is given if modeling elements are used in an invalid manner. While the former might be checked with low efforts, the latter usually requires a very complicated analysis to prove properties like deadlock in the models. A deadlock in a process model is given if a certain instance of the model (one or more but not necessarily all) can not continue working, while it has not yet reached its end.

The only drawback is that every business process is part of another process, which makes the visualization of all processes incorporating the main business process a difficult task. This problem can be solved by creating a subprocess and connector aiming to describe how business processes interact in order to achieve a complete system functionality (Figure 3).

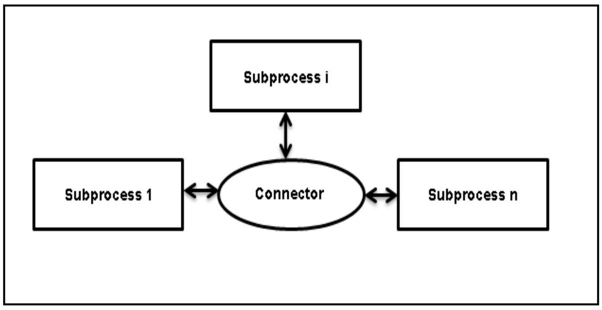

Fig. 3. Subprocess – connector.

A subprocess – connector is composed of one basic module called connector and a number of secondary modules called subprocesses. The main business process is described within the connector while subprocesses serve to describe those business processes, which interact with the main process. The subprocess – connector is designed to show the communication between separate processes that is accomplished by determining the input and output characteristics of every other subprocess (Figure 4).

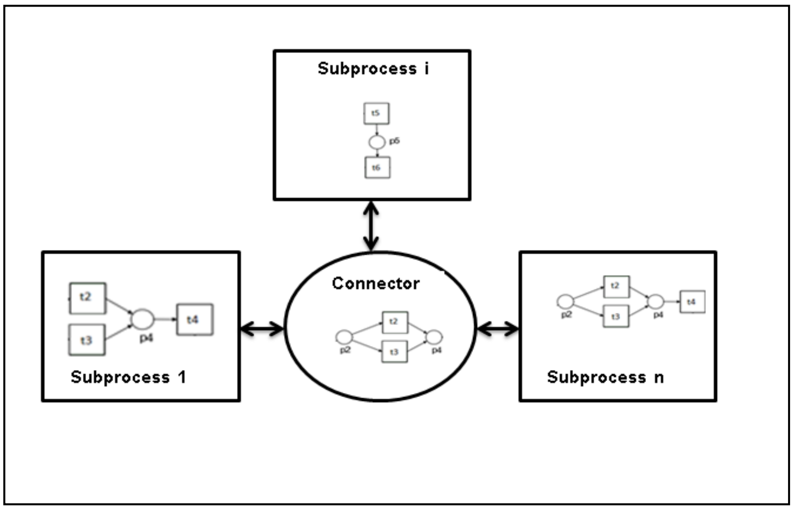

Fig. 4. Communication between separate processes in subprocess – connector.

Figure 5 represents a business process describing the separate stages of fuel oil loading at a filling station. The business process is represented with the help of subprocess – connector. This business process can be described with the following options:

Scenario 1: The driver parks the car, fills oil into the car tank and leaves the filling station.

Scenario 2: In case that the driver is in shortage of money to fill in fuel.

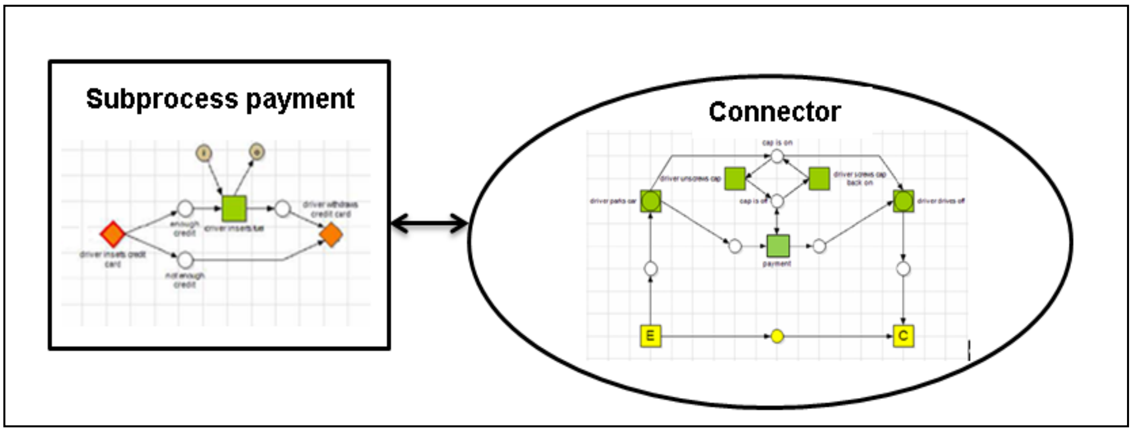

Fig. 5. Communication between separate processes in the subprocess – connector during a concrete business process execution.

The subprocess - connector is convenient for verifying the target properties of a business process and/or a system as a whole. The complete process provides an opportunity to report a number of deadlock markings, which can prevent serious errors like an incorrectly developed process as part of a series production that can cause dramatic problems to the firm, as well as additional work, legal problems, angry clients, managerial worries and depressed employees. Therefore, it is of crucial importance to check whether a given business process is correct before being started to function.

Once the processes describing the whole system have been modeled and each process simulated, they can be united by means of the created subrpocess – connector in order to achieve:

- visualization of processes within the whole system;
- simulation of business processes within the whole system;
- establishing the interaction between separate business processes.

3. Conclusion

The paper discusses the use of subprocess-connector that facilitates business process modeling. A novel approach to detect deadlocks in process models is described. The subprocess-connector requires a deeper understanding of the business process modeling and Petri nets.

Petri nets are a suitable tool for modeling and simulation of business processes within a system. To visualize all business processes in a system a subprocess – connector has been created that helps to detect:

- the deadlock markings in a system;
- the lack of communication between separate subprocesses and the main business process that may cause doubling of a given subprocess;

The entire process leads to optimizing the business processes of the enterprise.

Acknowledgements

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