

Database Technology Landscape in South Tyrol

A survey on the usage of Database Technology in South Tyrol conducted by the Faculty of Computer Science of the Free University of Bozen-Bolzano for the NOI Techpark Südtirol / Alto Adige in the context of the DAVINCI project.



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Executive Summary

In this study we analyze the database technology landscape of companies and institutions in the Autonomous Province of Bolzano-South Tyrol. The study is based on a survey that has been conducted on 62 companies and institutions of different sizes and brings insights on the Database Management Systems (DBMS) used in this part of Italy, the reason for choosing these products, as well as future developments in this field.

Motivation: Understanding which technologies are currently in use in South Tyrol is important for many aspects, e.g. policy makers can understand the relevance of a given technology on the territory and estimate the impact of their initiatives; universities can understand what kind of education is important for students to be productive in their future work; practitioners can understand what kind of skills are required to be successful within the local market.

Problem statement: This study sheds light on two questions: 1) which database management systems (DBMS) are currently in use in South Tyrol and 2) towards which DBMS are companies migrating to. Within the study, we determine the actual product names, motivations, and the context in which DBMSs are used.

Approach: We chose to devise a questionnaire, which we sent to every company and institution in South Tyrol we are aware of that have their own IT department or provide IT services to others. In total, we contacted 155 companies and institutions.

Results: We obtained 62 answers (response rate of 40%) which show that the most used DBMS in South Tyrol are the Microsoft SQL Server, MySQL, and PostgreSQL. Almost half of the companies use one or more of these three technologies. The main reasons are because the expertise for these technologies is available within the company and because it is easy to integrate these technologies with other software. Only few companies want to change DBMS (18%); if they want to change, then in two years or later and mostly towards PostgreSQL.

1 Introduction and Motivation

The aim of this study is to analyze the usage of DBMS in companies and institutions of the Autonomous Province of Bolzano-South Tyrol.

Concretely, we looked for answers to the following questions:

1. Which DBMS are currently in use?
2. What are the main reasons to use a specific DBMS?
3. Which functionalities are currently missing in the used DBMS?
4. Is licensing an important factor for the choice of a DBMS?
5. What are the motivations of changing DBMS?
6. If a change is planned, from which system to which system are people migrating?
7. In which other areas are Open Source products used?

In this work, we put a particular focus on the usage of Open Source¹ solutions, as well as possible reasons to migrate to another DBMS.

This study gives insights into the usage of database technologies in South Tyrol with respect to products, types, and licensing.

2 Research Questions and Methodology

2.1 Company selection

For the study we chose 155 companies and institutions in South Tyrol that either have an own IT department or provide IT services to others. The goal was to contact companies that have control over the choice of their DBMS and to be exhaustive, i.e., to contact all companies we are aware of that match the above criteria.

2.2 Questionnaire development

The study was conducted using an online survey and the companies have been contacted via email. A main design decision was to keep the time to answer short, i.e., below 5 minutes, to increase the response rate.

The questionnaire was developed starting from the following two questions:

1. Which DBMS are currently in use? (present)

¹In this study, we use the term "Open Source" throughout the text, instead of, e.g., "Free Software" or "Libre Software", following the definition of the Open Source Initiative. Other terms might be more appropriate, e.g., the Free Software Foundation Europe (FSFE) states that "Free Software is software that guarantees a set of freedoms to its users. It is 'free' as in freedom not as in 'free of charge'. Although a variety of terms are used to refer to it, at FSFE we prefer to talk about Free Software because this better reflects the philosophy of the four freedoms which are intrinsic to it [7]." Nevertheless, purely because we feel that in South Tyrol the term "Open Source" is (still) more common and because in German and Italian questionnaires we could leave the English term "Open Source" untranslated to make it clear that we mean not only that the

2. Which DBMS will be changed into different ones? (future)

Therefore, formulated as a GQM[4] goal, the questions become:

1. Analyze **South Tyrolean companies** for the purpose of **understanding** with respect to **the database systems currently in use** from the viewpoint of **company-internal IT personnel** in the context of **a questionnaire**.
2. Analyze **South Tyrolean companies** for the purpose of **understanding** with respect to **the Open Source database systems that will be used in the future** from the viewpoint of **company-internal IT personnel** in the context of **a questionnaire**.

Following the GQM approach we can generate two types of questions:

1. Questions that characterize the **object of study** with respect to the **overall goal**
2. Questions that characterize or evaluate relevant **attributes of the object of study** with respect to the **focus**

Based on the defined measurement goals, we defined the questions for goal 1:

RQ1: Which DBMS are currently in use? Why?

RQ2: In which departments do you use database systems?

RQ3: Which functionalities are currently missing in the used DBMS?

The questions for goal 2 are:

RQ4: Is licensing an important factor for the choice of a DBMS?

RQ5: What are the motivations for changing DBMS? If a change is planned, from which system to which system are people migrating?

RQ6: In which other areas are Open Source products used?

Based on these research questions, we derived the following questions for the questionnaire²:

Q1.1 Which DBMS are you currently using? and which are the most important considerations for your DBMS choice [5]? (RQ1)

Q1.2 In which departments do you use database systems? (RQ2)

Q1.3 Which features are you currently missing in the database system you use? (RQ3)

Q2.1 In your choice for a database system, which role did the fact that it is Open Source/closed source play? (RQ4)

Q2.2 How likely is it that you will change database systems in the future? (RQ5)

Q2.3 In which other areas do you use Open Source products? (RQ6)

source code is accessible, but that all aspects of a Free/Libre Open Source Software definition are intended.

²Within the questionnaire, questions in Italian are labeled as Q1.1, Q1.2, etc., in German as F1.1, F1.2

In question Q1.1 respondents can give multiple motivations for the choice of every DBMS they have in use. To provide a set of possible options, we mapped the main factors described in [5] to a set of DBMS characteristics that companies can choose to express their preference towards a given system.

1. Usability

- SQL language flexibility
- Availability of expertise in your company
- Easy integration with other software products that you are using

2. Visualization & Reporting

- *Skipped because it relates more to business intelligence (BI) systems.*

3. Security

- Reliable data storage
- User access control

4. Functionality

- *Skipped because it relates more to BI systems and is already covered by other questions in the questionnaire.*

5. Support & Development

- Support

6. Integration

- Easy integration with other software products that you are using

7. Scalability

- Replication/ Scalability/ Cloud
- Data access speed

8. Cost and Suitability

- Price

9. Updates

- Support

The final questionnaire has thus six questions for a total answering time of around five minutes and it was implemented in two Google Forms, one in Italian and one in German.

2.3 Pilot study

Before sending it to all companies on the list, the questionnaire was first proposed to ten companies for an initial pilot study. After the first answers, we decided to apply the following modifications to the questionnaire:

1. We modified question Q2.1 so that instead of asking if the specific license is important or irrelevant, respondents can specify if an Open Source license or a closed source license is important or irrelevant
2. We extended the examples we gave for Open Source products in Q2.3

2.4 Execution

We formulated the following e-mails in German and Italian to invite companies to answer our questionnaire:

Sehr geehrte (*Company*),

Wir führen gerade eine Studie mit Unternehmen in Südtirol durch, bei der wir herausfinden möchten, welche Datenbanksysteme im Einsatz sind. Die Studie ist eine Zusammenarbeit zwischen NOI AG und der Freien Universität Bozen innerhalb eines Projekts finanziert von der Europäischen Union.

Der Fragebogen besteht aus 6 Fragen und das Ausfüllen dauert ungefähr 5 Minuten. Am Ende des Fragebogens können Sie eine E-Mailadresse hinterlassen um das Ergebnis der Studie zu erhalten.

Der Fragebogen in deutscher Sprache befindet sich unter folgendem Link: <https://forms.gle/MJP6KVegDwfWUq547>, der in italienischer Sprache unter folgendem: <https://forms.gle/KAXzBCCUnYHhomB46>

Für unsere Studie ist es notwendig, dass ihr Informatikverantwortlicher (oder ein Stellvertreter) uns die Antwort innerhalb des 21.05.2019 zukommen lassen kann.

Vielen Dank für Ihre Teilnahme.

mit freundlichen Grüßen, Smart Data Factory - Technology Transfer Lab
@unibz

Spett.le (*Company*),

stiamo attualmente conducendo uno studio con le aziende altoatesine per scoprire quali sistemi di gestione di database vengono utilizzati. Lo studio è una collaborazione tra la NOI S.p.A. e la Libera Università di Bolzano all'interno di un progetto finanziato dall'Unione Europea.

Il questionario è composto da 6 domande ed ha un tempo di completamento di circa 5 minuti. Alla fine del questionario ci sarà la possibilità di lasciare un indirizzo email per ricevere i risultati dello studio.

Può trovare il questionario in lingua italiana al seguente link: <https://forms.gle/KAXzBCCUnYHhomB46>, quello in lingua tedesca al seguente: <https://forms.gle/MJP6KVegDwfWUq547>

Per lo studio sarebbe importante che il vostro responsabile ICT (o un suo rappresentante) rispondesse entro il 21.05.2019.

Grazie mille per la vostra partecipazione.

Cordialmente, Smart Data Factory - Technology Transfer Lab @unibz

The questionnaires behind the links were developed in Google Forms and had the structure depicted in Figure 1.

After starting the questionnaire, companies have the option to either give their name or to enter their productive sector, number of employees, and their turnover. If they specify their name, we obtain this data for them consulting public records, e.g., of the chamber of commerce. Using this data, companies can be classified as micro, small, medium or large companies, using the definition of Small and Medium Enterprises (SME) given by the European Commission [3]. We base our classification on the number of employees and turnover (see Table 1).

After this step, the six questions are presented, with an additional, final, optional step to leave an e-mail address to be informed about the results of the study.

The questionnaires were sent starting from the 3rd of May 2019, with a first deadline for the 21st of May 2019. We then reminded companies to fill in the questionnaire another time on the 21st of May 2019 with a new deadline at the 28th of May 2019. To send the e-mails, we used the software SendBlaster³.

3 Results

From the 155 contacted companies we obtained 62 answers resulting in a response rate of 40%. The questionnaire was provided in German and Italian, and the distribution of answers between these two languages was 79% in German and 21% in Italian. In case the answer contained the name of the company, we searched on publicly released databases as well as the company website for the relevant data. For 10% of companies it was not possible to trace back the turnover and for 3% the number of employees.

The following sub-sections are structured as follows: Section 3.1 describes the companies and institutions that answered the questionnaire along several dimensions, e.g., company size. Section 3.2 describes the answers for the research questions 1, 2, and 6 (RQ1, RQ2, and RQ6). Section 3.3 describes the answers for the research questions 3 and 4 (RQ3 and RQ4). Section 3.4 describes the answer for research question 5 (RQ5).

³<https://www.sendblaster.it>

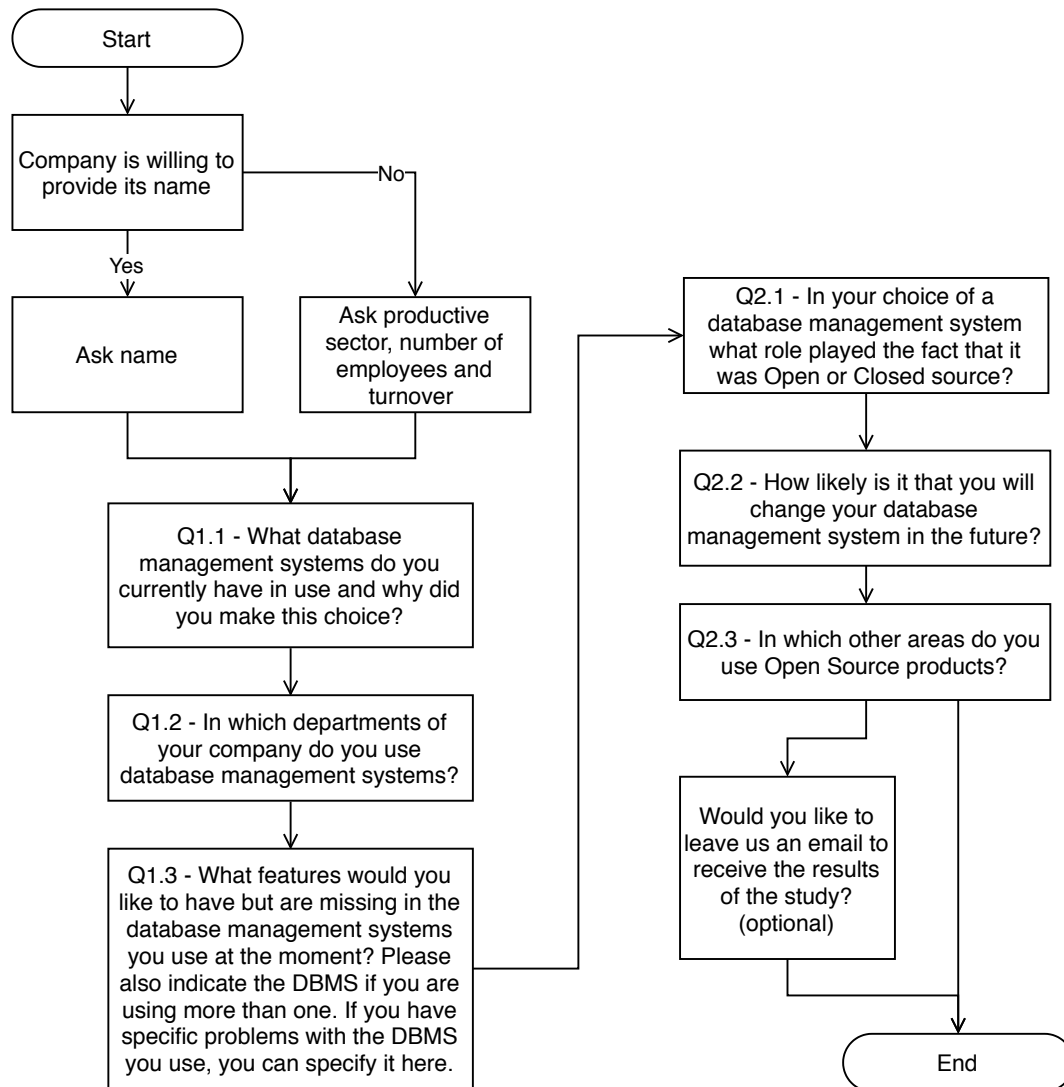


Figure 1: Questionnaire structure.

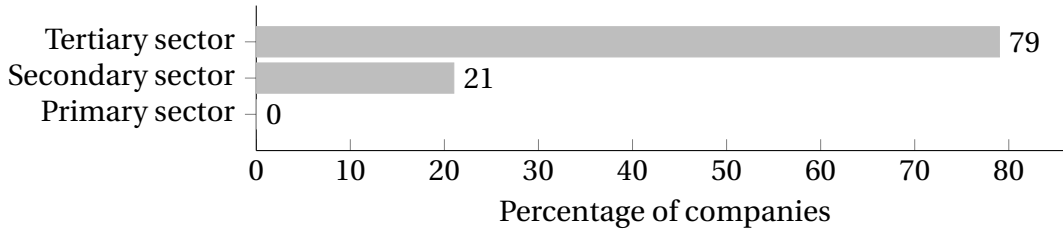


Figure 2: Sector in which companies are working.

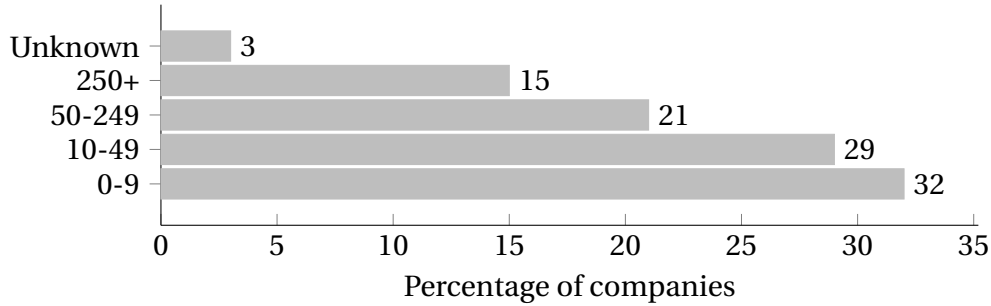


Figure 3: Number of employees of companies.

3.1 Subject Overview

We first analyzed the sector distribution of companies and institutions that were involved in the study. Figure 2 shows the distribution of the companies that answered to the questionnaire according to the three-sector model [6]: raw materials (primary sector), manufacturing (secondary sector), and services (tertiary sector). 79% of the companies work in the tertiary sector, i.e., transport and communications, facility management, commercial services, tourism, insurance and banking services, public administration, research and development, information technology”. 21% in the secondary sector, i.e., all activities of the food industry, mining, metal and steel industry, mechanical engineering, defence industry, petrochemical industry, paper industry, construction industry, processing industry, automotive industry, pharmaceutical industry, textile industry, chemical industry. No companies in the primary sector including agriculture, fisheries, livestock and forestry, i.e. logging and mining. While this may indicate a strong bias, companies of the primary sector in South Tyrol do generally not have an own IT infrastructure, but rather use services of companies included in the tertiary sector.

The distribution based on number of employees is shown in Figure 3, and the distribution based on the turnover in Figure 4.

Leveraging this information, we further divided the companies into four categories: micro, small, medium-sized, and large. Table 1 summarizes the criteria as indicated by the European Commission [3] (based on number of employees and turnover only). The final distribution based on company size is shown in Figure 5. For 10% of companies this categorization was not possible, because of missing number of employees and/or

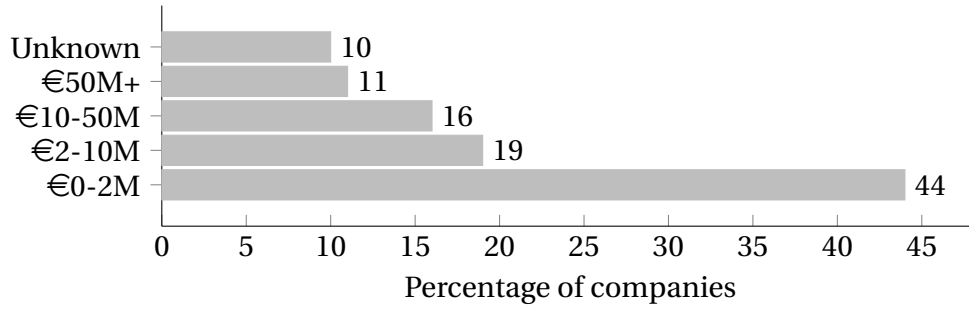


Figure 4: Turnover in Million of companies.

Table 1: Calculation of micro, small and medium-sized enterprises.

Size	Employees	Turnover
Micro	< 10	≤ €2M
Small	< 50	≤ €10M
Medium-sized	< 250	≤ €50M

turnover. As can be seen from the distribution, the size of companies that answered to the questionnaire is slightly skewed towards small ones.

3.2 Usage of Database Management Systems

We now focus on the current usage of DBMS. Table 2 shows the DBMS products used by companies in the study, i.e., all products used by at least one company, with their type, license, and initial release year.

⁴AWS Aurora: <https://aws.amazon.com/rds/aurora/>; Elasticsearch: <https://www.elastic.co>; File-Maker: <https://www.filemaker.com>; Firebase: <https://firebase.google.com/docs/database>; Firebird: <https://firebirdsql.org>; Google BigQuery: <https://cloud.google.com/bigquery/>; H2: <http://www.h2database.com/>; IBM DB2: <https://www.ibm.com/products/db2-database>; InfluxDB: <https://www.influxdata.com>; Interbase: <https://www.embarcadero.com/products/interbase>; MariaDB: <https://mariadb.org>; MS Access: <https://products.office.com/en/access>; MS SQL Server:

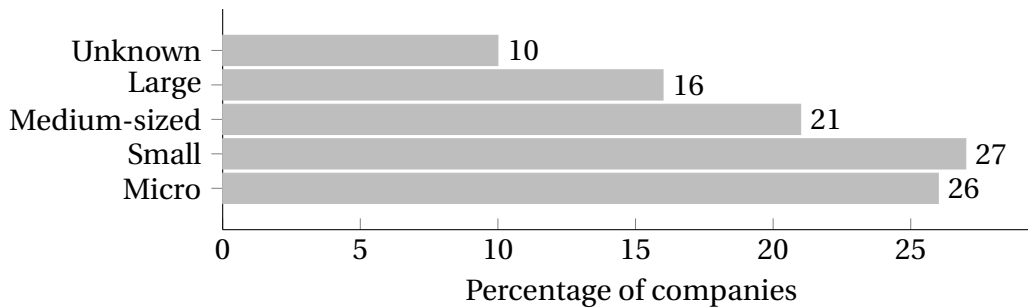


Figure 5: Size of companies.

Table 2: DBMS products reported by the study with their type, license, and age.

DBMS product ⁴	Type/Data Model	License	Initial release
AWS Aurora	Relational	Proprietary	2014
Elasticsearch	NoSQL (Search engine)	Open Source	2010
FileMaker	Relational	Proprietary	1985
Firebase	NoSQL (Document store)	Proprietary	2012
Firebird	Relational	Open Source	2000
Google BigQuery	Relational	Proprietary	2010
H2	Relational	Open Source	2005
IBM DB2	Relational	Proprietary	1983
InfluxDB	NoSQL (Time Series DBMS)	Open Source	2013
Interbase	Relational	Proprietary	1984
MariaDB	Relational	Open Source	2009
MS Access	Relational	Proprietary	1992
MS SQL Server	Relational	Proprietary	1989
MongoDB	NoSQL (Document store)	Open Source	2009
MySQL	Relational	Open Source	1995
Oracle	Relational	Proprietary	1980
PostgreSQL	Relational	Open Source	1996
RavenDB	NoSQL (Document store)	Open Source	2010
Redis	NoSQL (Key-value store)	Open Source	2009
SAP HANA	Relational	Proprietary	2010
SQLite	Relational	Open Source	2000

We found that companies use between one and eight different DBMS. The distribution of how many different DBMS are used by companies is shown in Figure 6. Generally companies use few different DBMS, i.e., more than 70% use up to three. Only a limited number of companies use more than five.

Figure 7 shows the percentage of companies using a particular DBMS. Microsoft's SQL Server is the most used DBMS of the region, covering 48% of the DBMS used in the region. MySQL and PostgreSQL are placed second, each with 45% of usage rate. Oracle is ranked fourth. Interestingly, in the top-4 we have two proprietary and two Open Source systems.

⁴<https://www.microsoft.com/en-us/sql-server/sql-server-2017>; MongoDB: <https://www.mongodb.com>; MySQL: <https://www.mysql.com>; Oracle: <https://www.oracle.com/database/>; PostgreSQL: <https://www.postgresql.org>; RavenDB: <https://ravendb.net>; Redis: <https://redis.io>; SAP HANA: <https://www.sap.com/products/hana.html>; SQLite: <https://www.sqlite.org/>;

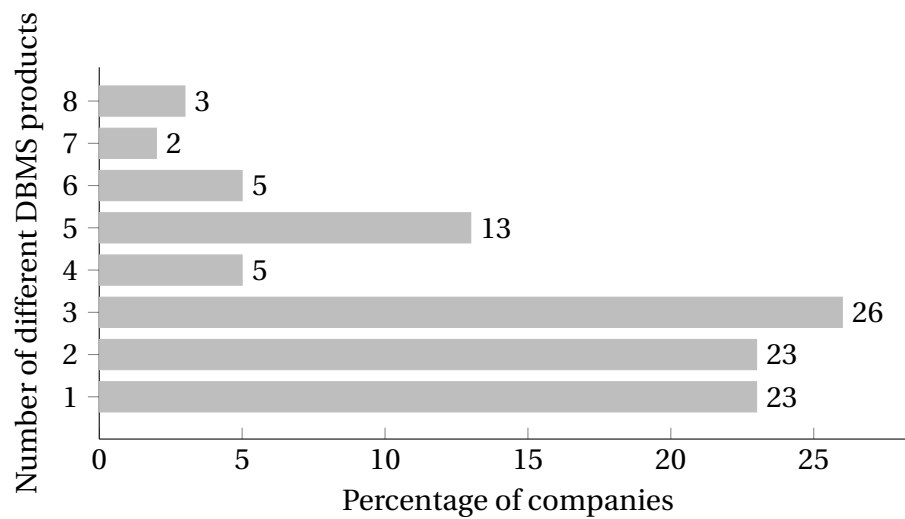


Figure 6: Number of DBMS products used by companies.

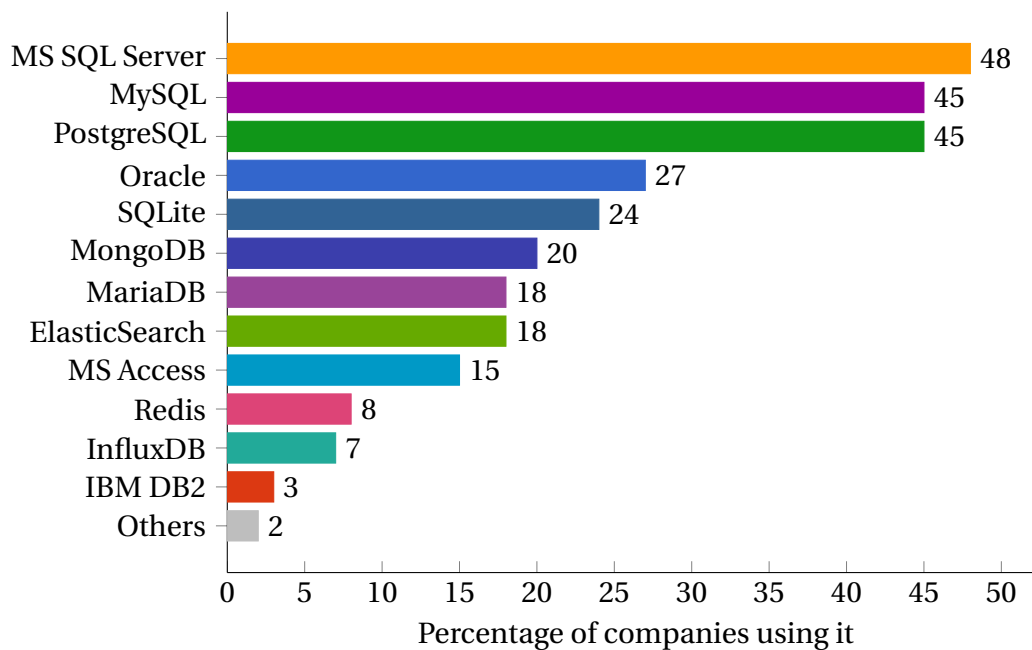


Figure 7: Usage of DBMS products.

Compared to the popularity ranking of DBMS reported by db-engines.com [1] at the time of the survey, there is an over-representation of SQLite and an under representation of IBM DB2. The top-10 most popular systems according to this knowledge base are:

1. Oracle
2. MySQL
3. Microsoft SQL Server
4. PostgreSQL
5. MongoDB
6. IBM Db2
7. Elasticsearch
8. Redis
9. Microsoft Access
10. Cassandra

Note that even though a comparison can be interesting, the score employed by db-engines.com is not only given, as in this study, by the percentage of companies using a DBMS, but is a more complex score that takes into account multiple factors [2].

To the best of our knowledge there is only one previous similar study conducted in South Tyrol [11]. In this study of 2003, 131 companies were interviewed and the questions covered a broader range of topics, only one being on the usage of DBMS. Furthermore, the study was mostly conducted on small companies as in their results only 15% of them reported a turnover higher than €1 million, whereas in our study 46% reported a turnover higher than €2 million (cf. Figure 4). In their study they reported that MS Access was the most popular DBMS, as 37.4% of companies were using it, whereas in our study MS Access is only on the ninth place. Second placed they reported MS SQL Server with 31.3%, which in our survey resulted the most employed. Next, MySQL with 29.8% was on place three, Oracle and Sybase shared place 4 with each 16.8%. IBM DB2 with 11.5% and Informix with 6.9% made it to places 6 and 7 respectively. PostgreSQL was not mentioned at that time while in our study PostgreSQL find itself at place 3. Note that MongoDB, MariaDB, ElasticSearch, Redis and InfluxDB did not exist at that time, and that SQLite was relatively new (cf. Table 2).

Next, we compare the DBMS usage of the top-4 DBMS from Figure 7 for companies of different sizes. The result is shown in Figure 8. We found that 100% of the large companies in our study use MS SQL Server, while for smaller companies the percentage decreases and reaches 25% for micro-sized companies. For PostgreSQL we observe the opposite: while only 30% of large companies use it, it is the DBMS of choice for more than half of the small and micro-sized companies.

Figure 9 shows the usage of DBMS divided into relational [13] and NoSQL [12] systems. We can clearly see that most of the DBMS in use are relational DBMS, since only approximately 20% of the used systems are NoSQL-based. We also analyzed the percentage of companies that use exclusively relational or NoSQL systems. The results show that 64% of the companies use exclusively relational DBMS, while 36% use a combination of NoSQL and relational DBMS. No company in the study exclusively uses NoSQL systems.

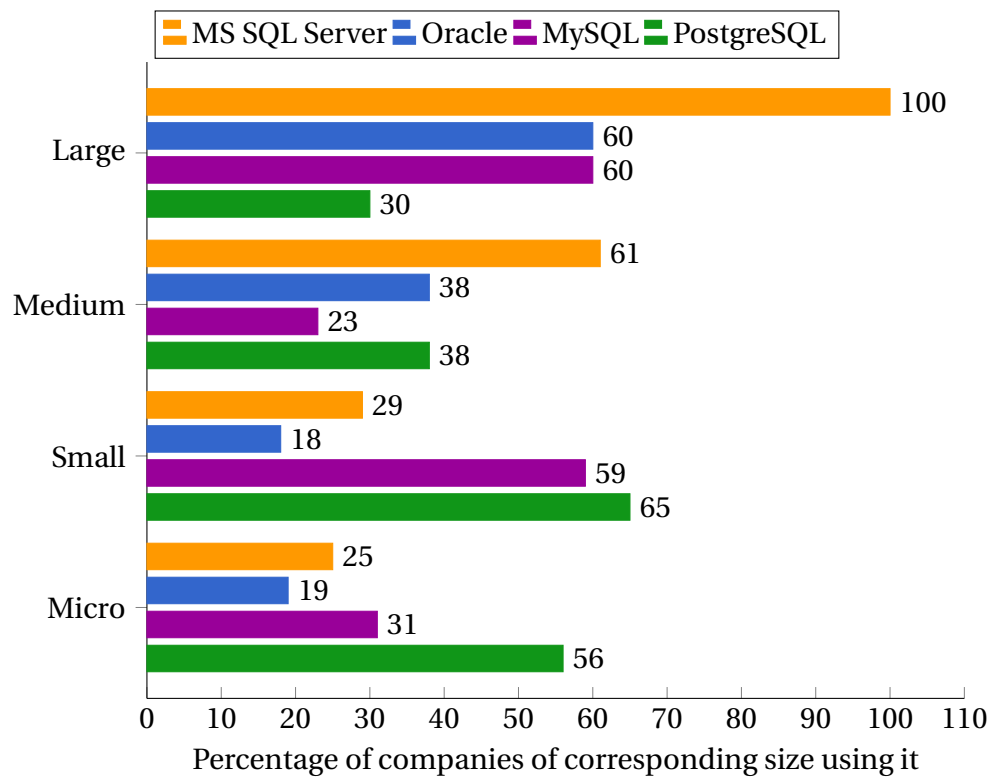


Figure 8: Usage of DBMS products by company size.

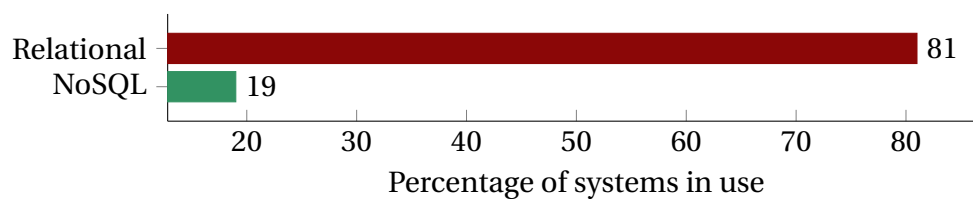


Figure 9: Usage of relational and NoSQL DBMS.

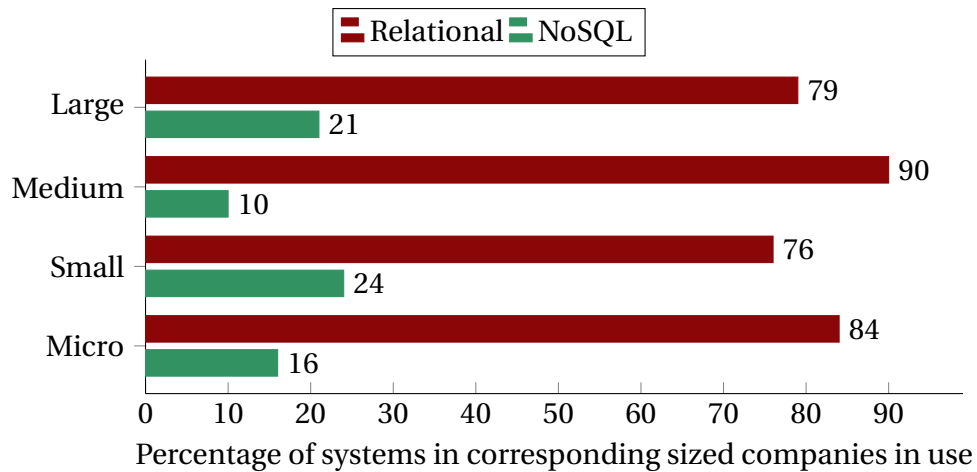


Figure 10: Usage of relational and NoSQL DBMS by company size.

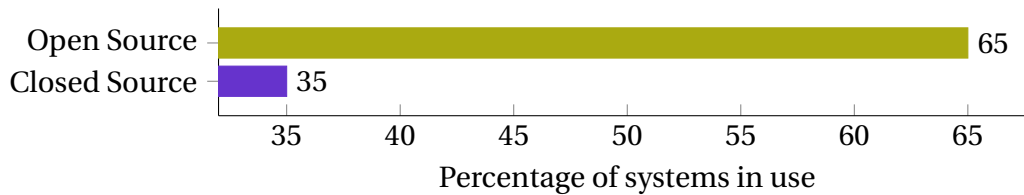


Figure 11: Usage of Open Source and closed source DBMS.

Figure 10 shows the same picture for companies of different sizes. In all cases relational DBMS are dominating.

Figure 11 shows the percentage of employed DBMS divided into Open Source and proprietary, i.e. closed, source systems. With 65% Open Source systems are ahead, which is not surprising given that seven DBMS in the top-10 of used systems are Open Source (cf. Figure 7 and Table 2).

To better describe the context in which Open Source Systems are used, we asked the respondents to tell us in which other areas they use Open Source solutions. Figure 12 depicts the results.

Using this contextual information, we were curious to know if there is a correlation between using Open Source products in general and using an Open Source DBMS. Therefore we asked ourselves the following questions:

Both: How many respondents **use** Open Source database systems and **use** other Open Source products?

Only DBMS: How many respondents **use** Open Source database systems but **do not use** other Open Source products?

Only Other: How many respondents **do not use** Open Source database systems but **use** other Open Source products?

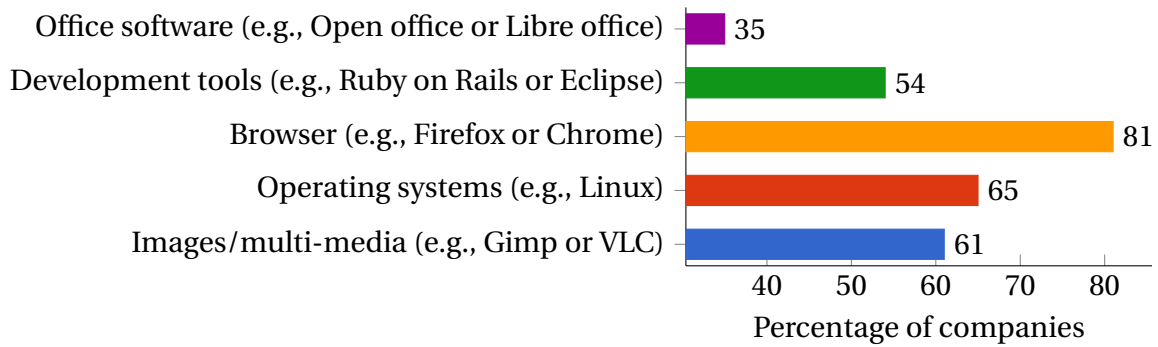


Figure 12: Usage of other Open Source products.

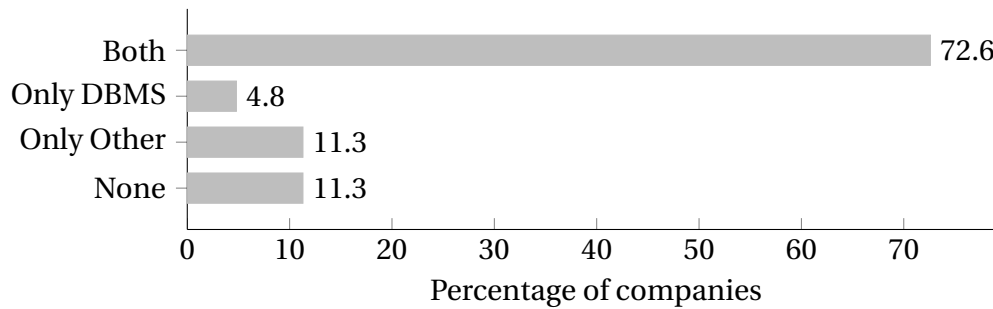


Figure 13: Relationship between usage of a Open DBMS and the general use of Open Source software.

None: How many respondents **do not use** Open Source database systems and **do not use** other Open Source products?

Analyzing the data, we obtained the results depicted in Figure 13.
From this data we conclude that:

- If respondents use an Open Source DBMS, then they are likely (72.6 %) to use also other Open Source products and vice versa⁵
- It is very unlikely (4.8 %) that a respondent uses only a Open Source DBMS but no other Open Source software.
- Few companies do not use any Open Source software (11.3 %)

Next, we show the usage of Open Source and proprietary DBMS for companies of different sizes in Figure 14. For large and medium-sized companies roughly the same number of Open Source and proprietary systems are used, while for small and micro-sized companies Open Source DBMS dominate.

⁵This relationship does not describe a causality, i.e., we do not know which of the two causes the other

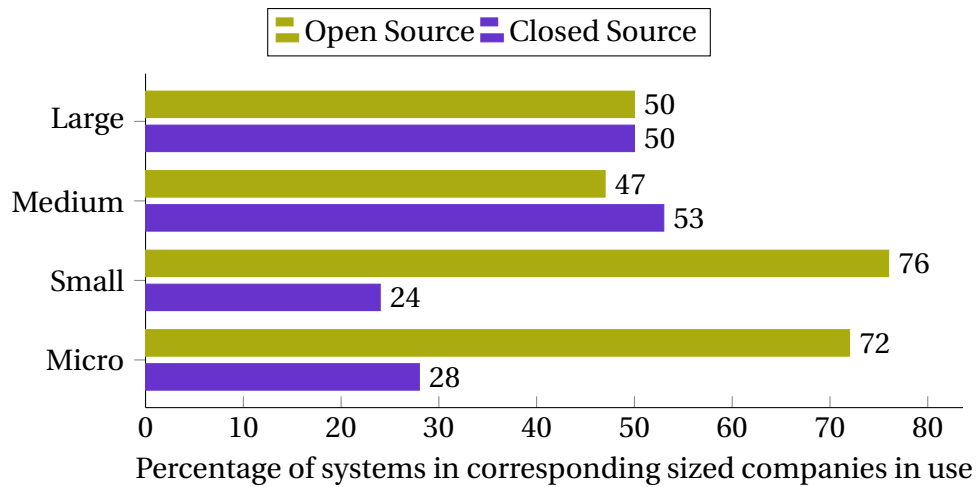


Figure 14: Usage of Open Source and closed source DBMS by company size.

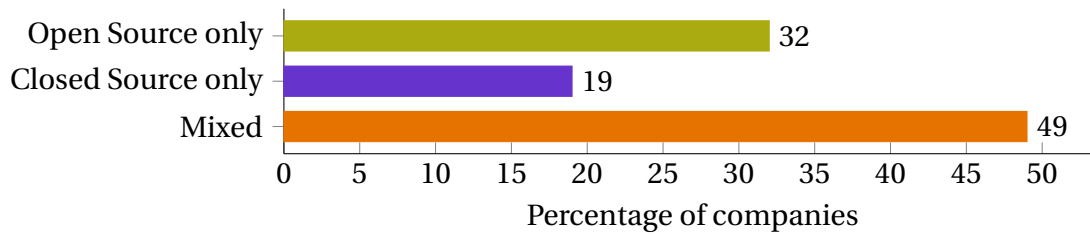


Figure 15: Exclusive usage of Open Source and closed source DBMS.

We now analyze the ratio of companies using exclusively one type of licensing for their DBMS: either Open Source or proprietary. The results are shown in Figure 15. Half of the companies use a mix of Open Source and proprietary DBMS. 32% use exclusively Open Source systems and 19% exclusively proprietary DBMS.

Figure 16 additionally shows the usage of Open Source and proprietary systems in the different departments of companies. The percentage is calculated based on companies that use DBMS in that respective departments otherwise they are ignored. Proprietary systems are used the most in the “Purchase” department, followed by “Accounting and Finance” and “Human Resources”. On the other hand “Research and Development” and “Marketing” are the two departments where Open Source is mostly employed.

3.3 Choice of Database Systems

We now focus on the reasons why companies chose a specific DBMS over the others. The question was presented as a matrix where for each DBMS, companies could tick a number of predefined reasons that could be behind their choice. All possible reasons are listed in

one.

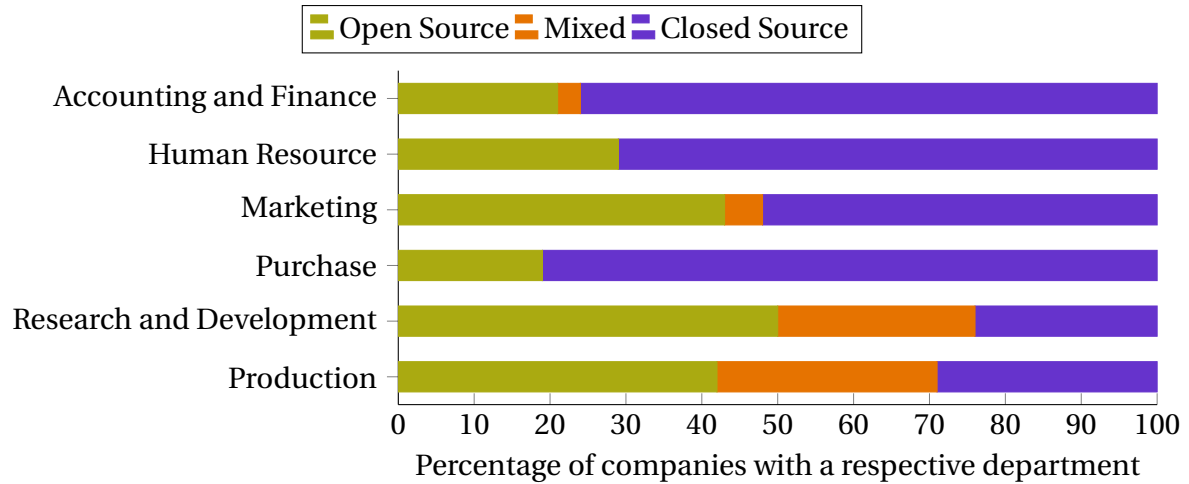


Figure 16: Usage of Open Source and closed source DBMS in different departments.

Chapter 2 and the results are shown in Figure 17. Overall, the most important reason is the presence of expertise in the company followed by “Easy integration with other software”. Interestingly the presence of support and user access control are instead important for only 19% and 16% of the DBMS respectively.

Since the number of DBMS used by each company can vary, we repeated the analysis by only considering each reason once per company, instead of multiple times for each DBMS. These results are shown in Figure 18. The general trend is very similar to the above: for 83% of the companies the presence of expertise in company is important. Price is an important factor for 50% of the companies for at least one of their DBMS. Also for this case, support and user access control seem not to be very important.

To further investigate the reasons behind the choices of DBMS, we added a free text field where companies could indicate important features they consider missing or lacking in the DBMS they are currently using. This field was not frequently used, indicating that most probably the most important features are covered by their DBMS. Only 8 companies answered to this field, out of which 2 expressed that there are no missing features. In the remaining 6 answers, 2 would like to have more support for temporal queries and the others find the following features lacking: execution of queries from multiple sources, in-memory queries, a mechanism to automatically impute missing data in case of server failures, a mix of SQL and NoSQL in the same DBMS, and a more flexible and less expensive license model for their DBMS.

We also asked whether Open Source is important for the choice of a DBMS. The result is shown in Figure 19. We have the same relative positions already seen in Figure 15, but with a pronounced dichotomy between those who consider that the distinction is irrelevant and those who consider that Open Source is important. Out of all companies that consider Open Source important, $\frac{2}{3}$ use exclusively Open Source DBMS, the remaining $\frac{1}{3}$ use a mix of Open Source and proprietary DBMS. For those that consider the licensing irrelevant, 60% use a mix of Open Source and proprietary DBMS and 10% use exclusively

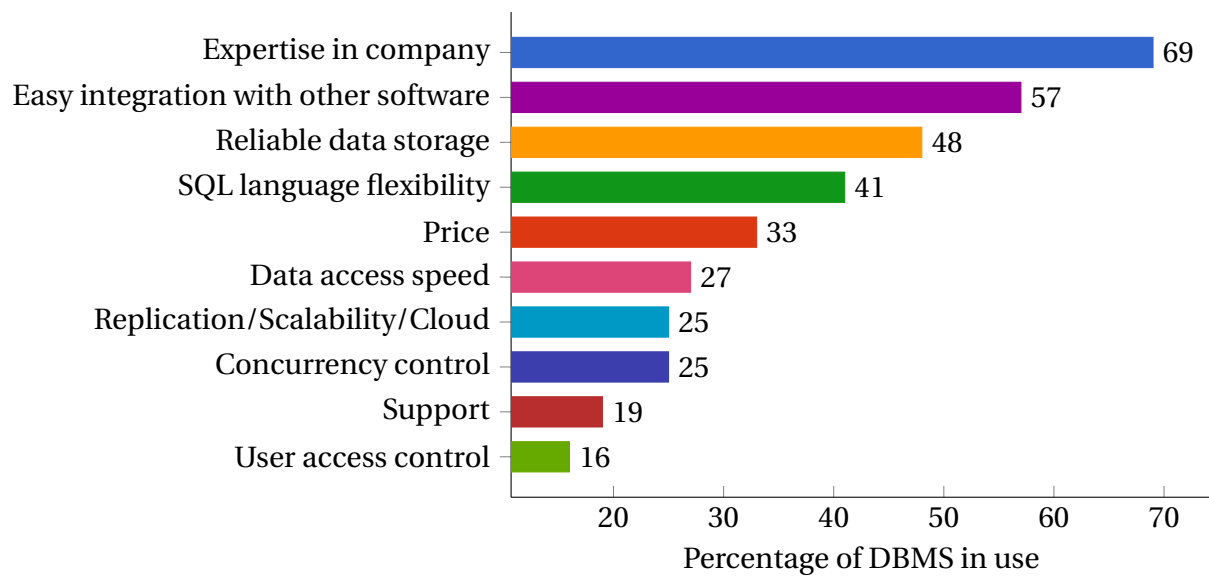


Figure 17: Reasons for the choice of a DBMS product.

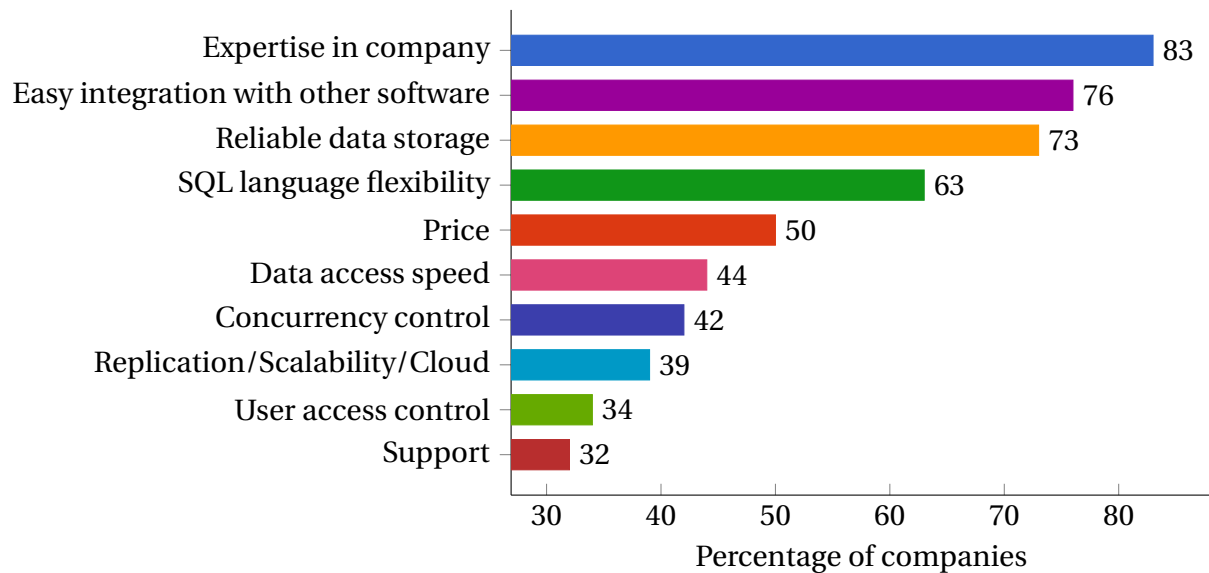


Figure 18: Reasons specified at least once by a company for the choice of a DBMS product.

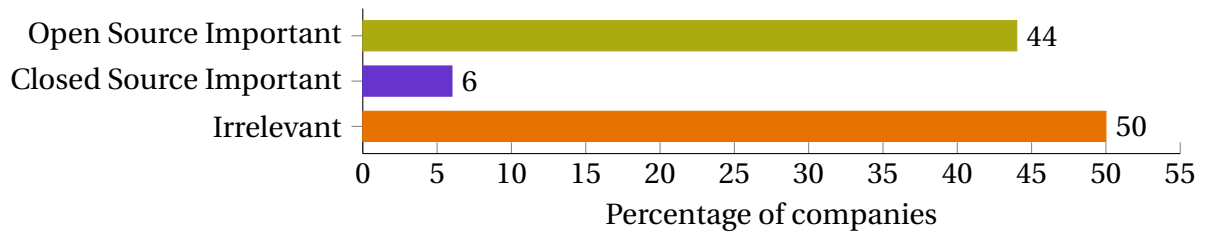


Figure 19: Importance of Open Source for a DBMS choice.

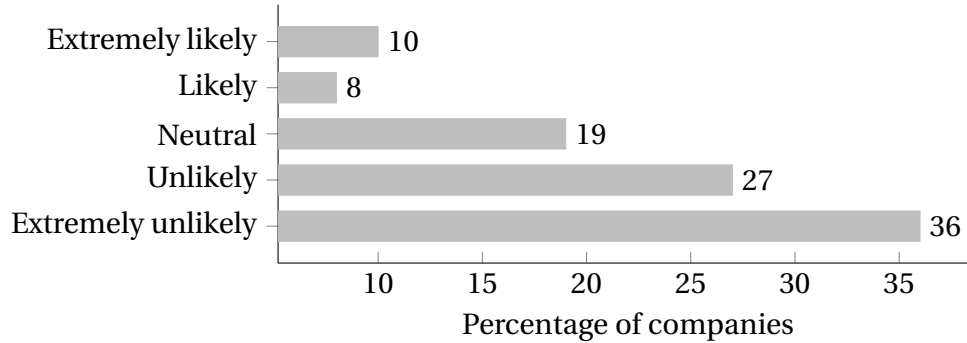


Figure 20: Probability of change of a DBMS product.

proprietary systems. Only 4 companies consider closed source important for the choice of a DBMS and half of them use exclusively closed source DBMS, the other two instead have mixed systems.

We also asked the reason for why they consider one of the licensing scheme important, or irrelevant. The major reason for the choice of “Irrelevant” is that companies are more interested in the functionality rather than the licensing. Companies that consider Open Source an important factor reported that it is either due to the company philosophy, or the independence from the vendor and the fear of vendor lock-in. For those who consider closed source important instead, the primary motivation is the availability of professional support and the guarantee that a product is developed and updated on a regular and continuous pace.

3.4 Future Perspectives

The second part of our survey is concerned with the question whether companies tend to change DBMS and, if so, what are their future directions. Out of all companies that compiled the survey, only 18% indicate that it is extremely likely or at least likely that they will change one of their DBMS in the future, see Figure 20. The majority consider it unlikely or even extremely unlikely. This is understandable, as changing a DBMS is a major undertaking for a company.

Of all companies that answered this question, 36% also provided a time frame. These includes all companies that indicated that it is likely or extremely likely to change DBMS,

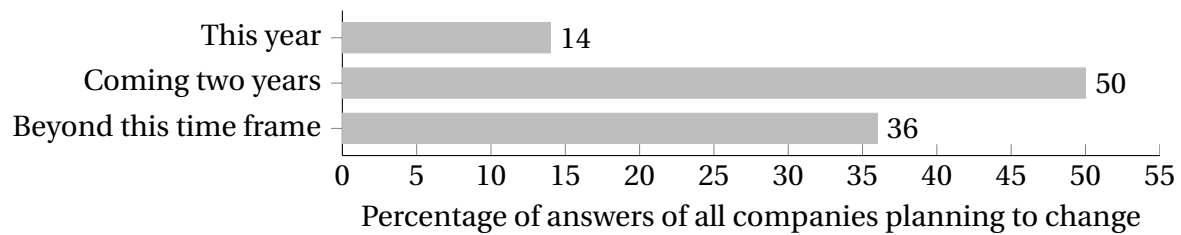


Figure 21: Time frame of change for a DBMS product.

half of those that indicated neutrality, and 18% of those that consider it unlikely of extremely unlikely. For this last group of companies this can be possibly indicating a will that due to external factor is likely to remain unfulfilled. The results are given in Figure 21.

We can now have a look at the DBMS that are subject to change in the future. Figure 22 shows the flow of DBMS, only including those that lose shares or gain new ones. IBM DB2 is the biggest loser, disappearing completely in favor of SAP HANA. This is, according to the feedback we had, due to the migration to the new SAP infrastructure that uses SAP HANA as a back-end. The biggest winner is instead PostgreSQL with an increase of 29% and eventually surpassing the number of companies that use MS SQL Server, should all planned migrations be realised. The new shares of PostgreSQL come from various DBMS, mostly MS SQL Server and Oracle, but also MySQL and RavenDB. The reasons for this change to PostgreSQL according to companies is mostly due to the price of the DBMS. MS SQL Server with -3% remains rather stable, it loses shares in favor of PostgreSQL, but gains new ones from Oracle and MySQL. In terms of absolute numbers, Oracle loses the most: 7 out of 17 companies using it plan to move to a different DBMS (-41%). The main reason provided for this are the high licensing costs. MySQL loses shares mainly to its fork MariaDB. These DBMS are rather similar, but as stated by the companies MariaDB, unlike MySQL, is not part of the Oracle Corporation. We also analyzed the relative ratios of NoSQL vs. relational DBMS as well as Open vs. closed source DBMS in this future perspective. Compared to the current state of NoSQL and relational systems as shown in Figure 9, there is only a very small change in the future. NoSQL systems gain +1%, which would result in a final usage of 80% of relational systems and 20% of NoSQL systems. This is mainly due to some relational DBMS that could be migrated to Elasticsearch, MongoDB and Redis. A higher impact can be observed on the ratio of Open and closed source systems. Compared to the current state, as shown in Figure 11, Open Source systems can gain a further 5%, resulting in a final possible employment of 70% for Open Source and 30% for proprietary systems. The main reason for this can be seen in Figure 22, where part of the proprietary DBMS (MS SQL Server and Oracle) are planned to be migrated to the Open Source DBMS PostgreSQL in the future.

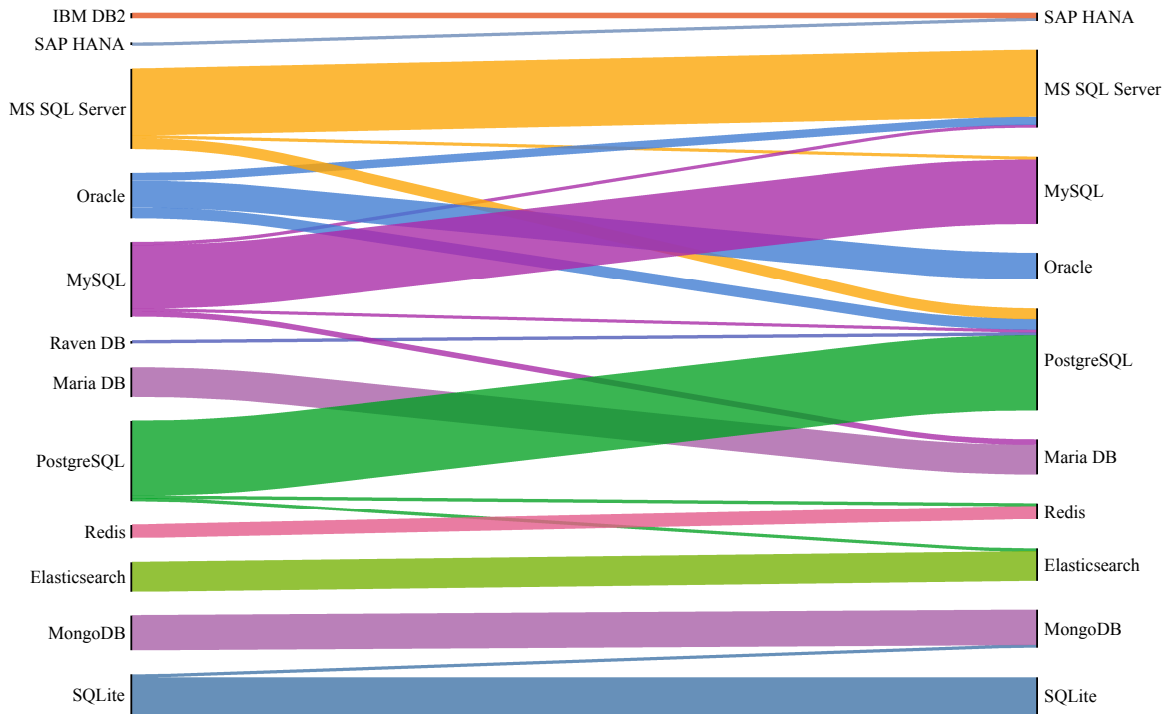


Figure 22: DBMS migration plans.

4 Key Findings

We divide this sections into the same sections as we divided the results section: the usage of database management systems, the reasons why companies chose a specific DBMS, and the future perspectives.

Usage of Database Management Systems Figure 7 shows that the most used database management systems are Microsoft SQL Server, MySQL, and PostgreSQL. Figure 8 shows that (comparing only large with micro-enterprises) large companies tend to have a higher usage of Microsoft SQL Server, smaller companies a higher usage of Open Source systems like Postgres and MySQL. One issue in this interpretation is that also commercial systems like Oracle and MS SQL Server have zero-cost versions of their product, called "Express editions". This makes the comparison between DBMSs that cost with those that have no costs difficult, since we did not elicit this in our questionnaire.

The figures 9 and 10 show that relational systems dominate NoSQL systems in general as well as for every company size. We are aware that relational database systems lately promote their systems as to be also a NoSQL database, e.g., MySQL claims on its website that NoSQL+SQL=MySQL or PostgreSQL might be presented as a NoSQL database just because it contains elements such as columns that support JSON as a datatype [10]. In the analysis we did not consider them as NoSQL systems.

Figure 11 shows that there a clear preference for Open Source systems even though

most companies use both (see Figure 15). One possible explanation is that 99% of all European businesses are SMEs, and of all SMEs, 9 out of 10 are so called micro-enterprises, i.e., companies with less than 10 employees [8]. South Tyrol is not different [9] and this has an impact on the chosen technologies. Choosing technologies with a lower up-front cost might be a consequence of this circumstance. This might also show that Open Source systems are of a quality that is comparable to proprietary systems.

Choice of Database Systems The figures 19 and 18 show that the main reasons to choose a particular DBMS are the available expertise in the company and the easy integration with other software.

Future Perspectives The figures 20 and 21 show that the probability to change the DBMS is very low (18%) and that if a company decides to change, this change is planned in the coming two years or beyond. Figure 22 confirms that most companies are currently not willing to change. If we look at the most dominant changes, we can observe that: PostgreSQL gains shares from MS SQL Server and Oracle, MS SQL gains shares from Oracle, Maria DB gains shares from MySQL. In summary PostgreSQL seems to become the most popular system within the region.

5 Conclusions

Here we presented a study on a considerable subset of local companies, evenly distributed between micro, small and medium companies, but slightly underrepresented on large companies. This study gives an insight on the distribution of Database Management Systems usage in South Tyrol and how companies are planning to move in the near future. Using the available information, we compared the results with the rest of the world and with the situation in South Tyrol in the past.

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A Questionnaire in Italian

This section reports the questions as we asked them within the Italian questionnaire. The questionnaire begins asking if a company prefers to specify its name or prefers to specify the productive sector, number of employees and turnover (see Figure 23).

Questionario sull'uso corrente e futuro di sistemi di gestione di database

Grazie per la sua partecipazione. L'obiettivo che ci siamo posti è di capire quali sistemi di gestione di database (DBMS) sono attualmente in uso in Alto Adige e come la situazione sta evolvendo. Questa attività rientra nel progetto DAVINCI (FESR1063) finanziato dal Fondo Europeo di Sviluppo Regionale (FESR) ed è una collaborazione fra la NOI AG e la Libera Università di Bolzano. Il questionario è composto da due sezioni per un totale di 6 domande ed un impegno di circa 5 minuti.

* **Erforderlich**

Preferisce dirci il nome dell'azienda per cui lavora (risposta veloce) o preferisce specificare settore, numero di dipendenti e fatturato? *

Questa informazione ci serve per inquadrare l'azienda a fini statistici.

- ☐ Preferisco specificare il nome dell'azienda.
- ☐ Preferisco specificare il settore produttivo, numero di dipendenti e fatturato.

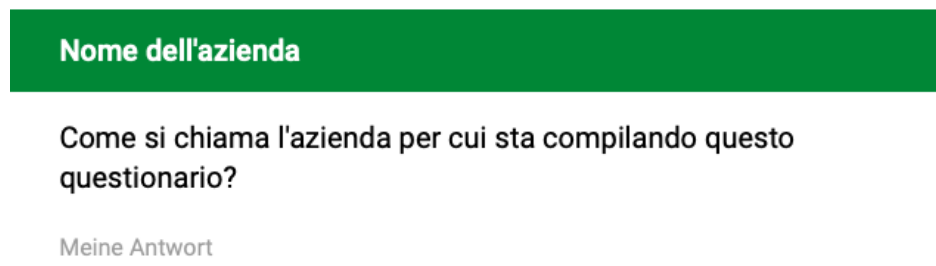
Figure 23: Starting screen of the Italian questionnaire.

If respondents answer that they want to specify the name of the company, they see Figure 24 otherwise they see Figure 25.

After answering this first part, Figure 26 shows the screen to elicit Q1.1, i.e., RQ1. This question asks which and why DBMS are currently used.

The various options respondents can tick for each DBMS are the following:

- Flessibilità del linguaggio SQL (SQL language flexibility)
- Disponibilità di competenza nella vostra azienda (Availability of expertise in your company)
- Facile integrazione con altri prodotti software che state utilizzando (Easy integration with other software products you are using)



Nome dell'azienda

Come si chiama l'azienda per cui sta compilando questo questionario?

Meine Antwort

Figure 24: Question about the name of the respondent.

- Archiviazione affidabile dei dati (Reliable data storage)
- Controllo della concorrenza (dati coerenti) (Monitoring of competition (consistent data))
- Replicazione/Scalabilità/Cloud (Replication/Scalability/Cloud)
- Controllo accessi utente (User access control)
- Velocità di accesso ai dati (Data access speed)
- Prezzo (Price)
- Supporto (Support)
- Altro (Other)

If a respondent answers "other" in the previous question, Figure 27 appears so that it is possible to enter the name of a DBMS that is not in the list.

Figure 28 depicts the questionnaire to elicit Q1.2, i.e., RQ2. This question asks in which departments database systems are used.

Figure 29 depicts the questionnaire to elicit Q1.3, i.e., RQ3. This question asks which features are currently missed in the DBMS currently used.

Figure 30 depicts the questionnaire to elicit Q2.1, i.e., RQ4. This question asks about the role that a DBMS is Open Source/closed source.

The Figures 31, 32, and 33 depict the questionnaire to elicit Q2.2, i.e., RQ5. This question asks how likely it is to change DBMS in the future, from which DBMS one would change, towards which DBMS, how fast, and why.

Figure 34 depicts the questionnaire to elicit Q2.3, i.e., RQ6. This question asks in which other areas Open Source products are used.

Figure 35 depicts the optional question so that respondents can leave their e-mail address to be informed about the results of the questionnaire.

Settore, numero di dipendenti e fatturato

In quale settore opera l'azienda per cui sta compilando questo questionario?

- ☐ Settore primario, che comprende l'agricoltura, la pesca, l'allevamento, la selvicoltura, ossia lo sfruttamento delle foreste e l'attività mineraria
- ☐ Settore secondario, che comprende tutte le varie attività dell'industria alimentare, l'industria mineraria, l'industria metallurgica e siderurgica, l'industria metalmeccanica, l'industria della difesa, l'industria petrolchimica, l'industria cartaria, l'industria delle costruzioni, l'industria manifatturiera, l'industria automobilistica, l'industria farmaceutica, l'industria tessile, l'industria chimica
- ☐ Settore terziario: trasporti e comunicazioni, facility management, servizi commerciali, turismo, servizi assicurativi e bancari, pubblica amministrazione, ricerca e sviluppo, informatica

Quanti dipendenti ha l'azienda per cui sta compilando questo questionario?

- ☐ <10
- ☐ <50
- ☐ <250
- ☐ >=250

Quant'è il fatturato dell'azienda per cui sta compilando questo questionario?

- ☐ ≤ € 2.000.000
- ☐ ≤ € 10.000.000
- ☐ ≤ € 50.000.000
- ☐ > € 50.000.000

Figure 25: Question about the productive sector, number of employees and turnover.

Sistemi di gestione di database attualmente in uso

Q1.1 - Quali sistemi di gestione di database avete attualmente in uso e per quale motivo avete fatto questa scelta?

Per visualizzare più risposte scrollare a destra

	Flessibilità del linguaggio SQL	Disponibilità di competenza nella vostra azienda	Facile integrazione con altri prodotti software che state utilizzando	Archiviazione affidabile dei dati	Controllo della concorrenza (dati coerenti)	Replicazione / Scalabilità / Cloud
Oracle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MySQL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Microsoft SQL Server	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
PostgreSQL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MongoDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IBM Db2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Microsoft Access	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Redis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Elasticsearch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Teradata	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SQLite	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
MariaDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
InfluxDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Altro	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 26: Which DBMS are you currently using? and which are the most important considerations for your DBMS choice?

Se sopra ha selezionato "Altro", per favore inserisca qui il nome del database.

Meine Antwort

Figure 27: Entering the name of a DBMS not in the list.

Q1.2 - In che reparti della vostra azienda usate sistemi di gestione di database?

	Open Source	Closed Source
Produzione	<input type="checkbox"/>	<input type="checkbox"/>
Ricerca e Sviluppo	<input type="checkbox"/>	<input type="checkbox"/>
Acquisti	<input type="checkbox"/>	<input type="checkbox"/>
Marketing	<input type="checkbox"/>	<input type="checkbox"/>
Risorse Umane	<input type="checkbox"/>	<input type="checkbox"/>
Contabilità e Finanza	<input type="checkbox"/>	<input type="checkbox"/>
Altro	<input type="checkbox"/>	<input type="checkbox"/>

Figure 28: In which departments do you use database systems? (RQ2).

Q1.3 - Che funzionalità vorreste avere ma mancano nei sistemi di gestione di database che utilizzate al momento? Per favore indicate anche il DBMS nel caso ne usaste più di uno. Se avete problemi specifici con il DBMS che usate, potete specificarlo qui.

Meine Antwort

Figure 29: Which features are you currently missing in the database system you use? (RQ3).

Sistemi di gestione di database in previsione per il futuro

Q2.1 - Nella vostra scelta di un sistema di gestione di database che ruolo ha giocato il fatto che sia Open o Closed source?

- ☐ Irrilevante
- ☐ Open Source è importante
- ☐ Closed Source è importante

Perché?

Meine Antwort

Figure 30: In your choice for a database system, which role did the fact that it is Open Source/closed source play? (RQ4).

Q2.2 - Quanto è probabile che cambierete sistema di gestione di database in futuro?

	1	2	3	4	5	
Estremamente improbabile	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Estremamente probabile

Se avete intenzione di cambiare: da quale DBMS?

- ☐ Oracle
- ☐ MySQL
- ☐ Microsoft SQL Server
- ☐ PostgreSQL
- ☐ MongoDB
- ☐ IBM Db2
- ☐ Microsoft Access
- ☐ Redis
- ☐ Elasticsearch
- ☐ SQLite
- ☐ Sonstiges: _____

Figure 31: How likely is it that you will change database systems in the future? (RQ5), question that asks **from** which DBMS one might switch.

Se avete intenzione di cambiare: a quale DBMS?

- ☐ Oracle
- ☐ MySQL
- ☐ Microsoft SQL Server
- ☐ PostgreSQL
- ☐ MongoDB
- ☐ IBM Db2
- ☐ Microsoft Access
- ☐ Redis
- ☐ Elasticsearch
- ☐ SQLite
- ☐ Sonstiges: _____

Figure 32: How likely is it that you will change database systems in the future? (RQ5), question that asks **to** which DBMS one might switch.

Se avete intenzione di cambiare: in quale arco di tempo?

- ☐ Quest'anno
- ☐ Nei prossimi due anni
- ☐ Più in là nel tempo

Se avete intenzione di cambiare: perché?

Meine Antwort _____

Figure 33: How likely is it that you will change database systems in the future? (RQ5), question that asks about the time frame within the switch should take place and the reason.

Q2.3 - In quali altre aree usate prodotti Open Source?

- ☐ Sistemi Operativi (es. Linux)
- ☐ Office software (es. Open office / Libre office)
- ☐ Browser (es. Firefox, Chrome)
- ☐ Immagini/ multimedia (es. Gimp, VLC)
- ☐ Strumenti di sviluppo software (es. Ruby on Rails, Eclipse)
- ☐ Sonstiges: _____

Figure 34: In which other areas do you use Open Source products? (RQ6).

**Vuole lasciarci un'email per ricevere i risultati dello studio?
(opzionale)**

Meine Antwort _____

Figure 35: Optional step to leave the e-mail address at the end of the questionnaire.

B Questionnaire in German

This section reports the questions as we asked them within the German questionnaire. The questionnaire begins asking if a company prefers to specify its name or prefers to specify the productive sector, number of employees and turnover (see Figure 36).

Fragebogen zur aktuellen und zukünftigen Nutzung von Datenbankmanagementsystemen

Vielen Dank für Ihre Teilnahme. Unser Ziel ist es, zu verstehen, welche Datenbank-Managementsysteme (DBMS) in Südtirol derzeit im Einsatz sind und wie sich die Situation entwickelt. Diese Aktivität ist Teil des vom Europäischen Fonds für regionale Entwicklung (EFRE) finanzierten DAVINCI-Projekts (EFRE1063) und ist eine Zusammenarbeit zwischen der NOI AG und der Freien Universität Bozen. Der Fragebogen besteht aus zwei Abschnitten für insgesamt 6 Fragen und einem Engagement von ca. 5 Minuten.

* Erforderlich

Möchten Sie uns lieber den Namen des Unternehmens nennen, für das Sie tätig sind (schnelle Antwort) oder möchten Sie die Branche, die Anzahl der Mitarbeiter und den Umsatz angeben? *

Diese Informationen werden verwendet, um das Unternehmen für statistische Zwecke zu erfassen.

- ☐ Ich bevorzuge es, den Namen der Firma anzugeben.
- ☐ Ich bevorzuge es, den Produktionssektor, die Anzahl der Beschäftigten und den Umsatz anzugeben.

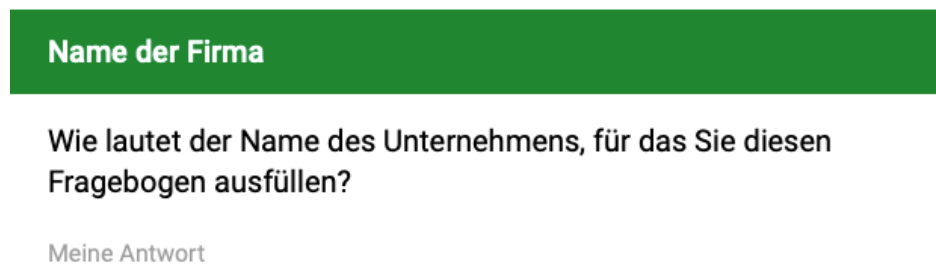
Figure 36: Starting screen of the German questionnaire.

If respondents answer that they want to specify the name of the company, they see Figure 37 otherwise they see Figure 38.

After answering this first part, Figure 39 shows the screen to elicit F1.1, i.e., RQ1. This question asks which and why DBMS are currently used.

The various options respondents can tick for each DBMS are the following:

- Flexibilität der SQL-Sprache (SQL language flexibility)
- Verfügbarkeit von Fachwissen in Ihrem Unternehmen (Availability of expertise in your company)
- Einfache Integration mit anderen Softwareprodukten, die Sie verwenden. (Easy integration with other software products you are using)



Name der Firma

Wie lautet der Name des Unternehmens, für das Sie diesen Fragebogen ausfüllen?

Meine Antwort _____

Figure 37: Question about the name of the respondent.

- Zuverlässige Datenspeicherung (Reliable data storage)
- Steuerung der Parallelität (konsistente Daten) (Monitoring of competition (consistent data))
- Replikation/Skalierbarkeit/Cloud (Replication/Scalability/Cloud)
- Benutzerzugriffskontrolle (User access control)
- Datenzugriffsgeschwindigkeit (Data access speed)
- Preis (Price)
- Unterstützung (Support)
- Sonstiges (Other)

If a respondent answers "other" in the previous question, Figure 40 appears so that it is possible to enter the name of a DBMS that is not in the list.

Figure 41 depicts the questionnaire to elicit F1.2, i.e., RQ2. This question asks in which departments database systems are used.

Figure 42 depicts the questionnaire to elicit F1.3, i.e., RQ3. This question asks which features are currently missed in the DBMS currently used.

Figure 43 depicts the questionnaire to elicit F2.1, i.e., RQ4. This question asks about the role that a DBMS is Open Source/closed source.

The Figures 44, 45, and 46 depicts the questionnaire to elicit F2.2, i.e., RQ5. This question asks how likely it is to change DBMS in the future, from which DBMS one would change, towards which DBMS, how fast, and why.

Figure 47 depicts the questionnaire to elicit F2.3, i.e., RQ6. This question asks in which other areas Open Source products are used.

Figure 48 depicts the optional question so that respondents can leave their e-mail address to be informed about the results of the questionnaire.

Branche, Mitarbeiterzahl und Umsatz

In welcher Branche ist das Unternehmen, für das Sie diesen Fragebogen ausfüllen, tätig?

- ☐ Primärsektor, einschließlich Landwirtschaft, Fischerei, Viehzucht und Forstwirtschaft, d.h. Holzschlag und Bergbau.
- ☐ Sekundärsektor, der alle Tätigkeiten der Lebensmittelindustrie, des Bergbaus, der Metall- und Stahlindustrie, des Maschinenbaus, der Rüstungsindustrie, der petrochemischen Industrie, der Papierindustrie, der Bauindustrie, der verarbeitenden Industrie, der Automobilindustrie, der Pharmaindustrie, der Textilindustrie, der chemischen Industrie umfasst.
- ☐ Tertiärer Sektor: Verkehr und Kommunikation, Gebäudemanagement, Handelsdienstleistungen, Tourismus, Versicherungs- und Bankdienstleistungen, öffentliche Verwaltung, Forschung und Entwicklung, Informationstechnologie

Wie viele Mitarbeiter hat das Unternehmen, für das Sie diesen Fragebogen ausfüllen?

- ☐ <10
- ☐ <50
- ☐ <250
- ☐ >=250

Wie hoch ist der Umsatz des Unternehmens, für das Sie diesen Fragebogen ausfüllen?

- ☐ ≤ € 2.000.000
- ☐ ≤ € 10.000.000
- ☐ ≤ € 50.000.000
- ☐ > € 50.000.000

Figure 38: Question about the productive sector, number of employees and turnover.

Derzeit im Einsatz befindliche Datenbankmanagementsysteme

F1.1 - Welche Datenbankmanagementsysteme haben Sie derzeit im Einsatz und warum haben Sie sich dafür entschieden?

Um mehr Antworten anzuzeigen nach rechts scrollen

	Flexibilität der SQL- Sprache	Verfügbarkeit von Fachwissen in Ihrem Unternehmen	Einfache Integration mit anderen Softwareprodukten, die Sie verwenden.	Zuverlässige Datenspeicherung	Steuerung der Parallelität (konsistente Daten)	Re Sk
Oracle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
MySQL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Microsoft SQL Server	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
PostgreSQL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
MongoDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
IBM Db2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Microsoft Access	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Redis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Elasticsearch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Teradata	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
SQLite	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
MariaDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
InfluxDB	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Sonstiges	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Figure 39: Which DBMS are you currently using? and which are the most important considerations for your DBMS choice?

Falls Sie oben "Sonstiges" gewählt haben, geben Sie hier bitte den Namen der Datenbank an.

Meine Antwort

Figure 40: Entering the name of a DBMS not in the list.

F1.2 - In welchen Abteilungen Ihres Unternehmens verwenden Sie Datenbankmanagementsysteme?

	Open Source	Closed Source
Produktion	<input type="checkbox"/>	<input type="checkbox"/>
Forschung und Entwicklung	<input type="checkbox"/>	<input type="checkbox"/>
Einkauf	<input type="checkbox"/>	<input type="checkbox"/>
Marketing	<input type="checkbox"/>	<input type="checkbox"/>
Personalabteilung	<input type="checkbox"/>	<input type="checkbox"/>
Buchhaltung und Finanzen	<input type="checkbox"/>	<input type="checkbox"/>
Sonstiges	<input type="checkbox"/>	<input type="checkbox"/>

Figure 41: In which departments do you use database systems? (RQ2).

F1.3 - Welche Funktionen würden Sie sich wünschen, aber in den von Ihnen derzeit eingesetzten Datenbankmanagementsystemen fehlen? Bitte geben Sie auch das DBMS an, wenn Sie mehr als eines verwenden. Wenn Sie spezifische Probleme mit dem von Ihnen verwendeten DBMS haben, können Sie es hier angeben.

Meine Antwort

Figure 42: Which features are you currently missing in the database system you use? (RQ3).

Datenbankmanagementsysteme im Hinblick auf die Zukunft

F2.1 - Welche Rolle spielte bei der Wahl eines Datenbankmanagementsystems die Tatsache, dass es sich um eine Open oder Closed Source handelte?

- ☐ Irrelevant
- ☐ Open Source ist wichtig
- ☐ Closed Source ist wichtig

Warum?

Meine Antwort

Figure 43: In your choice for a database system, which role did the fact that it is Open Source/closed source play? (RQ4).

F2.2 - Wie wahrscheinlich ist es, dass Sie Ihr
Datenbankmanagementsystem in Zukunft ändern werden?

1 2 3 4 5

Sehr unwahrscheinlich ☐ ☐ ☐ ☐ ☐ Sehr wahrscheinlich

Wenn Sie planen zu ändern: von welchem DBMS?

- ☐ Oracle
- ☐ MySQL
- ☐ Microsoft SQL Server
- ☐ PostgreSQL
- ☐ MongoDB
- ☐ IBM Db2
- ☐ Microsoft Access
- ☐ Redis
- ☐ Elasticsearch
- ☐ SQLite
- ☐ Sonstiges: _____

Figure 44: How likely is it that you will change database systems in the future? (RQ5), question that asks **from** which DBMS one might switch.

Wenn Sie planen zu ändern: zu welchem DBMS?

- ☐ Oracle
- ☐ MySQL
- ☐ Microsoft SQL Server
- ☐ PostgreSQL
- ☐ MongoDB
- ☐ IBM Db2
- ☐ Microsoft Access
- ☐ Redis
- ☐ Elasticsearch
- ☐ SQLite
- ☐ Sonstiges: _____

Figure 45: How likely is it that you will change database systems in the future? (RQ5), question that asks **to** which DBMS one might switch.

Wenn Sie planen zu ändern: in welchem Zeitraum?

- ☐ In diesem Jahr
- ☐ In den kommenden zwei Jahren
- ☐ Jenseits der Zeit

Wenn Sie planen zu ändern: warum?

Meine Antwort _____

Figure 46: How likely is it that you will change database systems in the future? (RQ5), question that asks about the time frame within the switch should take place and the reason.

F2.3 - In welchen anderen Bereichen setzen Sie Open-Source-Produkte ein?

- ☐ Betriebssysteme (z.B. Linux)
- ☐ Office software (z.B. Open office / Libre office)
- ☐ Browser (z.B. Firefox, Chrome)
- ☐ Bilder/Multimedia (z.B. Gimp, VLC)
- ☐ Softwareentwicklungswerkzeuge (z.B. Ruby on Rails, Eclipse)
- ☐ Sonstiges: _____

Figure 47: In which other areas do you use Open Source products? (RQ6).

Möchten Sie uns eine E-mail Adresse hinterlassen, um über das Resultat der Studie benachrichtigt zu werden? (optional)

Meine Antwort _____

Figure 48: Optional step to leave the e-mail address at the end of the questionnaire.