A Survey on the Relevance of the Performance of Model Transformations: Data of the Participant Search and the Questionnaire

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1 Overview

There are a number of techniques for analyzing and improving the performance of programs written in a general-purpose language. For model transformation languages such techniques are still unknown. These are domain-specific languages, which, simply said, are used to update models or create new models. Thus, these languages realize important operations in the context of Model-Driven Development.

Current research about the performance of transformations is strongly focused on the transformation engine, which executes the transformations. Consequently, we conducted an online survey to examine whether techniques for analyzing and improving the performance of transformations are needed.

Overall, our data set consists the results of the online survey and the information necessary to repeat the survey. The questionnaire was fully answered by 84 participants.
Our data set includes the processed answers and the anonymized raw data. Additionally, we have performed hypothesis tests. Their results and the variables used for them are also part of our data set. In order to support the repeatability of our study, our data set contains not only our questionnaire, but also the results of the snowballing we used for the design of the questions Q9 and Q15. Furthermore, we have conducted a Systematic Literature Review (SLR) about the transformation languages Atlas Transformation Language (ATL), Henshin, QVT o and Viatra, to find suitable participants for our study. Therefore, our data set also contains information about the execution of this SLR and its results.

In the following Section 2, we describe how we searched for potential participants (cf. Section 2.1), the design and execution of our questionnaire (cf. Section 2.2) and how we calculate the variable values for the variables used in our hypothesis tests (cf. Section 2.3). In Section 3 we document the processing steps we performed on the raw data, e.g., to anonymize the answers. Section 4 gives an overview of the different artifacts contained in our data set, each with a short explanation.

## 2 Data Collection

In this section we describe the steps we took to collect the data, consisting of searching for participants, designing the questionnaire and conducting the online survey, as well as calculating the variable values for our hypotheses.

### 2.1 Searched for Participants

In this section we describe how we searched for potential participants. We conducted a Systematic Literature Review (SLR) about the transformation languages Atlas Transformation Language (ATL), Henshin, QVT o and Viatra, in order to find suitable participants. We have already published a simplified description of our SLR and the inclusion and exclusion criteria in [GBTB20a, GBTB20b]. We extracted 659 authors and their e-mail addresses from the included publications, who we invited to participate in our study. We also invited transformation developers who we knew had experience with the performance of transformations, resulting in four further study participants.

During the execution of our SLR, we have taken the following steps:

1. Search in IEEE Xplore Digital Library and ACM Digital Library using defined search strings. Table 1 gives an overview of the used search strings.

2. Two persons rate independently of each other all publications found based on defined inclusion and exclusion criteria. The criteria we used are summarized in Table 2.

3. One person merges the ratings. If the ratings are different, this person reads the respective paper completely to determine a final rating.
4. If no final rating could be determined on the basis of the full text, the two persons discuss their rating based on the full text to agree on a final rating.

5. If step 4 does not result in a final rating, an additional person is consulted to help determine the rating based on the full text.

A paper is included and its authors extracted if one of the inclusion criteria applies and excluded if any exclusion criteria applies. Our data set contains all publications found by our search strings as well as their ratings (DataCollection/SLR.xlsx), whereby we marked included publications with I1–I8 and excluded publications only with an E. The list of publications on ATL, Henshin and Viatra contains publications until 8th July 2019 and the list of publications on QVTo contains publications until 19th August 2019.

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<tr>
<th>Library</th>
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<tr>
<td><strong>ATL</strong></td>
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<tr>
<td></td>
<td>((model transformation) AND ATL)</td>
<td>Search in metadata and full text, since 2014.</td>
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<td></td>
<td>ACM</td>
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<td><strong>Henshin</strong></td>
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<td><strong>QVTo</strong></td>
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Table 1: Overview of the search strings used.
Inclusion Criteria

11. ATL, Henshin, QVTo or Viatra is used to transform models.
12. Publication about the development of ATL, Henshin, QVTo or Viatra.
13. Publication about an approach to analyze transformation scripts that are defined in ATL, Henshin, QVTo or Viatra.
14. The authors plan to use ATL, Henshin, QVTo or Viatra.
15. The Viatra Query Language is used.
16. The authors discuss aspects such as language extensions, maintainability and quality improvement of QVTo.
17. The authors use a tool that is based on ATL, Henshin, QVTo or Viatra.
18. Based on full text

Exclusion Criteria

E1. Full text is not available.
E2. Publication is not written in English.
E3. We are the only authors of the publication.
E4. None of the inclusion criteria apply.

Table 2: Inclusion and exclusion criteria used to filter publications.

2.2 Questionnaire

We used a questionnaire consisting of 18 questions in our online survey, that is already published in [GBTB20b] and mentioned in [GBTB20a], and that is again contained in our data set (StudyMaterial/Questionnaire.pdf). We have created our questionnaire based on the guidelines of [SG14, Mal06, Vag06]. For the design of the questions Q9 and Q15 we conducted snowballing on 12th July 2019 to get an overview of possible metrics. We used the publication from van Amstel et al. [VABKP11] as starting point and conducted one step forward snowballing and one step backward snowballing. In our data set we provide the documentation of the snowballing and the analysis results (StudyMaterial/Snowballing.pdf).

We conducted the survey online by inviting the participants via their e-mail addresses. In order to increase the response rate, we sent a reminder e-mail after a certain time to those participants who had only partially filled out the questionnaire or not filled it out at all. We provide in our data set the resulting anonymized raw data (SurveyData/RawData.xlsx) and the processed data (SurveyData/ProcessedData.xlsx) of the 84 fully answered questionnaires.
2.3 Variables

In our data set we also provide the results of our hypothesis tests (Hypotheses/Results.pdf), which we performed using SPSS, the SPSS project (Hypotheses/DataAnalysis.sav) and the used variables (Hypotheses/Variables.xlsx). In the following we briefly describe the calculation of the values of the variables used.

**modelElement_WA** An ascending number from 1 to 6 (rank) is assigned to the intervals (interval) of question Q8. The answers of each participant are used as weights \( w \) to calculate the weighted average. It holds: \( \text{modelElement}_\text{WA} = \frac{\sum \text{rank}_{\text{interval}} \times w_{\text{interval}}}{100} \).

**satisfaction** We weight the answers to question Q12 with 0=“Never” to 4=“Always”. The weight of the given answer is assigned to the variable.

**role_rating** We have assigned a weighting to each answer option of question Q2: 1=“User”, 2=“Researcher with transformations as object of research, e.g. analysis of the transformation script” and 3=“Engine developer or transformation language developer”. The maximum of the given answers is assigned to the variable.

**analyze** We weight the answers to question Q14 with 0=“No” or 1=“Yes”. The weight of the given answer is assigned to the variable.

**averageCase** We weight the answers to question Q11 regarding the average case with 0=“Not at all important” to 6=“Extremely important”. The weight of the given answer is assigned to the variable.

**worstCase** We weight the answers to question Q11 regarding the worst case with 0=“Not at all important” to 6=“Extremely important”. The weight of the given answer is assigned to the variable.

3 Data processing

We had to make some changes to achieve anonymity of the participants and to ensure traceability between the raw data and the processed data. In the following we have documented these changes.

**Changes to the raw data (SurveyData/RawData.xlsx):**

- In order to ensure traceability, we have assigned each entry a unique ID.
- In order to make the data anonymous, we removed some columns that contained meta-information, e.g. time stamps.
- In order to make the data anonymous, we edited some answers from free text fields. We marked the corresponding parts with < > and the hint that something was changed. Affected entries are: ID 41 and ID 172.
Changes to the processed data (SurveyData/ProcessedData.xlsx):

- In order to ensure traceability, we use the same unique IDs as in the raw data.
- In order to make the data anonymous, we removed some columns that contained meta-information or that are not part of the questionnaire, e.g. time stamps.
- We removed columns that contained questions about data handling.
- In order to make the data anonymous, we edited some answers from free text fields. We marked the corresponding parts with <> and the hint that something was changed. Affected entries are: ID 41 and ID 172.
- We removed all entries of questionnaires that were not completely answered or where the questions regarding the data handling were answered negatively.
- The entry with the ID 66 was removed, because due to the answers in the free text fields it was not clear whether the other answers are usable.
- The entries ID 51, ID 60 and ID 182 did not distribute 100% in the answer to question Q8. We scaled up the answers accordingly.
- We found out during a follow-up interview with ID 172 that he had an error in his answer to question Q6. We adjusted the answers according to his correction, so that 99% of his transformations are in QVTo and not 99% in Henshin.

4 Artifacts

Our artifact consists of several pieces of data:

DataCollection/SLR.xlsx contains all publications found during our SLR and their ratings. The files ATL_ACM.csv, ATL_IEEE.csv, Henshin_ACM.csv, Henshin_IEEE.csv, QVTo_ACM.csv, QVTo_IEEE.csv, Viatra_ACM.csv and Viatra_IEEE.csv contain the same information per language.

StudyMaterial/Questionnaire.pdf contains the questionnaire used (without questions regarding data handling).

StudyMaterial/Snowballing.pdf contains the results of forward and backward snowballing, and an overview of the metrics we found.

SurveyData/RawData.xlsx contains the questionnaire answers as raw data. The file RawData.csv contains the same data.

SurveyData/ProcessedData.xlsx contains the questionnaire answers as processed data. The file ProcessedData.csv contains the same data.

Hypotheses/Results.pdf contains the documented results of the hypotheses tests.
Hypotheses/DataAnalysis.sav is the SPSS project used to test our hypotheses.

Hypotheses/Variables.xlsx contains the variables used for our hypotheses tests. The file Variables.csv contains the same data.

References


[GBTB20b] Groner, Raffaela; Beaucamp, Luis; Tichy, Matthias; Becker, Steffen: An Exploratory Study on Performance Engineering in Model Transformations: Data of the mixed method study. Open Access Repositorium of the Ulm University. – http://dx.doi.org/10.18725/OPARU-32365


