RESEARCHING THE IMPACT OF PARALLEL CONSTRUCTIONS ON BPMN MODELS EFFICIENCY

Mykola Volosnikov, Andrii Kopp
National Technical University «Kharkiv Polytechnic Institute», Kharkiv

Business process modeling is an important tool in organizational management and information systems design. Business Process Model and Notation (BPMN) has become one of the most common standards for representing business processes.

The need to detect errors in BPMN models is based on their critical role in ensuring the reliability and efficiency of business operations. Errors in business process models can appear in the form of logical inconsistencies, deadlocks, or unachievable tasks that can potentially disrupt execution and compromise the efficiency of an entire organization. Parallel flows, which are often used to represent concurrent tasks, are particularly prone to such errors.

Therefore, our study seeks for the answers to the following research questions:

RQ1: How can the parallelism degree of a business process model be formally assessed?

RQ2: What is the impact of using parallel constructs in BPMN models on their error propensity?

Object of the study – the process of analyzing the impact of parallel constructions on BPMN model errors. Subject of the study – a software component for studying the impact of parallel constructions on BPMN model errors.

Purpose of the study – improving the quality of business process models by reducing errors caused by the use of parallel BPMN notation constructs.

It was found, that the Token Split (TS) measure is used to assess the impact of parallel (AND) gateways on BPMN models efficiency:

$$\mathrm{TS} = \sum_{g \in G_{or} \cup G_{and}} d_{out}(g) - 1,$$

where G_{or} is the set of OR gateways, G_{and} is the set of AND gateways, and $d_{out}(g)$ is the number of outgoing flows from a certain gateway $g \in G_{or} \cup G_{and}$.

The detection of TS thresholds for assessing the level BPMN models efficiency (Table 1) is performed by analyzing a large collection of 3729 BPMN models [1].

Table 1 – Threshold values for the BPMN TS measure

BPMN model efficiency thresholds	Very low	Fairly low	Fairly high	Very high
TS	≤ –0.95	> –0.95	> 0	> 0.95

By fitting a linear regression model to the data, an equation can be derived that predicts the TS value based on the number of AND gateways. This predictive model will be particularly useful for assessing the potential erroneous of BPMN models based on the gateways structure without the need to perform complex computations.

References:

1. BPMN for research, https://github.com/camunda/bpmn-for-research, 18.04.2025.