

# BPMeter: Web Service and Application for Static Analysis of BPMN 2.0 Collections

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**Abstract.** The number of business process models is constantly increasing as companies realize the competitive advantage of managing their processes. Measuring their size and structural properties can give useful insights. With the BPMeter tool, process owners can quickly compare their process with company’s process portfolio, researchers can statically analyze a process to see which modeling language features have been used in practice, while modelers can obtain an aggregated view over their processes. In this demonstration we show how to use BPMeter, which provides a simple Web application to visualize the results of applying over 100 different size and structure metrics to BPMN 2.0 process models. The visualization features measurements, statistics and the possibility to compare the measurements with the ones obtained from the entire portfolio. Moreover we show how to invoke its RESTful Web API so that the BPMeter analyzer can be easily integrated with existing process management tools.

**Keywords:** BPMN 2.0 · Process Model · Size Metrics · Structure Metrics · Collection Statistics · Web Application · REST API

## 1 Introduction

The Business Process Modeling and Notation (BPMN) language has become the de facto standard for process modeling [5], evident also from its ISO standardisation (ISO/IEC 19510:2013). In our work we calculate size and structure metrics on process models represented in the standard BPMN 2.0 format. BPMN offers greater control flow expressiveness than other modeling languages [8]. However such expressiveness is partially lost if analysis tools transform processes to canonical formats to store models captured in different notations [7,3], since only the elements common to all the modeling languages supported by that tool, are maintained in the canonical form. Therefore we have decided to focus only on BPMN 2.0 and support natively its analysis. Existing tools dealing with business process analysis target process mining [1], process repositories [7] or process

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modeling [6]. While calculation of certain process quality metrics is available as a plugin in some of them [7,1], since it is not their main goal, the available metrics are rarely exhaustive. Tools explicitly focused on process analysis [3,2] either lack an explicit API [2], and thus are hard to integrate with other tools, or they are command-line based [3], and thus less user friendly.

BPMeter is a public Web-based tool for extensive static analysis of the size and structure of BPMN 2.0 process models. Since we have different target users of the tool we have decided to offer it in two versions: 1) as a Web service aimed at: developers that need to integrate the analysis into their applications or researchers that want to use it as part of their analytics workflows; and 2) as a Web application with a visual interface, aimed at process owners or business analysts, to enable them to quickly compare their new or existing processes to other processes in the company or to the characteristics of reference models.

The tool uses as an input an individual business process model, or a collection of models designed in BPMN 2.0 using the serialization described in the standard. Only files in \*.xml, \*.bpmn or \*.bpmn20 format are accepted as input. The output includes the result of more than 100 metrics calculated over the input models. Many of the size metrics count the number of specific BPMN 2.0 elements found in the model. They count elements both on aggregated level (e.g., number of nodes, number of activities, number of gateways, number of events), and disaggregated level (e.g., number of script tasks, ad-hoc subprocess, exclusive split gateways). Simply counting BPMN 2.0 elements is not sufficient to gain a deep understanding of the models, thus we have also implemented additional structure metrics, where we analyse properties of the control flow and data flow of the process (e.g., parallel gateway fanin, data input distribution). The complete definition of the metrics can be found in [4, Chap.3.3].

## 2 BPMeter: Web Service

We introduce a REST API with only one resource (`/api`) which represents the action involved in calculating all metrics. The only allowed method to be called on this resource is POST. A (POST `/api`) request, carrying a single or multiple process model file(s) as a payload, tells the server to calculate the metrics for the sent model(s). The request is formatted as `application/octet-stream`. To facilitate the upload of one or more BPMN files, two variables need to be specified, `name` and `filename`. The value assigned to the name variable is always `name="models"`, while the filename variable takes as a value the name of the process model file. An example call of the API, where the `MODELn_PATH` stands for the absolute or relative path to the file that needs to be sent, is:

```
curl -X POST -F "models=@MODEL1_PATH" -F "models=@MODEL2_PATH"  
http://benchflow.inf.usi.ch/bpmeter/api
```

If the POST request is made using an unsupported file type the server responds with 403 `bad request` status and an error message. In case of a

successful request, the server responds with a JSON file representing an array containing the results of the metrics for each uploaded model. A metric is annotated with its name, category (Size or Structure) and type (Single Value Metric, Distribution Metric, Type Distribution Metric or Distribution Statistics Metric). The type determines the format of the corresponding value. A sample JSON file can be obtained by uploading a process model at: <http://benchflow.inf.usi.ch/bpmeter/api/test>.

### 3 BPMeter: Web Application

BPMeter is a responsive Web application, thus it is suitable for any screen size. Fig. 1 shows a screenshot of application's main view, on different devices. The Web application provides a log-in and authentication functionality so that models uploaded by a given user can be saved in a database, thus enabling the user to measure and compare a portfolio of multiple models. Anonymous users can also try out the Web application without creating an account by using the Demo version. The Demo only measures one model at a time, i.e., without taking advantage of the comparison feature.

The Web application uses the REST API described in Section 2 to call the analyzer Web service. The model/collection sent with the request is assigned an ID and is saved in temporary directory on the server. To provide for scalability, a First-In-First-Out (FIFO) queuing system is used to trigger the analysis. Once the task executor calculates the metrics for the given model/collection, the results are sent in JSON format to the client, which takes care of rendering them. As the analysis is running in the background, the client is not blocked and can browse previous results as the new ones are being computed. The client is informed of the arrival of new results by a notification message.

By using the menu, listing all the uploaded models (individual models, collections and models in the collections), the user can choose the model or the collection whose metrics should be visualized. The metrics over the entire portfolio are shown by default (by clicking on the home tab). The goal of the Web application is to provide visualisation of the results of the calculated metrics.

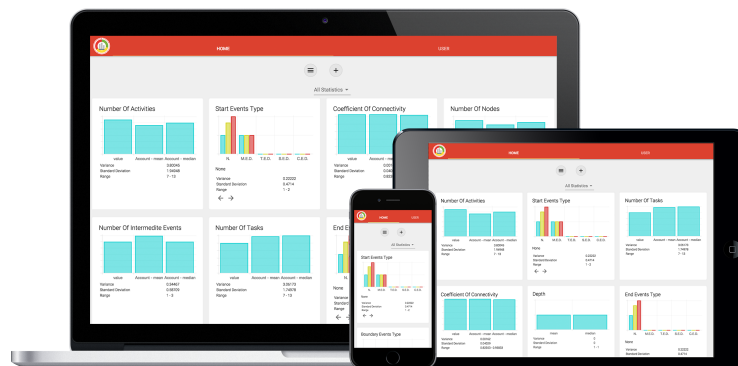


Fig. 1: BPMeter: Responsive Web Design

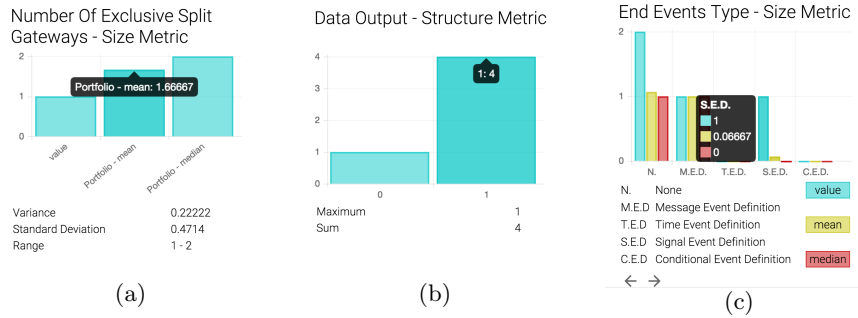


Fig. 2: Metric Types: (a) Single Value, (b) Distribution, (c) Type Distribution

There are three important use cases we would like to point out, i.e., analysing a single process, analysing a collection and analysing the entire portfolio. When analysing a single process, it could be useful to compare the process characteristics to the ones of the entire portfolio. Once a model/collection has been uploaded the user can decide to visualise all metrics or certain type of metrics as per their visualisation characteristics. The user can choose between three options:

1) Single Value Metrics, visually presented as a bar chart showing the result in the y axis. If the user has uploaded more than one model this type of metrics will also show as different bars the mean and median of user’s portfolio. Information regarding the variance, standard deviation and range is also provided numerically. For example, as per Fig. 2(a), the Number of exclusive split gateways in the analysed model is one while the median for the portfolio is two;

2) Distribution Metrics, i.e., metrics to analyse the incoming/outgoing flow of a gateway or data input/output of an activity. The number of flows/data are shown on the x axis while the number of gateways/activities having that number of flows/data is shown on the y axis. For example, as per Fig. 2(b), there are four activities with one data output and one activity with no data output;

3) Type Distribution Metrics, i.e., metrics which show how many events use a given type of event definition with information about the mean and the median of the portfolio, when analysing a single process. Information about the variance, standard deviation and range per event definition type are available by using the arrows below the graph. For example, as per Fig. 2(c), the analysed model uses two none events, one message event and one signal event. The mean and median for the portfolio are quite lower. As evident from the mentioned figures, hovering over a bar in the charts displays the x and y values of that bar.

This Web application is a prototype and while thorough testing has been performed on the calculation of the individual metrics per single model, further testing is necessary for the statistical information on collection and portfolio level. We recommend Google Chrome as a web browser since it is the browser used for testing the application. The application is available at <http://benchflow.inf.usi.ch/bpmeter>. A screencast describing some use cases is available at <http://benchflow.inf.usi.ch/bpmeter/screencast>.

## 4 Conclusion and Future Work

Companies have to manage hundreds, if not thousands, of processes, which makes an easy and fast access to a tool for analysing them quite valuable. Therefore we did not stop at developing a command-line based tool or a Web service, but decided to design a user-friendly Web interface to visualise measurements about the size and structure of a model or collection of models, but also to compare them with a whole portfolio of models. We see the added value of BPMeter precisely in the fact that we offer it both as a Web service and a Web application, as well as in the fact that it supports batch-analysis of entire model collections. This makes BPMeter attractive to process owners, business analysts, developers and researchers alike. The BPMN support is native, thus its full expressiveness is preserved. The analysis are detailed including over 100 metrics, and user accounts are available to create and manage own process portfolios.

Based on early feedback from test users, we are currently working on extending the Web application with some similarity metrics, the possibility of comparing the obtained metrics between multiple models (or aggregated metrics of multiple collections), searching for models with specific names or metric value ranges, and the ability of exporting the metrics in tabular format, in addition to the currently returned JSON by the Web service API.

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