Quality Assessment of Business Process Models based on Thresholds

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Process improvement is recognized as the main benefit of process modelling initiatives. Quality considerations are important when conducting a process modelling project. While the early stage of business process design might not be the most expensive ones, they tend to have the highest impact on the benefits and costs of the implemented business processes. In this context, quality assurance of the models has become a significant objective. An important step towards improved quality assurance is a precise assessment of quality. We analyze quality from the perspective of understandability and modifiability, which are both sub-characteristics of usability and maintainability, respectively.

Several initiatives about business process metrics were published [2]. The significance of these metrics relies on a thorough empirical validation of their connection with quality attributes. There are, to date, still rather few initiatives to investigate the connection between structural process model metrics and quality characteristics, so we detect a gap in this area which needs more empirical research. Experimental data is obtained by a total of six experiments: three to evaluate understandability and three to evaluate modifiability.

In accordance with the previously identified issues, the purpose of this paper is to contribute to the maturity of measuring business process models. The aim of our empirical research approach is to validate the connections between an extensive set of metrics (number of nodes, diameter, density, coefficient of connectivity, average gateway degree, maximum gateway degree, separability, sequentiality, depth, gateway mismatch, gateway heterogeneity, cyclicity and concurrency) and the ease with which business process models can be understood (understandability) and modified (modifiability). A correlation analysis and a regression estimation were applied in order to test the connection between the metrics and both the understandability and modifiability of the models. After the selection of the most suitable metrics for understandability and modifiability, we extracted threshold values in order to evaluate the measurement results. Such thresholds are an important aid to support the modeller of a business process.

The statistical analyses suggest rejecting the null hypothesis (***H0****: There is no correlation between structural metrics and understandability and modifiability)*, since the structural metrics apparently seem to be closely connected with understandability and modifiability. For understandability these include Number of

Nodes, Gateway Mismatch, Depth, Coefficient of Connectivity and Sequentiality. For modifiability Gateway Mismatch, Density and Sequentiality showed the best results. On the other hand, Table 2 shows the regression equations selected.

Table 1. Prediction models of understandability and modifiability

	Attr.	Experi.	Prediction model	p-value	MMRE	p(0.25)	p(0,30)
Time	U	E3	T3 = 47.04 + 2.46 nºnodes	.000	**.32**	**.51**	**.58**
	M	E4	E4 = 50.08 + 3.77 gateway mismatch + 422.95 density	.000	**.37**	**.31**	**.38**
Correct Answers	U	E2	CA2 = 3.17 - 0.005 nºnodes - 0.38 coeff. of connectivity + 0.17 depth - 0.015 gateway mismatch	.000	**.18**	**.79**	**.79**
	M	E4	CA4 = 1.85 - 3.569 density	.000	**.23**	**.82**	**.83**
Effi-cien-cy	U	E3	EF3 = 0.042 - 0.0005 nºnodes + 0.026 sequentiality	.000	**0.84**	**.22**	**.25**
	M	E4	EF4 = 0.006 + 0.008 sequentiality	.000	**.62**	**.32**	**.42**

After analyzing which measures are most useful, it is interesting to know what values of these measures indicate poor quality in models. That means, thresholds values could be used as an alarm of detecting low-quality structures in conceptual models. Extended results are depicted in [1]. The threshold values could be interpreted as follows: if number of nodes of a model is between 30 and 32, gateway mismatch is between 0 an 2, depth is 1, connectivity coefficient is 0,4 and sequentially is between 0,7 and 0,84 the probability of considering the model efficient in understandability tasks is about 70%, which means model has an acceptable level of quality.

This work has implications both for research and practice. The strength of the correlation of structural metrics with different quality aspects (up to 0.85 for gateway heterogeneity with modifiability) clearly shows the potential of these metrics to accurately capture aspects closely connected with actual usage. Moreover, we demonstrated how threshold values for selected measures can be found, and related these values to different levels of quality related to understandability and modifiability for business process models. From a practical perspective, these structural metrics can provide valuable guidance for the design of process models, in particular for selecting semantically equivalent alternatives that differ structurally. In future research we aim to contribute to the further validation and applicability of process model metrics.

References

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