Page 01

Welcome!

Thank your for participating in this survey! You have been identified to us as a professional in software engineering. We thus greatly value your opinion. By participating you are contributing to our goal of better understanding and improving software engineering practices.

In this survey, we ask you to answer questions on the following topic:

„*Use of multiple programming languages in the development of software systems*“

(Almost) all questions relate to the **last software project that you completed** as **part of your job** (that is, not to private, "unpaid" projects). The project should be in production, at least partially.

The survey consists of 22 questions separated into four sections. You will need about 15 minutes to complete the survey.

The questionnaire is completely anonymous. Your answers are evaluated as a part of a research project at the Computer Science Institute, Ludwig-Maximilians-Universität Munich, Germany.

For more information about the survey, including individual questions, or the research project in general, please feel free to contact Dr. Philip Mayer via e-mail. You can also find more information about our research project in general on our web page.

Thank you again for your time!

Page 02

Section 1 - use of programming languages

To begin with, we inquire about the use of programming languages. In this context, the term "programming language" covers both the common *universal* programming languages like Java, C#, Ruby, JavaScript or PHP, as well as *specialized* languages like HTML for web design, XML or .ini for system configuration, or shell scripting languages like batch or bash. The latter languages are sometimes also called "domain-specific languages" (DSLs).

All questions refer to languages used in the **software project you completed last** - regardless of whether you personally wrote code in a particular language or not.

Page 03

1. Which of the following *universal* programming languages were used in the software project you completed last?

Multiple answers may be selected.

□ C

□ C++

□ C#

□ Java

□ JavaScript

□ Objective-C

□ Perl

□ PHP

□ Python

□ Ruby

□ Scala

□ Other:

Page 04

2. Which of the following types of *specialized* programming languages were used in this project?

Multiple answers may be selected.

□ User interface design languages (e.g. HTML, CSS, templating languages)

□ Shell scripting languages (e.g. Linux/Unix shells or Windows Powershell)

□ Build control languages (e.g. Ant, Maven, or Makefile(s))

□ Configuration languages (e.g. .ini, .properties, .conf, or XML based formats)

□ Query languages (e.g. SQL or XPath)

□ Languages for implementing (business) rules (e.g. the rule language of Drools)

□ Parser and lexer input languages (e.g. Yacc, Lex)

□ Other:

Page 05

3. Were new, custom-made languages created and used in this project as well?

○ Yes, for the following purpose (e.g. “for user interface design”)

○ No

Page 06

4. In how many of the languages used in the project did developers write/change code?

Note: This question attempts to determine whether individual developers were rather writing/changing code in just one language, or whether individual developers were rather involved in all languages.

The ‘average developer’ wrote/changed code in:

One language **Half of the languages** **All languages**
| --------- | --------- | --------- | --------- | --------- | --------- | --------- | --------- |

Page 07

5. Do you feel that the use of multiple languages *in general* is beneficial or detrimental for the following aspects of software development?

Note: In contrast to most other questions, this question refers to your general assessment - *independent* of the project you completed last.

	Multi-language development is:				
	Very beneficial	**Rather beneficial**	**Neutral**	**Rather detrimental**	**Very detrimental**
For precise translation of requirements into code:	○	○	○	○	○
For creating the system architecture:	○	○	○	○	○
For implementing the initial code:	○	○	○	○	○
For later changes to the system:	○	○	○	○	○
For the understandability of the system (by developers):	○	○	○	○	○
For managing the build:	○	○	○	○	○
For the system (CPU) performance:	○	○	○	○	○
For memory usage:	○	○	○	○	○
For the effort required from developers:	○	○	○	○	○
For the motivation of developers:	○	○	○	○	○

Do you know of any aspects not mentioned above for which the development with multiple languages is beneficial or detrimental?

Page 08

6. Do you feel that multi-language programming in general has increased or decreased over time? What do you think the future holds?

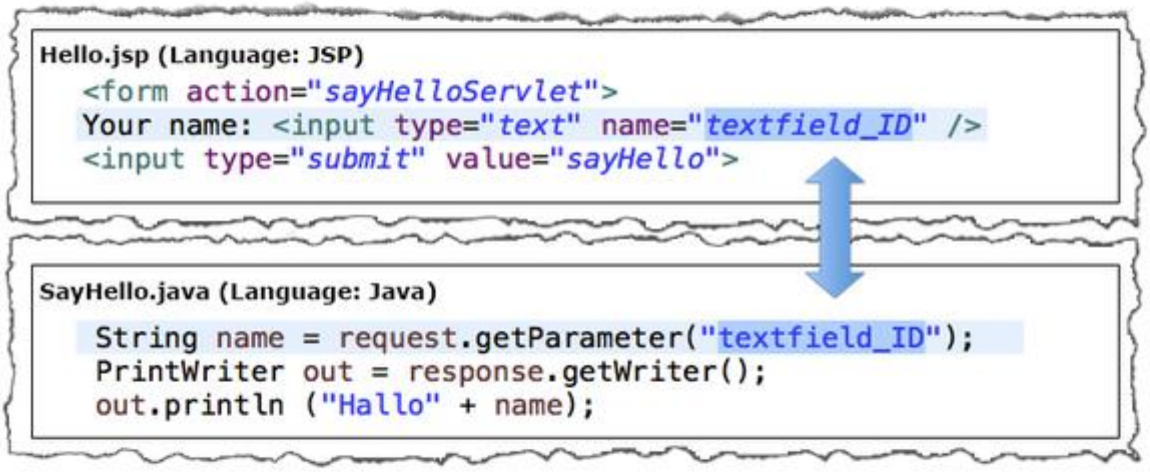
Note: In contrast to most other questions, this question refers to your general assessment - *independent* of the project you completed last.

	Fewer languages per project	**About the same number of languages**	**More languages per project**
In the past there were:	○	○	○
In the future there will be:	○	○	○

Page 09

Section 2 - cross-language links

Up to now we have been asking questions about programming languages in general. In the following we are interested in *links* between programming languages. Such links are often established via *identifiers*, as in the following example with HTML and Java.



Hello.jsp (Language: JSP)

```
<form action="sayHelloServlet">
Your name: <input type="text" name="textfield_ID" />
<input type="submit" value="sayHello">
```

SayHello.java (Language: Java)

```
String name = request.getParameter("textfield_ID");
PrintWriter out = response.getWriter();
out.println ("Hallo" + name);
```

Identifiers such as `textfield_ID` above link two languages together. If such *cross-language links* are not maintained carefully - e.g. by mistakenly renaming an identifier in just one language instead of every language - problems/bugs will occur.

The following questions refer to the existence of such links and the problems which arose due to their use - again regarding the **project you completed last** and independent of which team member worked with those links.

Page 10

7. Did cross-language links between the *universal* and *specialized* languages in the project you completed last?

Note: Please name individual combinations such as “Java and HTML”. We consider programming languages like Java, C/C++, C#, JavaScript or PHP as *universal programming languages*; whereas languages like HTML, SQL, XML, .properties, Makefile(s), or templating languages are considered to be *specialized programming languages*.

○ Yes, between the following languages:

○ No

Page 11

8. Did cross-language links also exist between *multiple universal languages* (such as Java and C)? If so, between which languages?

Note: We consider programming languages like Java, C/C++, C#, JavaScript or PHP as *universal programming languages*.

○ Yes, between the following languages:

○ No

Page 12

9. Did cross-language links also exist between *multiple specialized languages* (such as HTML and CSS)? If so, between which languages?

Note: We consider programming languages like HTML, CSS, SQL, XML, .properties, Makefile(s) or templating languages as *specialized programming languages*.

○ Yes, between the following languages:

○ No

Page 13

10. Did cross-language links lead to problems in the project you completed last? If so, which kinds of problems?

Multiple answers may be selected.

□ Changes to cross-language identifiers led to problems/bugs

□ Configuration of required libraries/frameworks was complex

□ The complexity of cross-language links led to less changes/refactorings being made

□ Configuring the build environment was more complex

□ The inner workings of the system were harder to understand and communicate

□ Writing unit tests was harder due to the dependencies introduced

□ Other problems:

□ No problems occurred

Page 14

11. *When* did cross-language related problems occur?

	Did not occur	**Rarely**	**From time to time**	**Frequently**	**All the time**
During (initial) implementation of requirements:	○	○	○	○	○
When changing code due to implementing the next requirement(s):	○	○	○	○	○
When changing code for improving code quality (refactoring):	○	○	○	○	○
During development and execution of unit tests (by developers):	○	○	○	○	○
During explicit test phases (by test personnel):	○	○	○	○	○
During alpha/beta/acceptance testing:	○	○	○	○	○
After system acceptance/delivery:	○	○	○	○	○

Did problems show up at any other time than those mentioned above?

Page 15
SP07

12. Which measures were taken to detect and prevent problems in cross-language links in the project you completed last?

Multiple answers may be selected.

□ Where possible, additional languages were avoided completely

□ Where possible, cross-language links were avoided

□ Cross-language identifiers and links were kept unchanged as much as possible

□ Special care was taken when changing cross-language links

□ Dedicated tools were used to detect cross-language linking problems

□ Dedicated tests were written to reveal problem with cross-language links

□ Additional measures:

□ No measures have been taken

Page 16

Section 3 - tools for managing cross-language links

You have made it to the third and thus second-to-last section in this questionnaire. In this part, we are interested in your experience with cross-language features of development environments. One might imagine the following features:

- automated *highlighting* of cross-language identifiers in the source code, for example with a different font color or background
- automated detection and identification of *errors* in cross-language links (e.g. "definition not found") in the source code
- option for *navigating* directly from one identifier to another ("jumping" between identifiers in different languages and files)
- automated *renaming* of linked identifiers across several languages (rename refactoring)

The following questions are to determine whether tools with such functionality were available in the **project you completed last** - and whether you regard such functionality as desirable in general.

Page 17

13. Which of the following features were present in the tools that were used in the project you completed last?

Note: Please also select an option if the feature was only available for *some* languages.

□ Highlighting of cross-language identifiers in the source code

□ Detection and identification of errors in cross-language links

□ Navigation between identifiers in several languages

□ Automated renaming of cross-language identifiers (rename refactoring)

□ Other features (including the name of the tool):

□ No support at all for cross-language links

Page 18

14. How important is support for the following features for cross-language links in tool support for you *in general*?

Note: In contrast to most other questions, this question refers to your general assessment - *independent* of the project you completed last.

	As how important do you rate:				
	Very unimportant	**Rather unimportant**	**Neutral**	**Rather important**	**Very important**
Highlighting of cross-language identifiers in the source code:	○	○	○	○	○
Detection and identification of errors in cross-language links:	○	○	○	○	○
Navigation between cross-language identifiers in several languages:	○	○	○	○	○
(Automated) renaming of cross-language identifiers (rename refactoring):	○	○	○	○	○

Tool support for cross-language links in general: ○ ○ ○ ○ ○

Are there other features not mentioned above that you would like to see in tool support?

Page 19

Last section - closing questions

You nearly made it! We just have some closing questions which help us evaluate your questionnaire.

Page 20

15. Since when do you work professionally in software development?

I work professionally in software development since the year

Page 21

16. Which of the following activities did you personally perform in the project you completed last?

Multiple answers may be selected.

- □ Operations
- □ Build/CI engineering
- □ Architectural design
- □ programming
- □ (User interface) design
- □ Test development
- □ Management
- □ Other:

Page 22

17. How many software developers worked on the project you completed last?

Note: Software developers are people who directly worked on the code. In case of fluctuations please submit an estimate of the average head count.

Number of developers:

Page 23

18. How long was the development phase (without maintenance) of the project you completed last?

Duration in months:

Page 24

19. The software system you developed in the project you completed last best fits the following category:

○ Desktop applications
○ Client/server applications
○ Server applications / services
○ Web applications
○ Embedded systems
○ Operating systems
○ Other:

Page 25

20. Do you have any additional remarks regarding the topic of multi-language development or this questionnaire?

Page 26

21. Thank you very much for taking the time to answer this questionnaire!

If you are interested in the results of the survey, you can enter your e-mail address below, which will of course be stored completely separately from you answers.

□ I am interested in **the results of this study**. Please send me an abstract by e-mail.

Last Page

Thank you for participating in this survey!

We would like to thank you very much for your help in this research project! Your answers have been stored. You may close your browser now.

If you have any questions at all regarding the survey, individual survey questions, or the research project in general, please feel free to contact Dr. Philip Mayer via e-mail.