

## STUDYING THE EFFICIENCY OF BUSINESS PROCESS MODELS USING COMPLEXITY METRICS

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Business process modeling allows representing organizational activities in a structured and visual format, which allows gaining a comprehensive understanding of the interrelated tasks, roles and systems involved in achieving specific business goals.

This facilitates communication between stakeholders, supports the alignment of Business and Information Technology domains, and also provides a basis for business process improvement and innovation.

Among the various standards and notations used in business process modeling, BPMN (Business Process Model and Notation) has gained the most popularity due to its ability to bridge the gap between business and IT perspectives.

However, the high complexity of business process models negatively affects the clarity of BPMN models and causes an increased risk of errors in the real business process execution, which entails time and financial losses.

The higher the Control-Flow Complexity (CFC) measure is, the harder it is to consider all potential states after a split, depending on its type, and therefore the more likely the business process model will contain errors:

$$CFC = \sum_{g \in G_{xor}} d_{out}(g) + \sum_{g \in G_{or}} (2^{d_{out}(g)} - 1) + \sum_{g \in G_{and}} 1,$$

where  $G_{xor}$  is the set of XOR gateways,  $G_{or}$  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  $g \in G_{xor} \cup G_{or} \cup G_{and}$ .

Determining the CFC for a BPMN model is a computationally challenging task due to the need to account for complex control flow structures, including branching, parallelism, and loops, throughout the process.

The detection of CFC thresholds (Table 1) for assessing the level of efficiency was achieved by analyzing a collection of 3729 BPMN models [1].

Table 1 – Threshold values for the BPMN CFC measure

BPMN model efficiency thresholds	Very low	Fairly low	Fairly high	Very high
CFC	$\leq 4$	$> 4$	$> 7$	$> 8$

A significant correlation was found between the CFC and the number of start events with a coefficient of  $r = -0.59$ . A linear regression model was constructed:

$$CFC = 9.59 - 2.11 \cdot |E_s|.$$

Regression analysis revealed a coefficient of determination  $R^2 = 0.35$ .

The obtained result supports the hypothesis that BPMN start events contribute to the modularization of business process models, thereby simplifying their control flow and reducing complexity.

### References:

1. BPMN for research, <https://github.com/camunda/bpmn-for-research>, 19.04.2025.